I-229 Corridor Study

I-229 Major Investment Corridor Study
Project PL 0100(87) 3616 P, PCN 044K

Sioux Falls, South Dakota
June 2017

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EXECUTIVE SUMMARY

The Interstate 229 (I-229) Corridor through the City of Sioux Falls is a critical traffic corridor that provides access to the expanding east side and allows access to downtown. The I-229 Major Investment Study (MIS) allows the City of Sioux Falls, the Sioux Falls Metropolitan Planning Organization, the South Dakota Department of Transportation, adjacent landowners, and area users to help determine the vision of the corridor. The I-229 Corridor Study is a subset of the I-229 MIS and focused on the I-229 mainline.

This study assesses existing and future conditions on I-229, the I-229 service interchanges and crossroads. The purpose of this study is to address the traffic operations and safety concerns for this corridor. There are several intersections/interchanges that currently experience congestion in the peak traffic hours. By year 2035, congestion is anticipated to increase at these intersections/interchanges and congestion is anticipated to occur on I-229 between Exit 5 (26th Street) and Exit 6 (10th Street).

Preliminary concepts for I-229 mainline to address the year 2035 transportation deficiencies have been developed. The preliminary concepts were screened to determine which concepts should be selected for further development and assessment. There were two (2) alternatives identified for further development. In addition to the alternatives identified for further development, intelligent transportation system solutions were identified for the corridor. The following are the recommended alternative scenarios to advance:

- ***I229-C1.*** I-229 6 Lanes from 26th St to 10th St
- ***I229-C2.*** I-229 6 Lanes from 26th St to 10th St + 65 mph Improved Curves
- ***I229-ITS.*** Potential ITS Solutions

The public was involved throughout the study through public open houses, landowner meetings, and a project website. Public comments, provided in person, in writing, or electronically, were used in the development and refinement of improvement alternatives. The project's Study Advisory Team consisted of representatives from the Federal Highway Administration (FHWA), South Dakota Department of Transportation (SDDOT), Sioux Falls Metropolitan Planning Organization (MPO), City of Sioux Falls, and HDR.

CHAPTER 1 - INTRODUCTION

Section 1.1 - I-229 Major Investment Corridor Study

The Interstate 229 (I-229) Corridor through the City of Sioux Falls carries commuters and tourism traffic, provides access to the expanding east side of this thriving community, and allows access to downtown. The I-229 Major Investment Study (MIS) allows the City of Sioux Falls, the Sioux Falls Metropolitan Planning Organization (MPO), the South Dakota Department of Transportation (SDDOT), adjacent landowners, and area users to help determine the vision of the corridor. The I-229 Corridor Study is a subset of the I-229 MIS.

An MIS provides a focused evaluation of transportation needs and issues within a corridor or sub-region. An MIS is designed to provide decision makers with information on the options available for addressing transportation challenges before making investment decisions. An MIS can lead to decisions on design concepts and scope of the investment.

The I-229 Major Investment Corridor Study (MIS) fulfills the following objectives:

1. Complete a traffic level of service analysis for both existing and future (2035) no-build conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions.
6. Create final products for use by the SDDOT, the City of Sioux Falls and the Sioux Falls Metropolitan Planning Organization, which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

The I-229 MIS has been separated into six individual sub-studies. The sub-studies include:

- *I-229 Corridor Study*
- *I-229 Exit 3 (Minnesota Avenue) Crossroad Corridor Study*
- *I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study*
- *I-229 Exit 6 (10th Street) Crossroad Corridor Study*
- *I-229 Exit 7 (Rice Street) Crossroad Corridor Study*
- *I-229 Exit 9 (Benson Road) Crossroad Corridor Study*

A map illustrating the study areas for each of the sub-studies is shown in ***FIGURE 1***.

The remainder of this document details the transportation efforts entailed in I-229 Corridor Study.

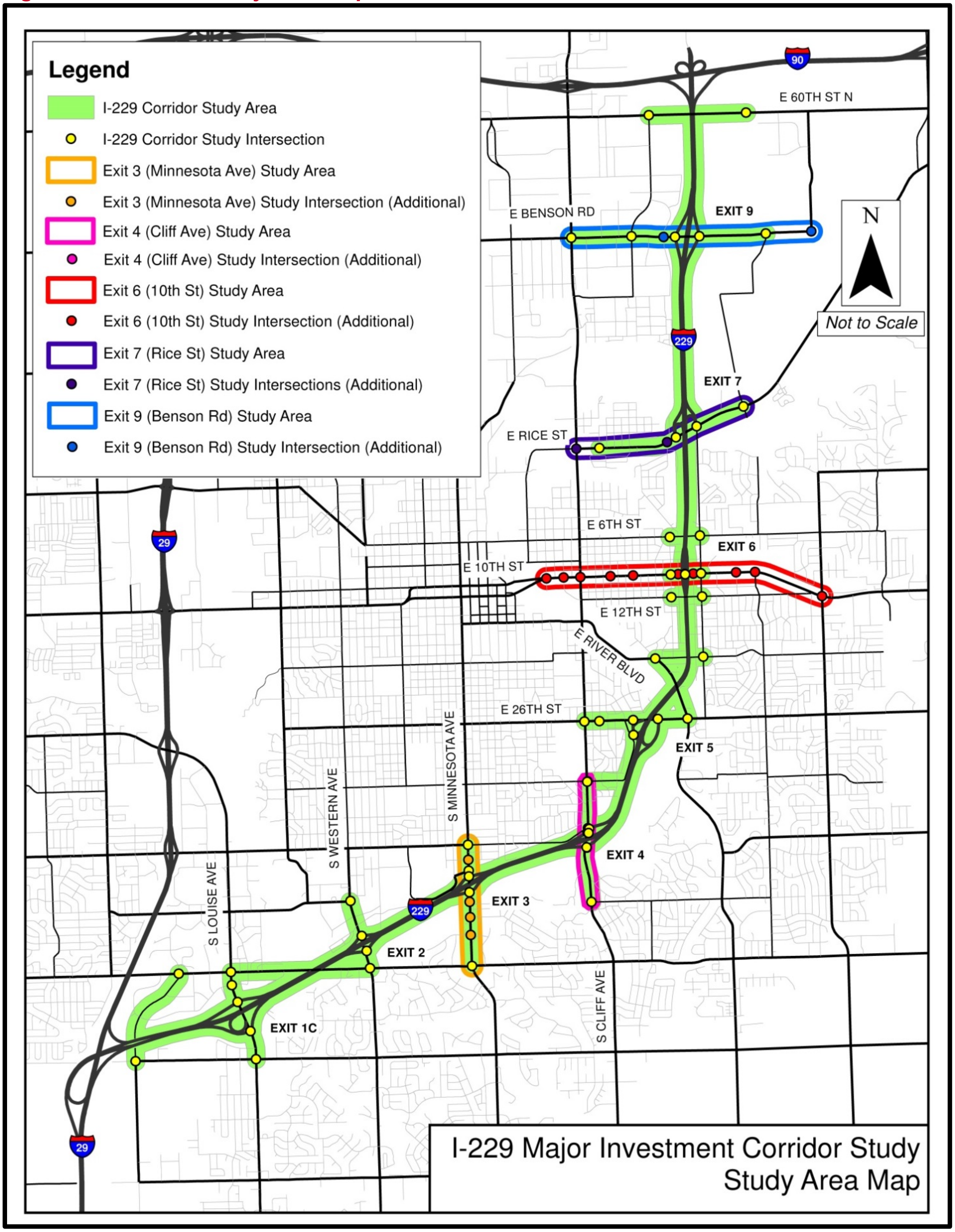
Section 1.2 - Project Description / Study Area

The study assesses existing and future conditions along the entire I-229 corridor, the service interchanges and the crossroad corridors. The I-229 corridor is located east of I-29 in the Sioux Falls metropolitan area. The mainline interstate study limits include a 10.5 mile section from the Solberg Avenue overpass to the 60th Street North overpass.

An illustration of the study area is shown in ***FIGURE 2***. There are eight service interchanges located on I-229 within the study area, including:

- Exit 1: Louise Avenue
- Exit 2: Western Avenue
- Exit 3: Minnesota Avenue
- Exit 4: Cliff Avenue
- Exit 5: 26th Street
- Exit 6: 10th Street
- Exit 7: Rice Street
- Exit 9: Benson Road

Figure 1. I-229 MIS Study Area Map

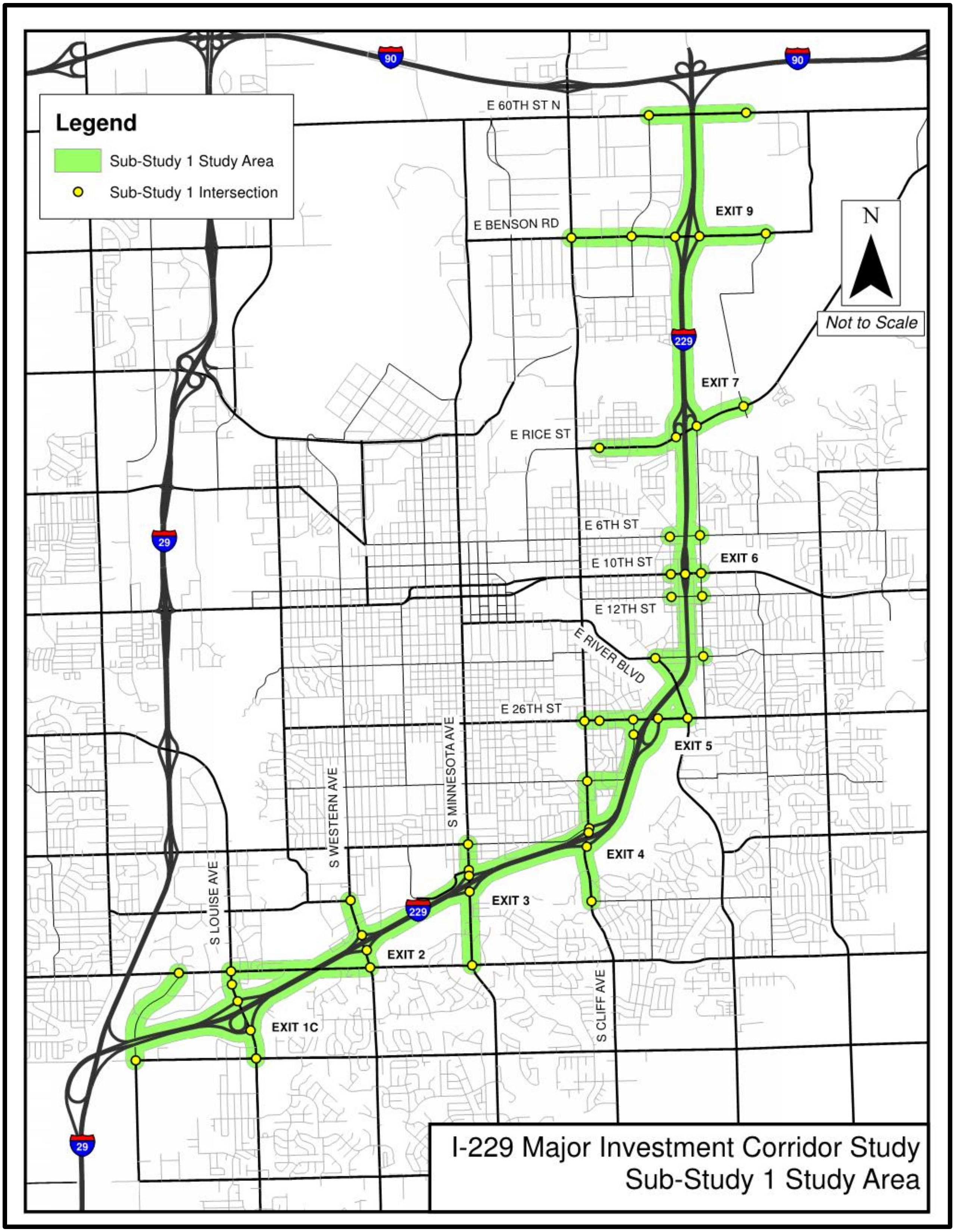


A subset of the arterial street network that connects to the I-229 corridor is included in the study area as well, including the following crossroad corridors:

- Solberg Avenue from 69th Street to 57th Street
- Louise Avenue from 69th Street to 57th Street
- 57th Street from Louise Avenue to Western Avenue
- Western Avenue from 57th Street to 49th Street
- Minnesota Avenue from 57th Street to 41st Street
- Cliff Avenue from 49th Street to 33rd Street
- 26th Street from Cliff Avenue to Southeastern Drive
- 33rd Street from Cliff Avenue to Yeager Road
- Yeager Road from 33rd Street to 26th Street
- Southeastern Avenue from 18th Street to 26th Street
- 18th Street from Southeastern Drive to Cleveland Avenue
- 12th Street from Lowell Avenue to Cleveland Avenue
- 10th Street from Jessica Avenue to Bahnson Avenue
- 6th Street from Lowell Avenue to Cleveland Avenue
- Rice Street from Wayland Avenue to Bahnson Avenue
- Benson Road from Cliff Avenue to Sycamore Avenue
- 60th Street North from Lewis Avenue to Bahnson Avenue (Proposed)

The study area also contains ramp terminal intersections at each interchange along I-229 and intersections adjacent to those ramp terminal intersections, also identified in ***FIGURE 2***.

Figure 2. Sub-Study 1 Study Area



Section 1.3 - Purpose

The purpose of this study is to address the traffic operations and safety concerns along the I-229 mainline, the service interchanges and the crossroads. The following is a list of specific issues/needs that were identified for this study:

- Mainline Level of Service (LOS) of C or better throughout the I-229 corridor
- Ramp merge/diverge LOS of C or better for all interchange ramps through the I-229 corridor
- Ramp terminal intersection LOS of C or better for all interchanges throughout the I-229 corridor
- Identification of areas not in compliance with current Interstate design standards
- Incident management planning to identify methods for handling mainline traffic during incidents, weather, and special events
- Safety concerns along the I-229 corridor

The primary goal of this study is to develop feasible solutions to address the identified issues and needs. The solutions will follow current design standards and provide acceptable traffic LOS and operations under both current and future traffic conditions.

Section 1.4 - Methods and Assumptions

The SDDOT provides a ***Methods and Assumptions*** template for SDDOT planning studies. This template guided the development of a specific document for the I-229 Corridor Study. This Methods and Assumptions document is used to outline technical methodologies and key assumptions used in the course of the study. The Methods and Assumptions document can be found in ***APPENDIX A. METHODS AND ASSUMPTIONS FOR SUB-STUDY 1***.

CHAPTER 2 - DATA COLLECTION

Section 2.1 - Traffic Data Collection

Traffic data used as the foundation for the I-229 MIS was gathered early in the project. Detailed traffic data can be found in ***APPENDIX B. TRAFFIC DATA COLLECTION***.

DATA COLLECTION SUMMARY

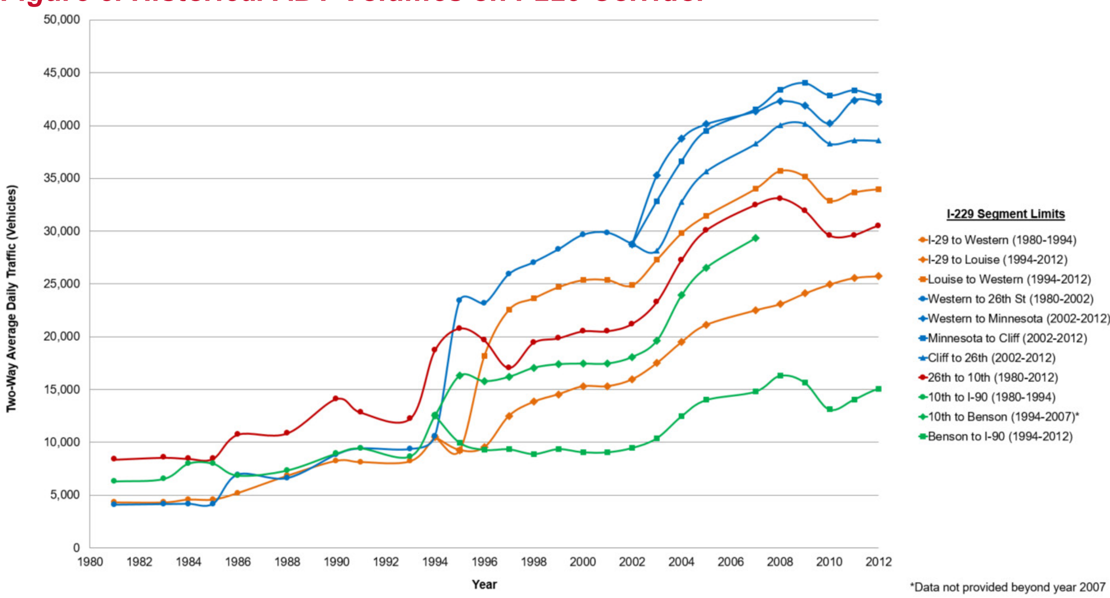
Existing traffic data is generally based on data from years 2012 and 2013. Key elements from the data collected include:

- I-229 mainline heavy vehicle percentages ranging from 5.1%-10.4%
- I-229 crossroads arterial street heavy vehicle percentages ranging from 1.5% - 6.3%
- Spot speed profile on I-229 mainline shows:
  - Northbound mean speeds ranging from 62 – 67 mph
  - Northbound 85th percentile speeds ranging from 67-72 mph
  - Southbound mean speeds ranging from 63- 65 mph
  - Southbound 85th percentile speeds ranging from 67- 69 mph
- Mean spot speeds on I-229 mainline during Jazz Fest on Saturday, July 19, 2013 did not significantly differ from average weekday mainline mean spot speeds (approximately 1 mph variation).

HISTORICAL I-229 MAINLINE TRAFFIC COUNTS

A graphical representation of historical average daily traffic volumes from 1990 to 2012 is shown in ***FIGURE 3***, based on historical traffic data from the ***Highway Needs and Project Analysis Report***, SDDOT. This graph shows continuous increases in I-229 traffic volumes, most notably in the segment between Western Ave. and 26th St. interchanges.

Figure 3. Historical ADT Volumes on I-229 Corridor



Section 2.2 - Origin-Destination Data Collection

As a part of this study, origin-destination (O-D) data was gathered using cell phone technology by AirSage. This technology uses anonymous location and movement data from mobile devices to track movements as cell phones transition from one cell tower to another cell tower in real time. This approach to O-D data collection has many advantages over traditional methods of data collection, most notably that it does not disrupt traffic or respondents, covers a wide geographic area, and provides high response rates for reliable data. AirSage uses a multi-step methodology to derive useful information and analytics from wireless signaling data provided by its wireless carriers.

The O-D data from AirSage was gathered for a 30-day period from February 12, 2013 to March 13, 2013. During this time, a total of 1.5 million unique devices were recognized. AirSage reported a sampling rate of 32.4% of the population in Sioux Falls.

The AirSage O-D data allowed for an understanding of regional travel patterns. An illustration of the percentage of vehicles entering and exiting the Sioux Falls metro area along the Interstate is shown in *FIGURE 4*. The percentages shown represent all trips starting and ending at the four major interstate points outside of the metro area (I-29 North, I-29 South, I-90 East and I-90 West).

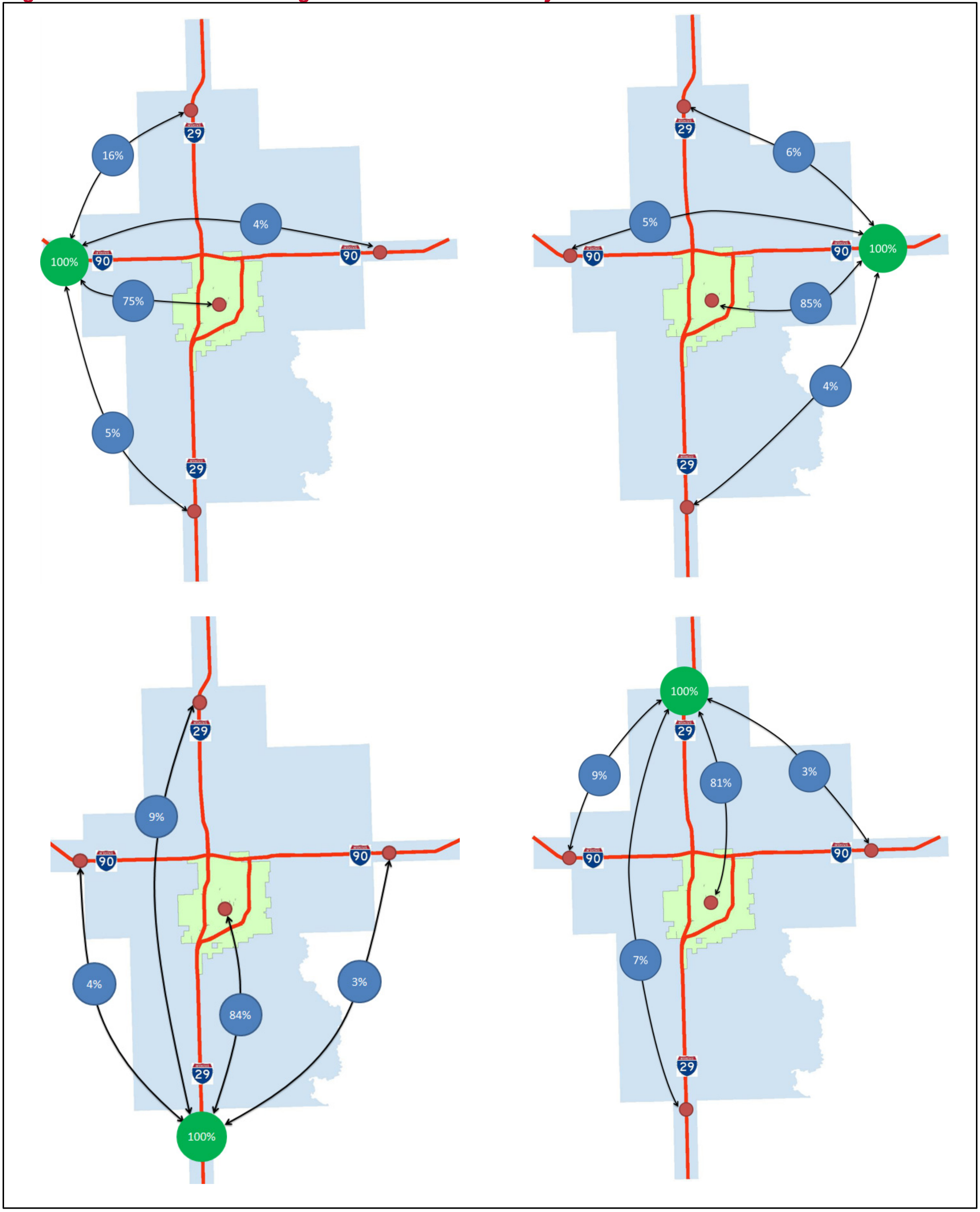
This assessment shows, for example, that of all of the trips (100%) that began or ended south of Sioux Falls on I-29, 84% of those trips either ended or began within the urban core of Sioux Falls, and 9% of those trips either ended or began north of Sioux Falls on I-29. These figures generally show the strong connection between the interstate system and local traffic in the urban core of Sioux Falls.

The data collection process involved approximately 100,000 cell phone device sightings per day and 1.5 million unique devices logged.

Data comparing trips by day of week indicated that Fridays have the peak number of trips and Sundays have the lowest number. For the average weekday vs. weekend day comparison, O-D trips between most zones decreased 15 to 50 percent, with the exception of areas containing shopping, special events and recreation.

Additional information related to the AirSage Origin-Destination data can be found in *APPENDIX C. ORIGIN-DESTINATION DATA COLLECTION*.

Figure 4. External Travel Origins and Destinations By Interstate Location



CHAPTER 3 - EXISTING AND YEAR 2035 NO-BUILD CONDITIONS

Section 3.1 - Macroscopic and Mesoscopic Traffic Modeling

MACROSCOPIC MODEL

Macroscopic Model Description

The macroscopic travel demand model is a computer simulation that evaluates the interaction of development patterns and the transportation system. The macroscopic model is the primary tool used for assessing future conditions on the Sioux Falls area transportation system. The model estimates travel demand by evaluating the location and population and employment levels by geographic location, and understanding the capacity, travel speed and connectivity offered by the roadway system. Travel demand forecasting predicts the number, purpose, origin and destination, and route of “trips” on a transportation network as a function of land use patterns.

The Sioux Falls MPO provided travel demand model files for the base calibrated model year of 2008. No additional regional calibration or regional validation was performed on the model for purposes of this study. The software platform used for the Sioux Falls travel model is Cube Voyager. The calibrated model files included loaded volumes for peak periods and daily traffic and included average daily traffic (ADT) counts.

The horizon year of 2035 was utilized for the future year analysis. The 2035 travel demand model correlates with socioeconomic data reflective of year 2035 and fiscally constrained transportation projects identified in ***Direction 2035***, the 2035 Sioux Falls MPO Long-Range Transportation Plan (LRTP), which was adopted in 2010.

Model Sub-Area Network

The I-229 sub-area is the portion of the regional travel model network that included the study area for the I-229 Corridor Study. This sub-area network includes I-229 from I-29 to I-90 as well as adjacent arterial street corridors. The sub-area validation is further described in ***APPENDIX D. DTA MODEL VALIDATION REPORT***. All calculated values were within the desirable range and the model deemed validated.

Macroscopic Model Application

Segment (link-level) volume outputs from the macroscopic model (both existing 2008 and future 2035) were used in the volume development process, in order to establish a full peak hour volume set in the study area. The volume development process is further described in ***APPENDIX D. DTA MODEL VALIDATION REPORT***.

Mesoscopic Model Description

Multi-resolution modeling - including mesoscopic simulation with dynamic traffic assignment (DTA) using Cube Avenue - was chosen to estimate realistic travel patterns in the congested study area network. Multi-resolution modeling is an analytic approach that attempts to make use of information at multiple scales, both spatially (area-based) and temporally (time-based).

The Cube Avenue model was developed by the project team based on the Sioux Falls MPO regional travel demand model with an added sub-area evaluation using mesoscopic simulation and DTA. The Cube Avenue model processes sequentially through three resolutions: the macro-scale, regional meso-scale, and sub-area meso-scale. Additional information about the Mesoscopic model can be found in ***Appendix D. DTA Model Validation Report***.

Mesoscopic Model Application

The purpose of the I-229 MIS multi-resolution model used for the I-229 Corridor Study is two-fold:

1. Aid in the volume development process for future year forecasts by establishing segment (link-level) assignments.
2. Provide a high level screening comparison for future year build scenarios and report measures of effectiveness at an aggregate level.

The mesoscopic model was calibrated for its intended use in this study. This model has shortcomings, which should be recognized in the future use of this model as a high-level screening tool for the I-229 MIS. The DTA model should be treated with a lower level of scrutiny compared to ***HCM 2010*** analysis, and any outputs from the model should be treated comparatively between scenarios rather than in an absolute manner. Additionally, the model was calibrated for the I-229 MIS and should not be used for other projects without recalibration of the model for that particular project.

Section 3.2 - Traffic Volume Development

Assessment of existing conditions and 2035 no-build conditions is based on traffic data collected and outputs from the 2035 macroscopic travel demand model developed as part of the overall I-229 MIS. Traffic data applicable to the I-229 Corridor Study includes base mapping, existing and 2035 no-build traffic volume data and crash data. The existing conditions analysis is representative of year 2012. Content in this chapter focuses on analysis of the I-229 mainline, the service interchanges and crossroads.

Section 3.3 - Traffic Capacity and Analysis Methodologies

Existing conditions (Year 2012) operational analysis included the analysis of 36 signalized intersections, 9 unsignalized intersections, 21 basic freeway segments, 14 weave segments, 4 merge areas and 3 diverge areas. All locations were analyzed for the AM peak hour (7:15 – 8:15 AM) and PM peak hour (4:30 – 5:30 PM). The operational analysis results include:

- Ramp terminal intersections
- Arterial intersections
- Basic Freeway, Ramp Junctions and Weave Areas

Analysis methodologies utilized for determining traffic capacities are outlined in ***APPENDIX E1. TRAFFIC CAPACITY ANALYSIS METHODOLOGIES***. LOS is based on procedures from the ***Highway Capacity Manual*** (***HCM 2010***).

Section 3.4 - Existing Conditions Operational Results

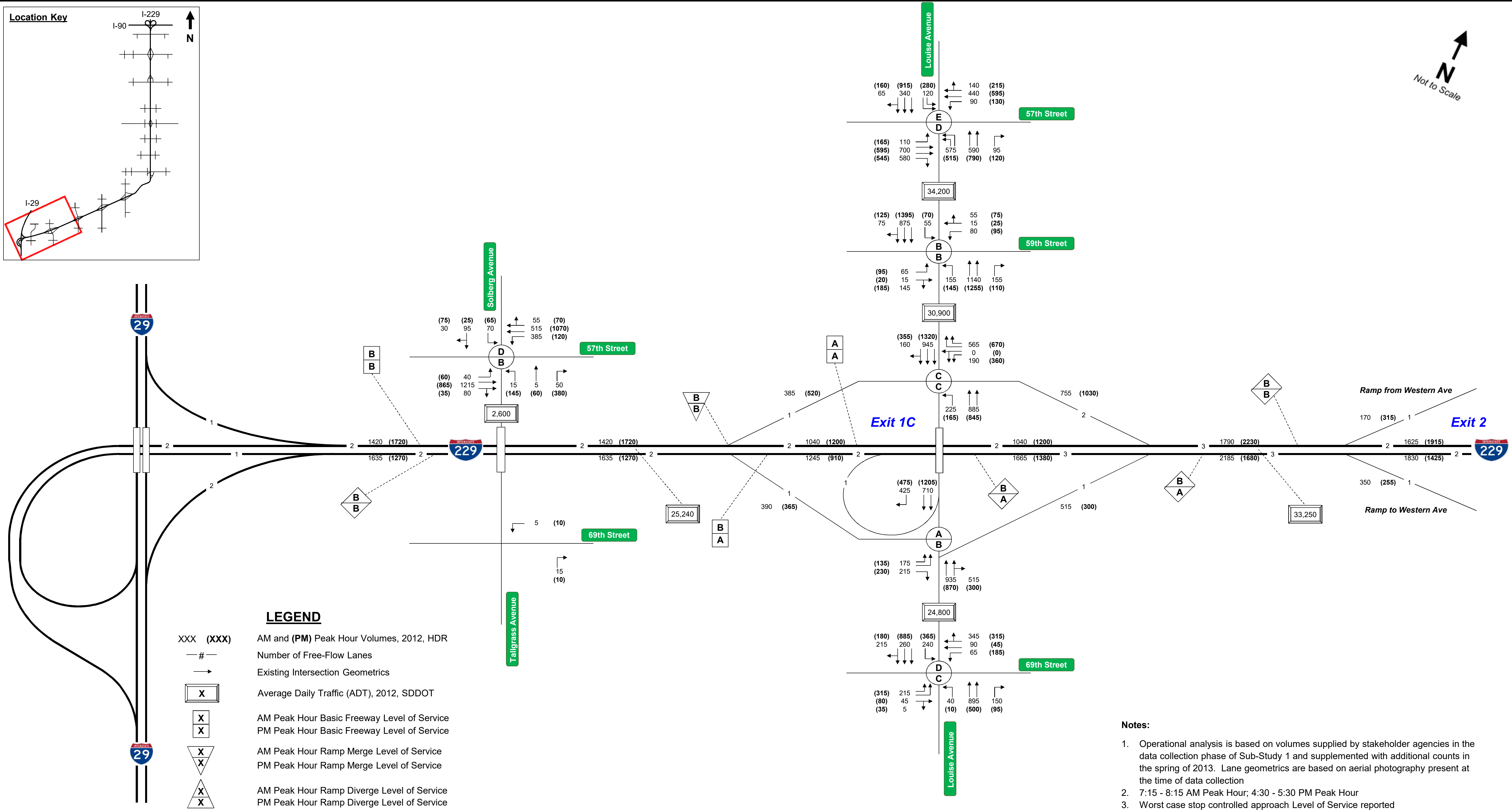
The existing conditions LOS results for all locations are depicted in ***FIGURES 5 THROUGH 9***.

This existing conditions analysis found that the freeway and ramps are operating at a desirable LOS of C or better throughout the study area. Several ramp terminal intersections have degraded beyond the acceptable threshold of LOS C and multiple arterial intersections have degraded beyond the acceptable threshold of LOS D. ***TABLE 1*** highlights intersections that do not meet the project specific LOS thresholds. The existing traffic analysis reports can be found in ***APPENDIX E2. EXISTING HCS 2010 REPORTS***.

Table 1. Existing Conditions Deficient Locations Based on Operational Analysis

LOCATION	AM	PM
57th Street & Louise Avenue	LOS E	
Western Avenue & I-229 SB Ramp Terminal		LOS D
57th Street & Western Avenue	LOS F	LOS E
41st Street & Minnesota Avenue	LOS E	LOS E
Minnesota Avenue & I-229 NB Ramp Terminal	LOS D	
Cliff Avenue & I-229 SB On-Ramp – *Worst stop-controlled movement LOS*		LOS D
Yeager Road & I-229 SB Ramp Terminal – *Worst stop-controlled approach LOS*	LOS F	LOS F
26th Street & I-229 NB Ramp Terminal	LOS D	
26th Street & Southeastern Avenue	LOS E	
10th Street & I-229 SPUI	LOS D	LOS E
10th Street & Cleveland Avenue	LOS E	
6th Street & Lowell Avenue – *Worst stop-controlled approach LOS*		LOS E
Rice Street & Bahnson Avenue – *Worst stop-controlled approach LOS*	LOS E	
Benson Road & I-229 SB Ramp Terminal – *Worst stop-controlled approach LOS*	LOS D	

Note: Acceptable threshold is LOS D for arterial intersections and LOS C for freeway, ramps, and ramp terminal intersections.



LEGEND

XXX (XXX) — AM and **(PM)** Peak Hour Volumes, 2012, HDR

—#— Number of Free-Flow Lanes

→ Existing Intersection Geometrics

X — Average Daily Traffic (ADT), 2012, SDDOT

X / X — AM Peak Hour Basic Freeway Level of Service; PM Peak Hour Basic Freeway Level of Service

X / X — AM Peak Hour Ramp Merge Level of Service; PM Peak Hour Ramp Merge Level of Service

X / X — AM Peak Hour Ramp Diverge Level of Service; PM Peak Hour Ramp Diverge Level of Service

X / X — AM Peak Hour Weaving Section Level of Service; PM Peak Hour Weaving Section Level of Service

X / X — AM Peak Hour Signalized Intersection Level of Service; PM Peak Hour Signalized Intersection Level of Service

X / X — AM Peak Hour Unsignalized Intersection Level of Service; PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

HDR

Existing Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
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Figure
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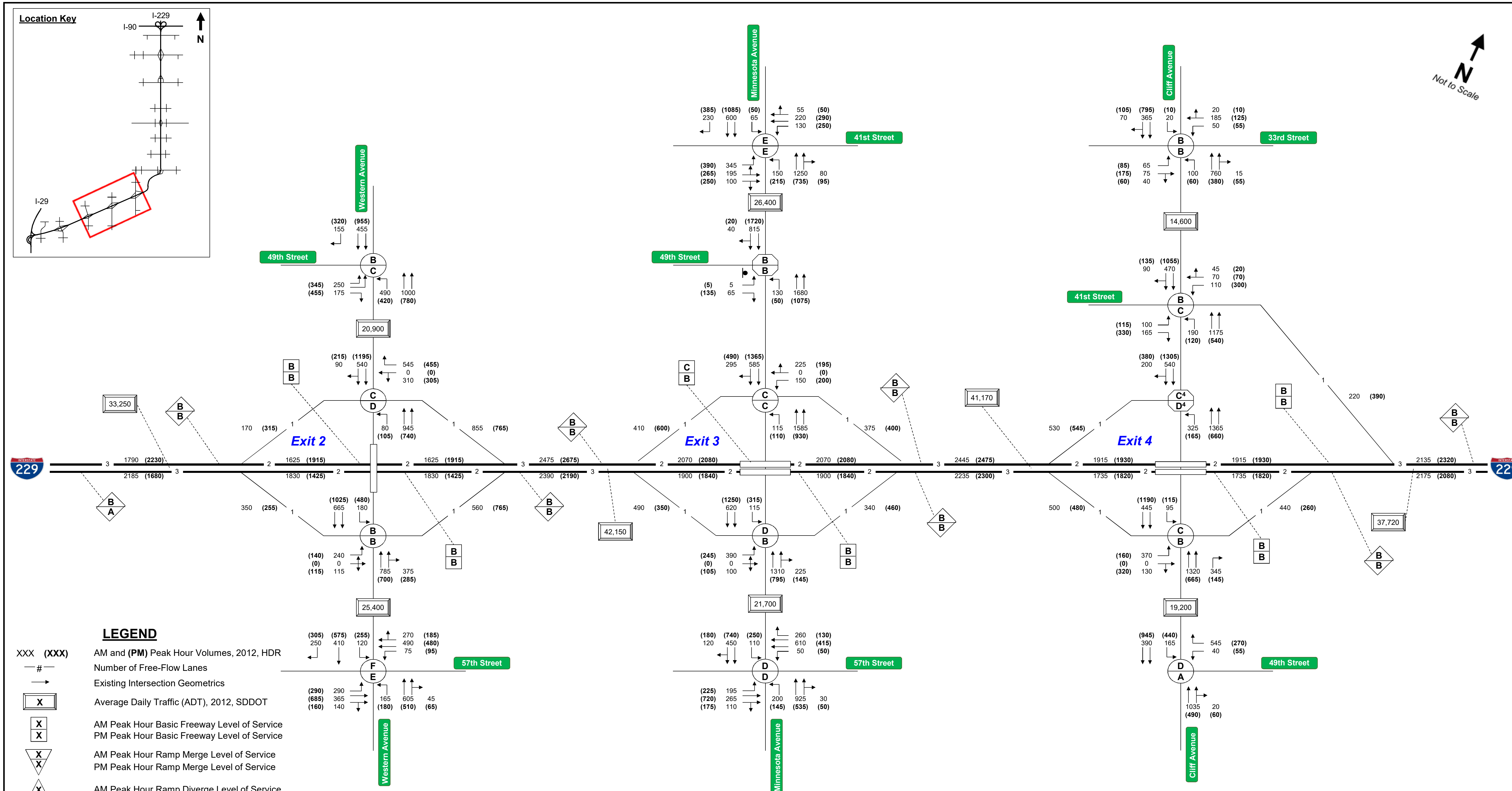

LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes, 2012, HDR
—#—	Number of Free-Flow Lanes
→	Existing Intersection Geometrics
X	Average Daily Traffic (ADT), 2012, SDDOT
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported
4. Worst case stop controlled movement Level of Service reported

HDR

Existing Conditions Traffic Operations Analysis

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Figure
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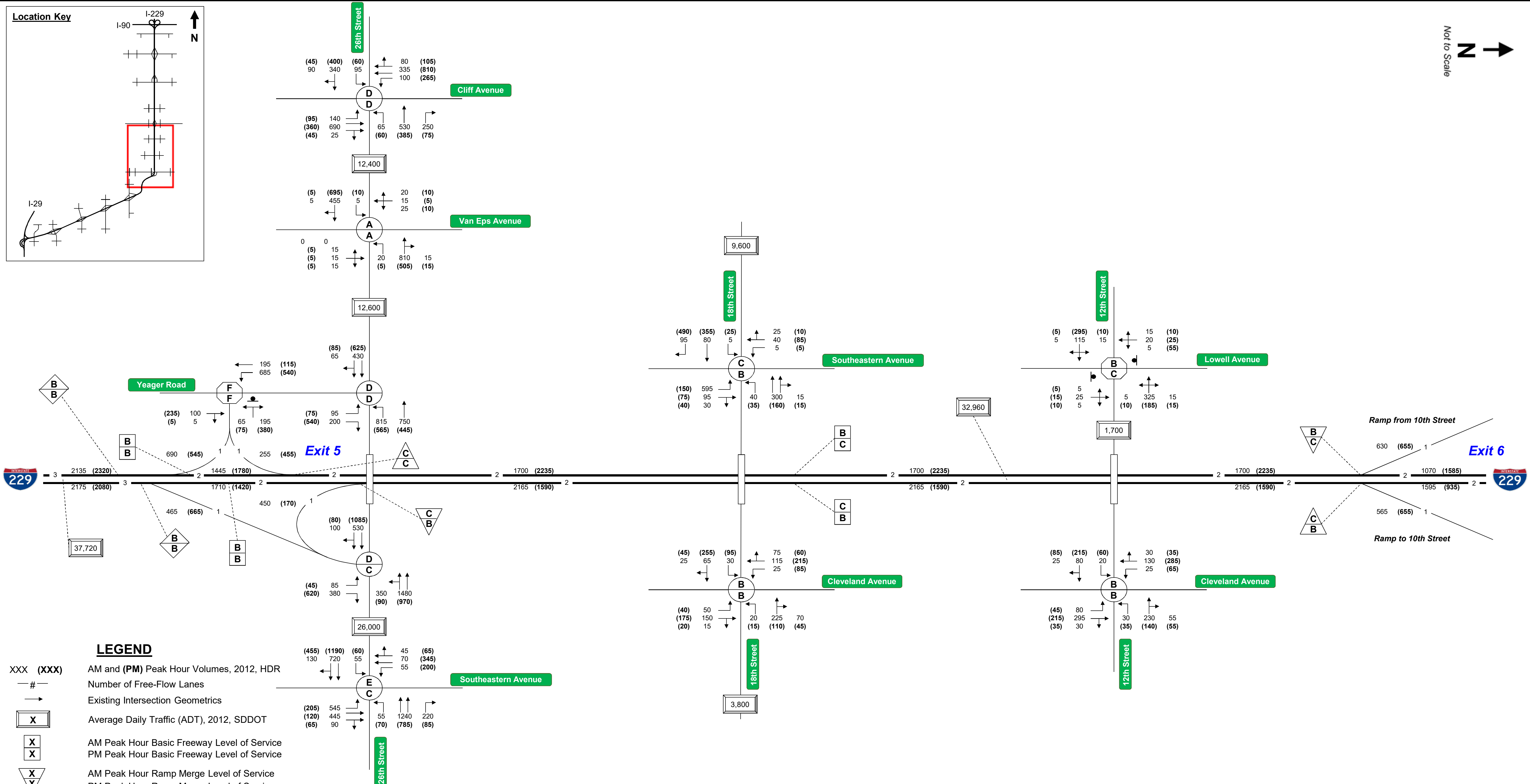

LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes, 2012, HDR
—#—	Number of Free-Flow Lanes
→	Existing Intersection Geometrics
X	Average Daily Traffic (ADT), 2012, SDDOT
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

HDR

Existing Conditions Traffic Operations Analysis

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Figure
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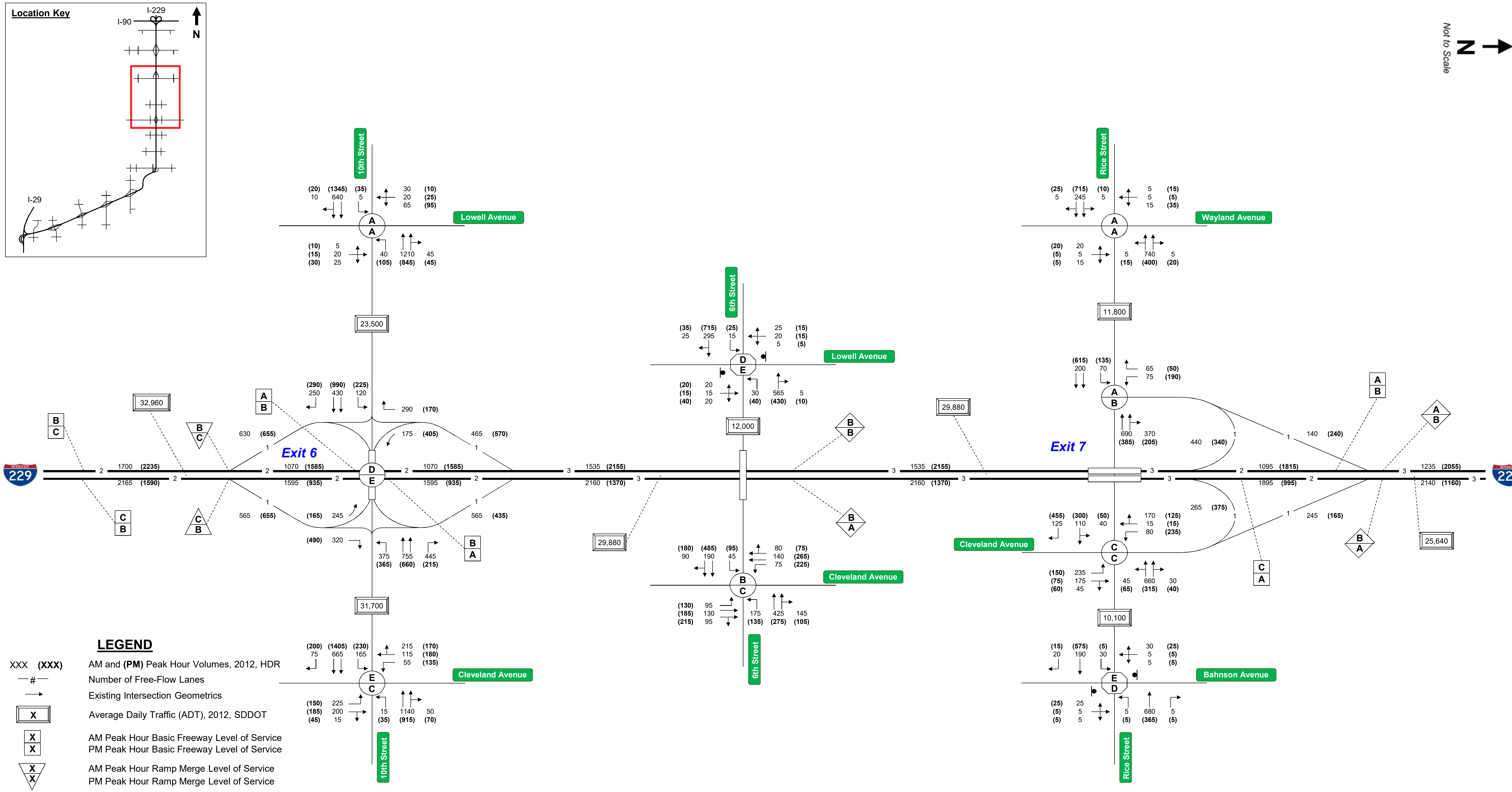

LEGEND

XXX (XXX)	AM and (PM) Peak Hour Volumes, 2012, HDR
—#—	Number of Free-Flow Lanes
→	Existing Intersection Geometrics
X	Average Daily Traffic (ADT), 2012, SDDOT
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

Existing Conditions Traffic Operations Analysis

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Figure
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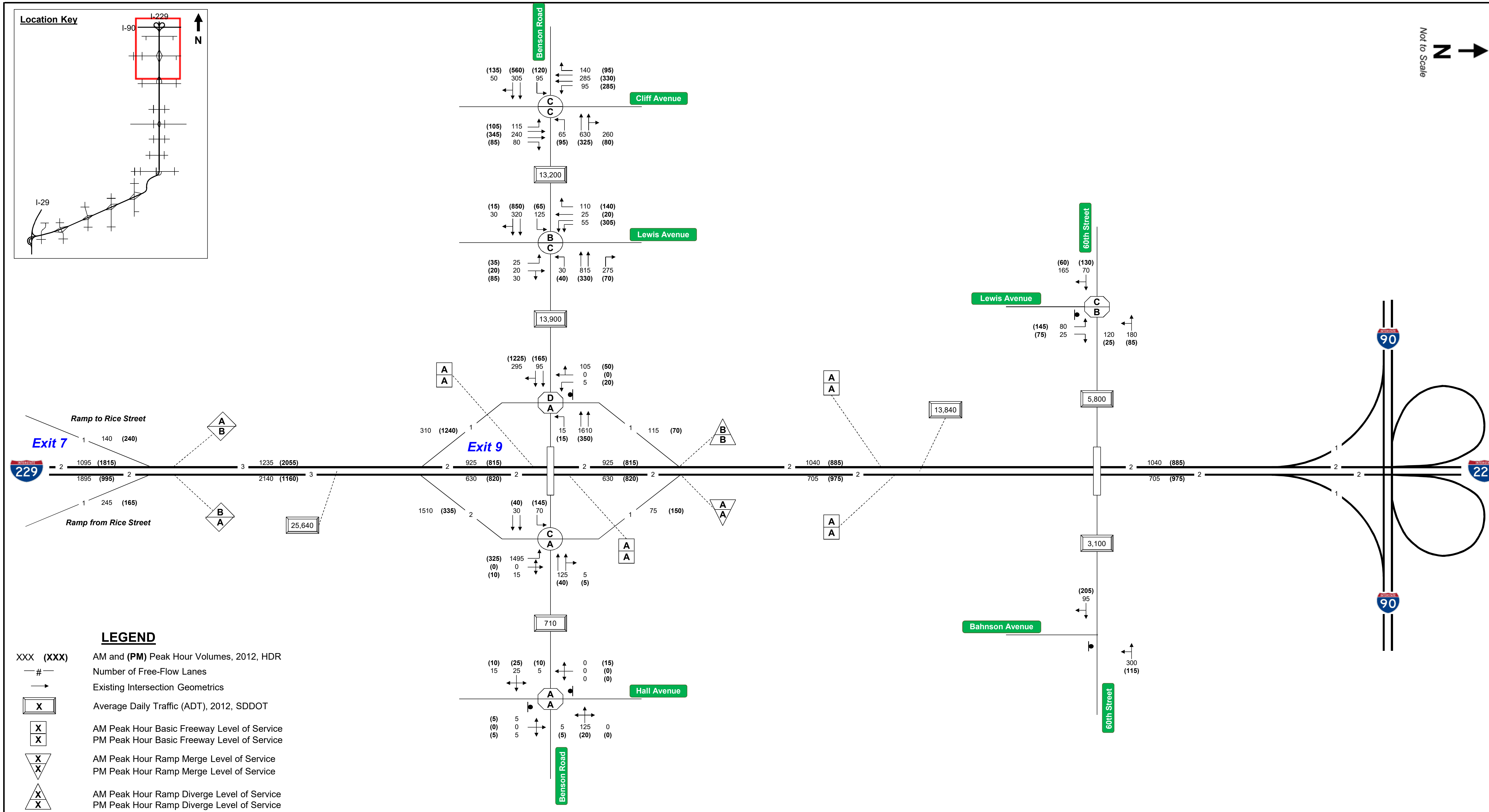

LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes, 2012, HDR
—#—	Number of Free-Flow Lanes
→	Existing Intersection Geometrics
X	Average Daily Traffic (ADT), 2012, SDDOT
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30 - 5:30 PM Peak Hour
3. Worst case stop controlled approach Level of Service reported

HDR

Existing Conditions Traffic Operations Analysis

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Section 3.5 - Year 2035 No-Build Operational Results

Traffic forecasts for year 2035 for the No-Build condition were established as part of the overall I-229 MIS. The balanced set of year 2035 No-Build volumes is included with the results of the Future No-Build analysis. Further information regarding the future year volume development can be found in ***Appendix E3. Year 2035 Future Volumes***.

Year 2035 No-Build conditions operational analysis included the analysis of 41 signalized intersections, 6 unsignalized intersections, 21 basic freeway segments, 14 weave segments, 4 merge areas, and 3 diverge areas.

A detailed report of the future No-Build operations can be found in ***Appendix E4. 2035 No-Build Operational Analysis Technical Memorandum***.

This year 2035 conditions analysis found that portions of the freeway and multiple ramps will operate worse than a desirable LOS of C or better throughout the study area. Several ramp terminal intersections will also degrade beyond the threshold of LOS C. In addition, numerous arterial intersections will degrade beyond the acceptable threshold of LOS D. ***Table 2*** highlights intersections and freeway facilities that will not meet the project specific LOS thresholds.

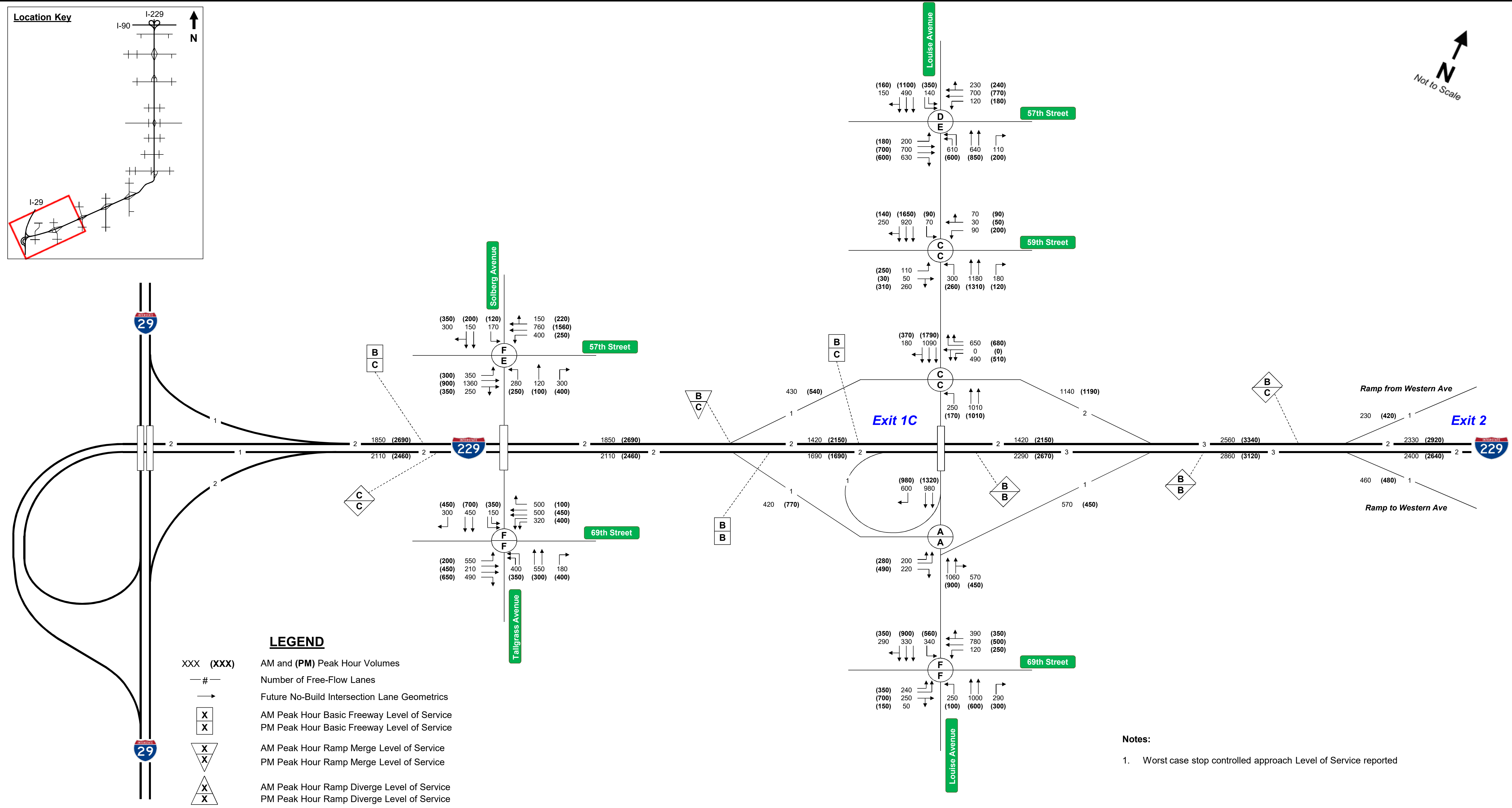
Final operational analysis LOS results for year 2035 No-Build AM and PM peak hour can be found in graphical format in ***Figures 10 through 14*** for study intersections, as well as basic freeway, merge, diverge and weaving segments.

Figure 15 displays peak hour intersection LOS results for the worst case between AM and PM peak hour.

Table 2. 2035 No-Build Conditions Deficient Locations Based on Operational Analysis

LOCATION	AM	PM
57th Street & Solberg Avenue	LOS F	LOS E
69th Street & Tallgrass Avenue	LOS F	LOS F
57th Street & Louise Avenue		LOS E
69th Street & Louise Avenue	LOS F	LOS F
49th Street & Western Avenue		LOS F
57th Street & Western Avenue		LOS E
41st Street & Minnesota Avenue		LOS E
49th Street & Minnesota Avenue – *Worst stop-controlled approach LOS*	LOS F	LOS F
Minnesota Avenue & I-229 NB Ramp Terminal	LOS D	
57th Street & Minnesota Avenue	LOS F	LOS F
Cliff Avenue & I-229 SB On-Ramp – *Worst stop-controlled movement LOS*	LOS D	LOS F
Cliff Avenue & I-229 NB Ramp Terminal	LOS D	
49th Street & Cliff Avenue	LOS E	
I-229 SB Diverge to 26th Street off-ramp	LOS D	LOS D
I-229 NB Mainline between 26th Street and 10th Street	LOS D	
I-229 SB Mainline between 26th Street and 10th Street	LOS D	LOS D
12th Street & Lowell Avenue – *Worst stop-controlled approach LOS*	LOS F	LOS F
I-229 NB Diverge to 10th Street off-ramp	LOS D	
I-229 SB Merge from 10th Street on-ramp	LOS D	LOS D
10th Street & I-229 SPUI		LOS E
10th Street & Cleveland Avenue	LOS F	LOS E
6th Street & Lowell Avenue – *Worst stop-controlled approach LOS*	LOS F	LOS F
Rice Street & I-229 NB Ramp Terminal / Cleveland Avenue	LOS D	LOS E
Benson Road & I-229 SB Ramp Terminal – *Worst stop-controlled approach LOS*	LOS F	LOS F
Benson Road & I-229 NB Ramp Terminal	LOS F	

Note: Acceptable threshold is LOS D for arterial intersections and LOS C for freeway, ramps, and ramp terminal intersections.



LEGEND

XXX **(XXX)** AM and **(PM)** Peak Hour Volumes

—#— Number of Free-Flow Lanes

→ Future No-Build Intersection Lane Geometrics

X / X AM Peak Hour Basic Freeway Level of Service / PM Peak Hour Basic Freeway Level of Service

X / X AM Peak Hour Ramp Merge Level of Service / PM Peak Hour Ramp Merge Level of Service

X / X AM Peak Hour Ramp Diverge Level of Service / PM Peak Hour Ramp Diverge Level of Service

X / X AM Peak Hour Weaving Section Level of Service / PM Peak Hour Weaving Section Level of Service

X / X AM Peak Hour Signalized Intersection Level of Service / PM Peak Hour Signalized Intersection Level of Service

X / X AM Peak Hour Unsignalized Intersection Level of Service / PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported

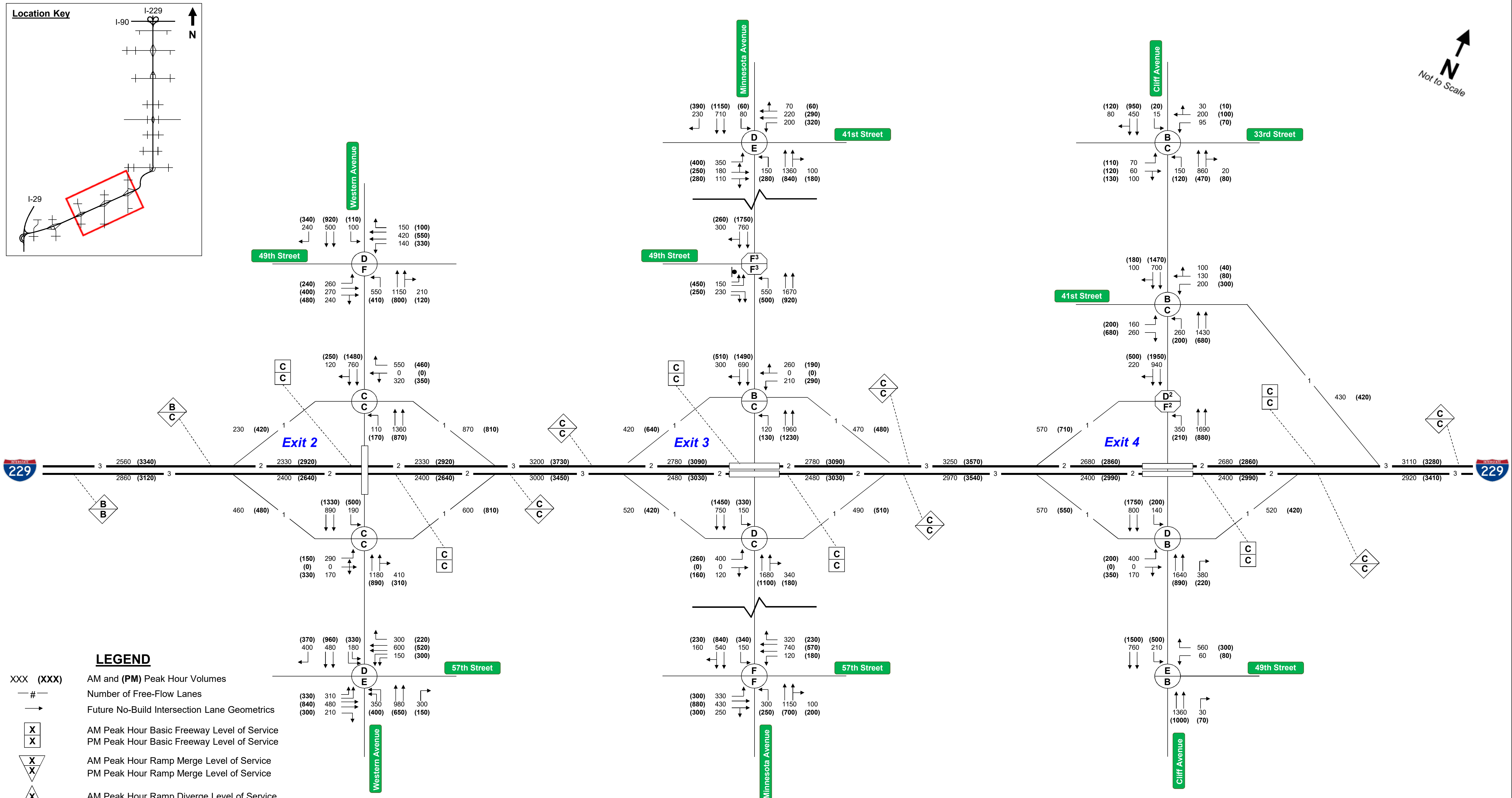
HDR

2035 No-Build Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
June 2017

Figure
10



LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Worst case stop controlled movement Level of Service reported
3. Level of Service reported from HCS 2010 analysis using a single left-turn lane and a single right-turn lane due to limitations of HCS 2010 software.

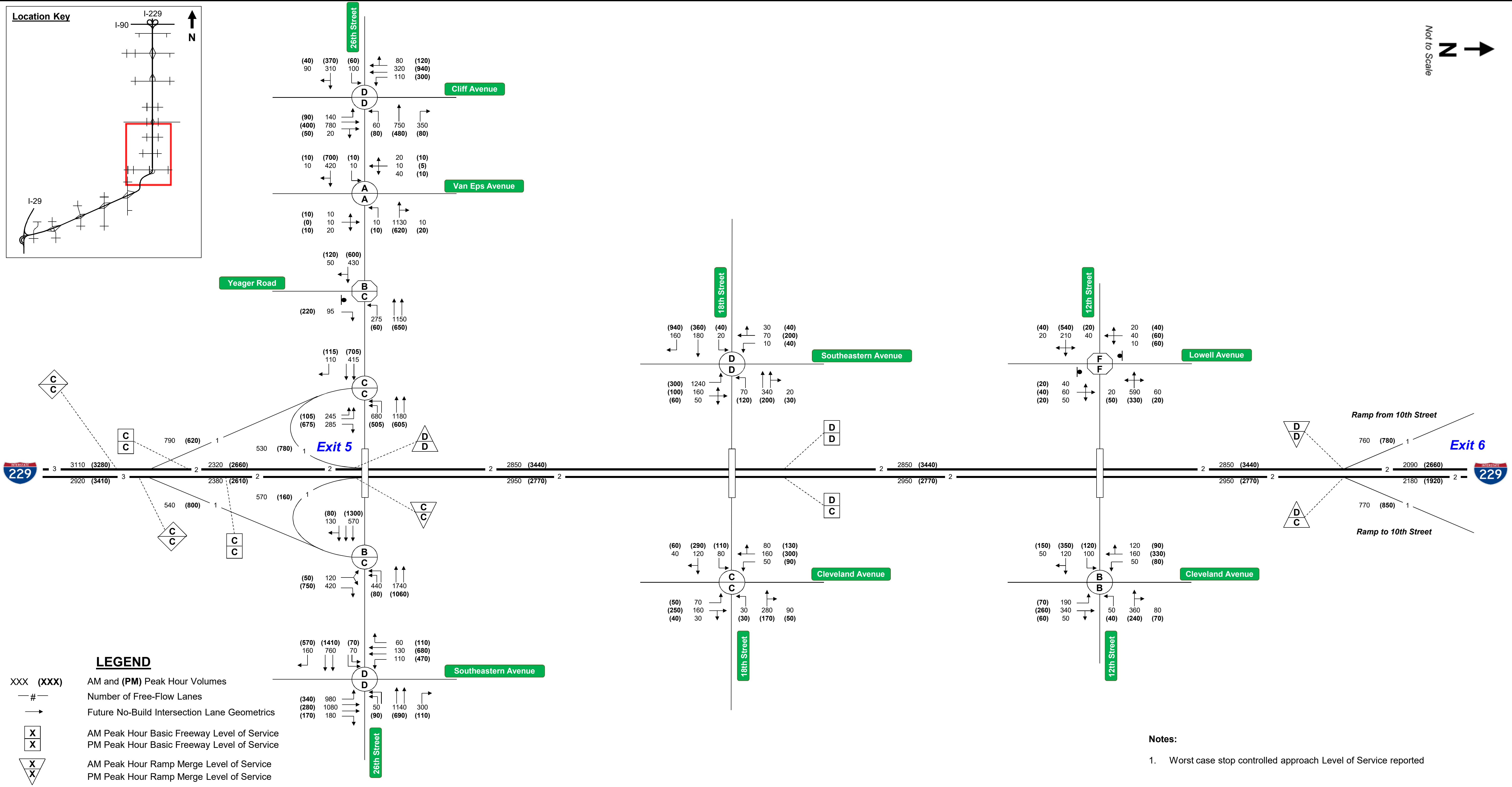
HDR

2035 No-Build Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
June 2017

Figure
11



LEGEND

XXX (XXX) AM and (PM) Peak Hour Volumes

—#— Number of Free-Flow Lanes

→ Future No-Build Intersection Lane Geometrics

AM Peak Hour Basic Freeway Level of Service
PM Peak Hour Basic Freeway Level of Service

AM Peak Hour Ramp Merge Level of Service
PM Peak Hour Ramp Merge Level of Service

AM Peak Hour Ramp Diverge Level of Service
PM Peak Hour Ramp Diverge Level of Service

AM Peak Hour Weaving Section Level of Service
PM Peak Hour Weaving Section Level of Service

AM Peak Hour Signalized Intersection Level of Service
PM Peak Hour Signalized Intersection Level of Service

AM Peak Hour Unsignalized Intersection Level of Service
PM Peak Hour Unsignalized Intersection Level of Service

Notes:

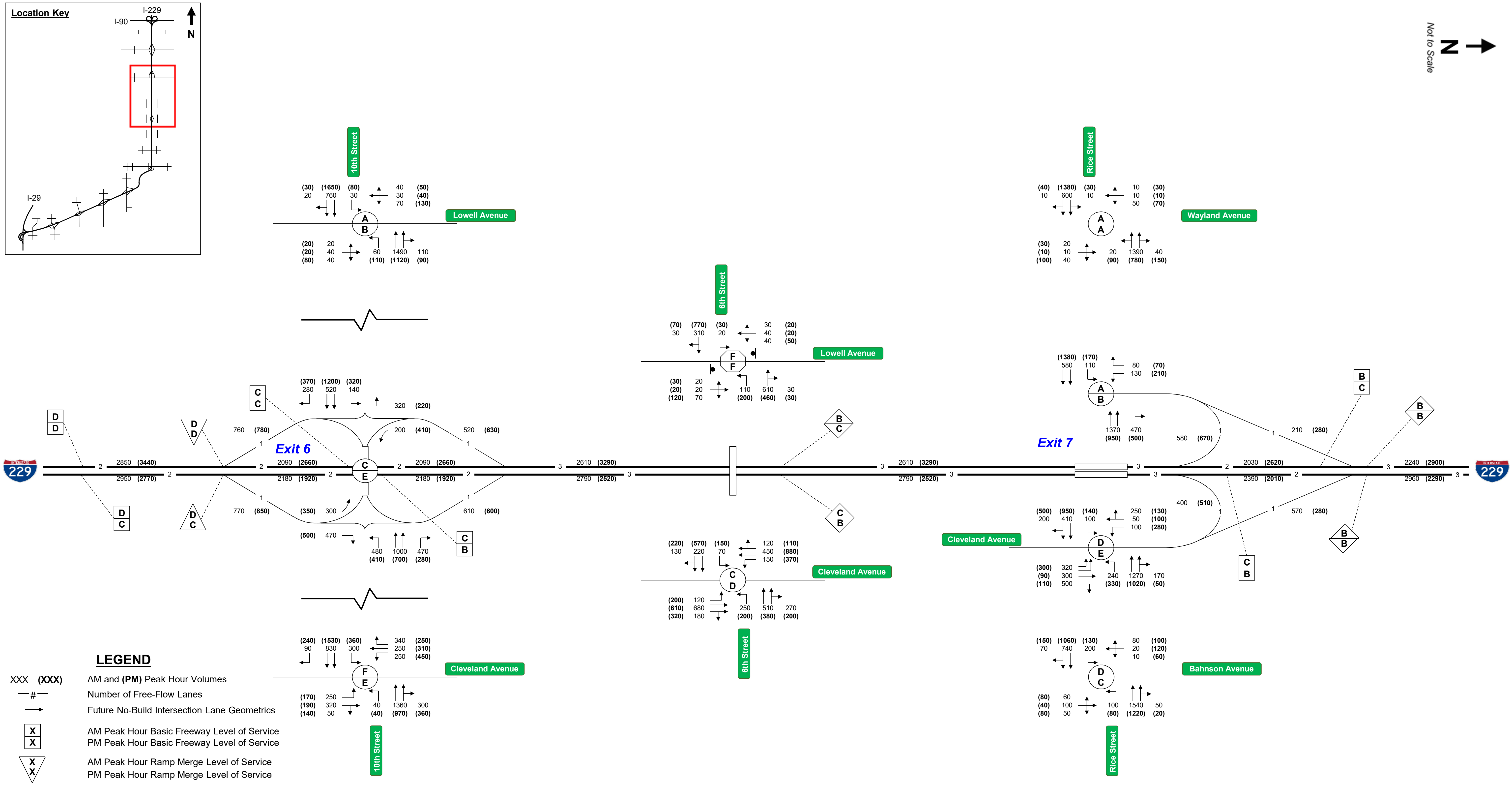
1. Worst case stop controlled approach Level of Service reported

2035 No-Build Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
June 2017

Figure
12



LEGEND

XXX (XXX) AM and (PM) Peak Hour Volumes

—#— Number of Free-Flow Lanes

→ Future No-Build Intersection Lane Geometrics

AM Peak Hour Basic Freeway Level of Service
PM Peak Hour Basic Freeway Level of Service

AM Peak Hour Ramp Merge Level of Service
PM Peak Hour Ramp Merge Level of Service

AM Peak Hour Ramp Diverge Level of Service
PM Peak Hour Ramp Diverge Level of Service

AM Peak Hour Weaving Section Level of Service
PM Peak Hour Weaving Section Level of Service

AM Peak Hour Signalized Intersection Level of Service
PM Peak Hour Signalized Intersection Level of Service

AM Peak Hour Unsignalized Intersection Level of Service
PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported

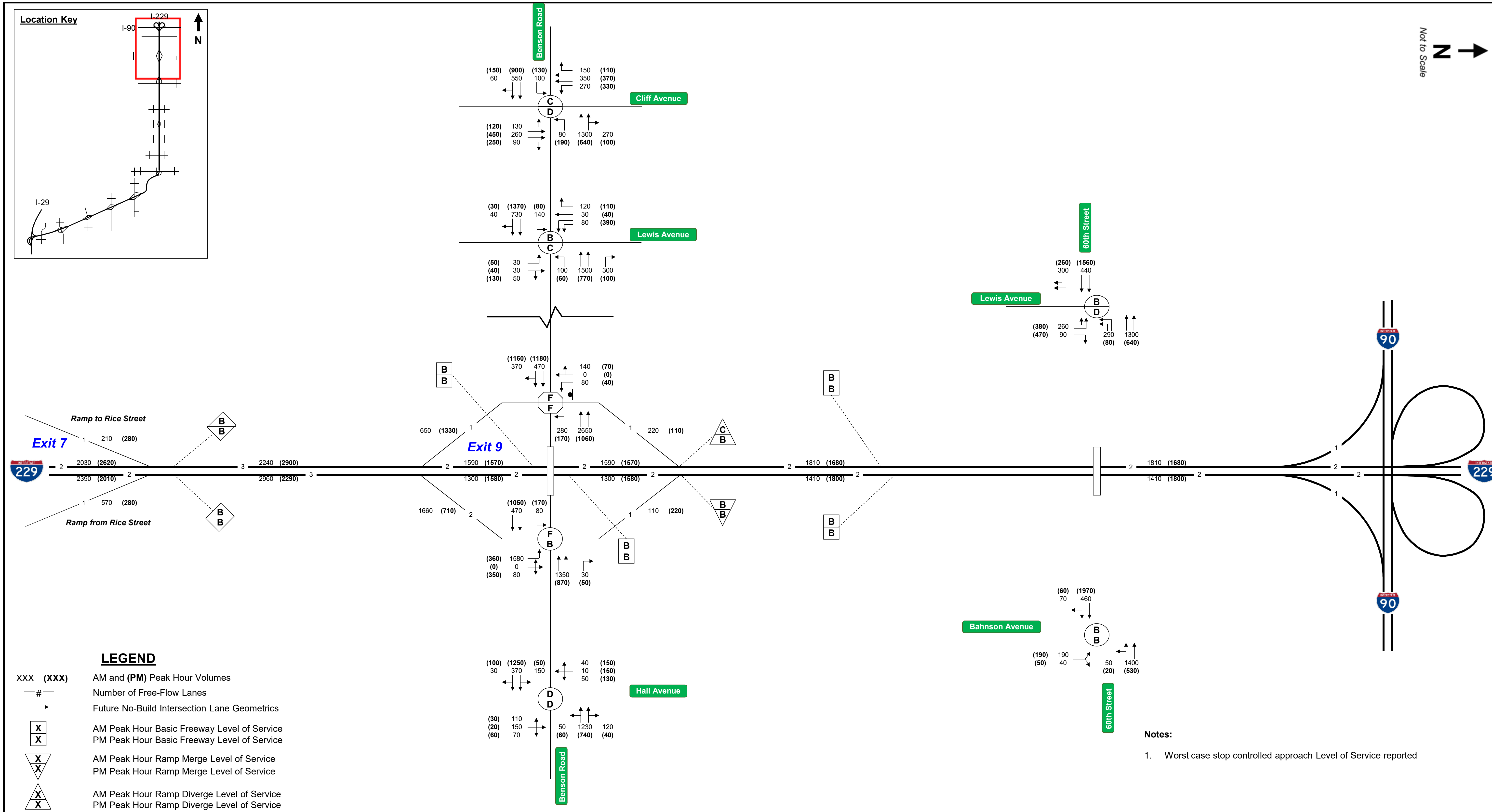
HDR

2035 No-Build Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
June 2017

Figure
13



LEGEND

XXX **(XXX)** AM and **(PM)** Peak Hour Volumes

—#— Number of Free-Flow Lanes

→ Future No-Build Intersection Lane Geometrics

AM Peak Hour Basic Freeway Level of Service
PM Peak Hour Basic Freeway Level of Service

AM Peak Hour Ramp Merge Level of Service
PM Peak Hour Ramp Merge Level of Service

AM Peak Hour Ramp Diverge Level of Service
PM Peak Hour Ramp Diverge Level of Service

AM Peak Hour Weaving Section Level of Service
PM Peak Hour Weaving Section Level of Service

AM Peak Hour Signalized Intersection Level of Service
PM Peak Hour Signalized Intersection Level of Service

AM Peak Hour Unsignalized Intersection Level of Service
PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported

HDR

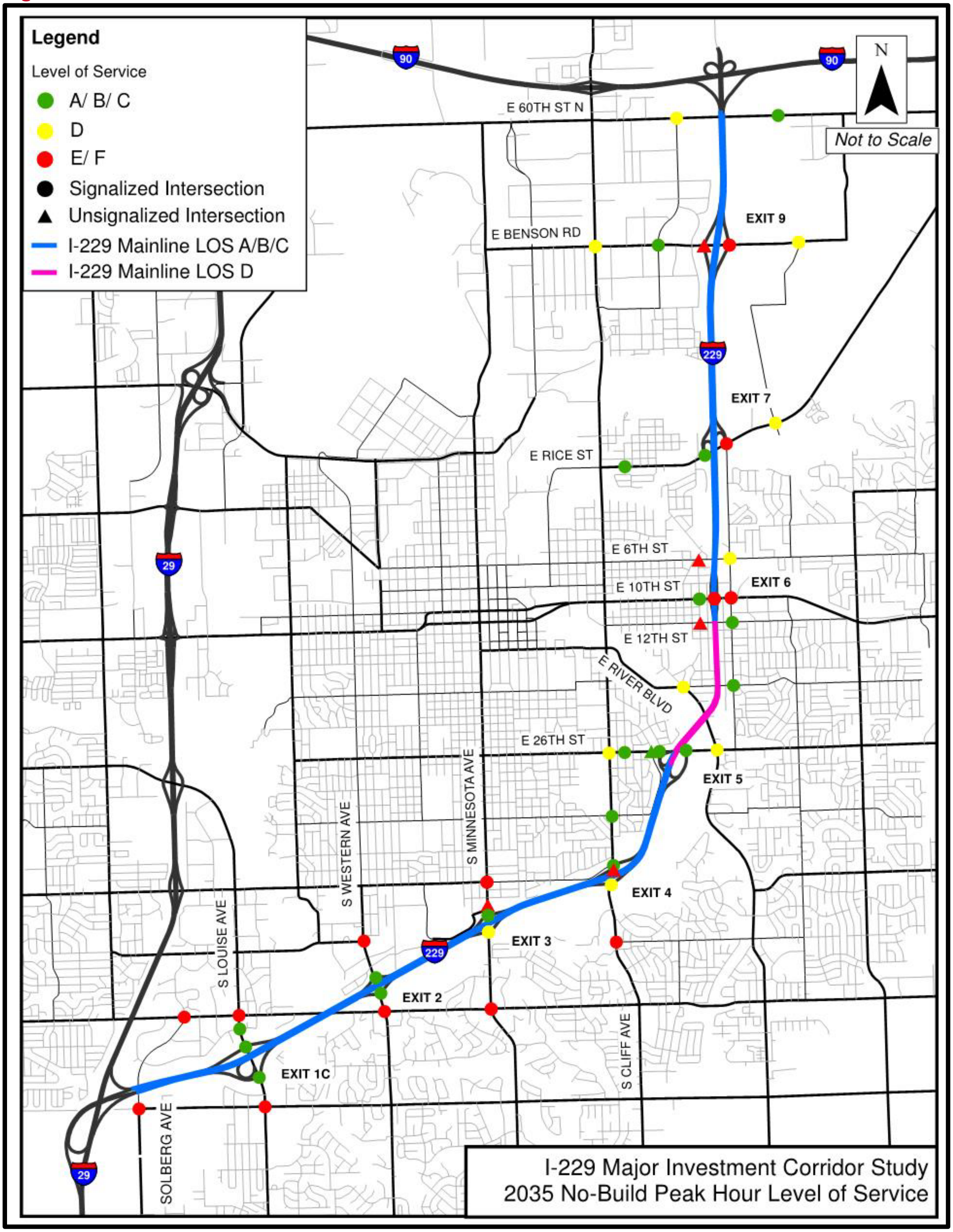
2035 No-Build Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date: June 2017

Figure 14

Figure 15. 2035 No-Build Peak Hour Level of Service



Section 3.6 - Crash / Safety Analysis

Crash data was reviewed for the study area based on the Crash Geodatabase which includes crashes between January 2009 and December 2012.

Segment and Intersection Crash Rates

Crash rates for interstate mainline segments, ramps, and arterial street intersections are provided in *Appendix F1. Existing Conditions Crash Rates*.

Crash Trends

Review of the crash summaries for each Interstate segment and arterial street intersection revealed a few crash trends:

- Many of the crashes on I-229 are associated with drivers losing control on slippery road conditions. Drivers in this group were cited for either driving too fast for conditions or following too closely.
- Driver distraction or use of electronic devices were cited in a growing number of crashes throughout the corridor. The ubiquitous use of cell phones, particularly in adverse weather conditions, appears to be elevating crash levels.
- A large percentage of the crashes on ramps and at intersections are related to drivers being unprepared for congestion. It has grown common for drivers in the PM peak travel period to encounter long queues on off ramps and at intersections. Unprepared drivers then risk either colliding with the rear of another vehicle or leaving the roadway to avoid a rear-end crash.

Potential Mitigation Measures

The general crash trends identified in the existing conditions suggest several potential strategies for reducing crash rates along the I-229 corridor:

- Provide enhanced driver information during inclement weather. Such information could include suggested travel speeds or temporary speed limits, notice of winter maintenance activities, notice of roadway conditions, and other information to help drivers respond to changing weather.
- Continued education about the effects of using cell phones and other electronic devices while driving.
- Congestion relief on corridor crossroads.

Each of the Interstate segments and arterial intersections that were identified as having crash rates outside of the critical rates are discussed in the following points.

Interstate segments:

- 10th Street interchange area, southbound – crashes appeared to be concentrated near the 10th Street overpass and were primarily single vehicle crashes under slippery conditions. *Provide driver information during inclement weather.*
- 10th Street to 26th Street, southbound – crashes appeared to be evenly distributed and were primarily single vehicle, sideswipe or rear-end crashes under slippery conditions. *Provide driver information during inclement weather.*
- Minnesota Avenue interchange area, southbound – crashes appeared to be concentrated near the Minnesota Avenue overpass and were primarily single vehicle crashes under slippery conditions. *Provide driver information during inclement weather.*
- Western Avenue to Louise Avenue, southbound – crashes appeared to be evenly distributed and were primarily single vehicle crashes under slippery conditions. *Provide driver information during inclement weather.*
- I-29 to Louise Avenue, northbound – crashes appeared to be concentrated near a drainage area and were either animal hits or single vehicle crashes under slippery conditions. *Provide driver information during inclement weather, check for deer crossing warning signs.*
- Louise Avenue to Western Avenue, northbound - crashes appeared to be concentrated near a drainage area and were either animal hits or single vehicle crashes under slippery conditions. *Provide driver information during inclement weather, check for deer crossing warning signs.*
- 26th Street to 10th Street, northbound – crashes appeared to be evenly distributed and were primarily single vehicle, sideswipe or rear-end crashes under slippery conditions. *Provide driver information during inclement weather.*

Interstate ramps:

- 10th Street on ramp, southbound – crashes were primarily rear-end type near the gore area. *Merge area was extended in 2012 and auxiliary lane may be considered.*
- Minnesota Avenue off ramp, northbound – crashes were primarily rear-end type near the gore area and terminal area. *Reduce congestion and queues on ramp. Consider advance driver information.*
- Cliff Avenue off ramp, northbound – crashes were primarily rear-end type near ramp terminal. *Reduce congestion and queues on ramp. Consider advance driver information.*
- 10th Street off ramp, northbound – crashes were primarily rear-end type near the gore area and terminal area. *Reduce congestion and queues on ramp. Consider advance driver information.*

Arterial intersections:

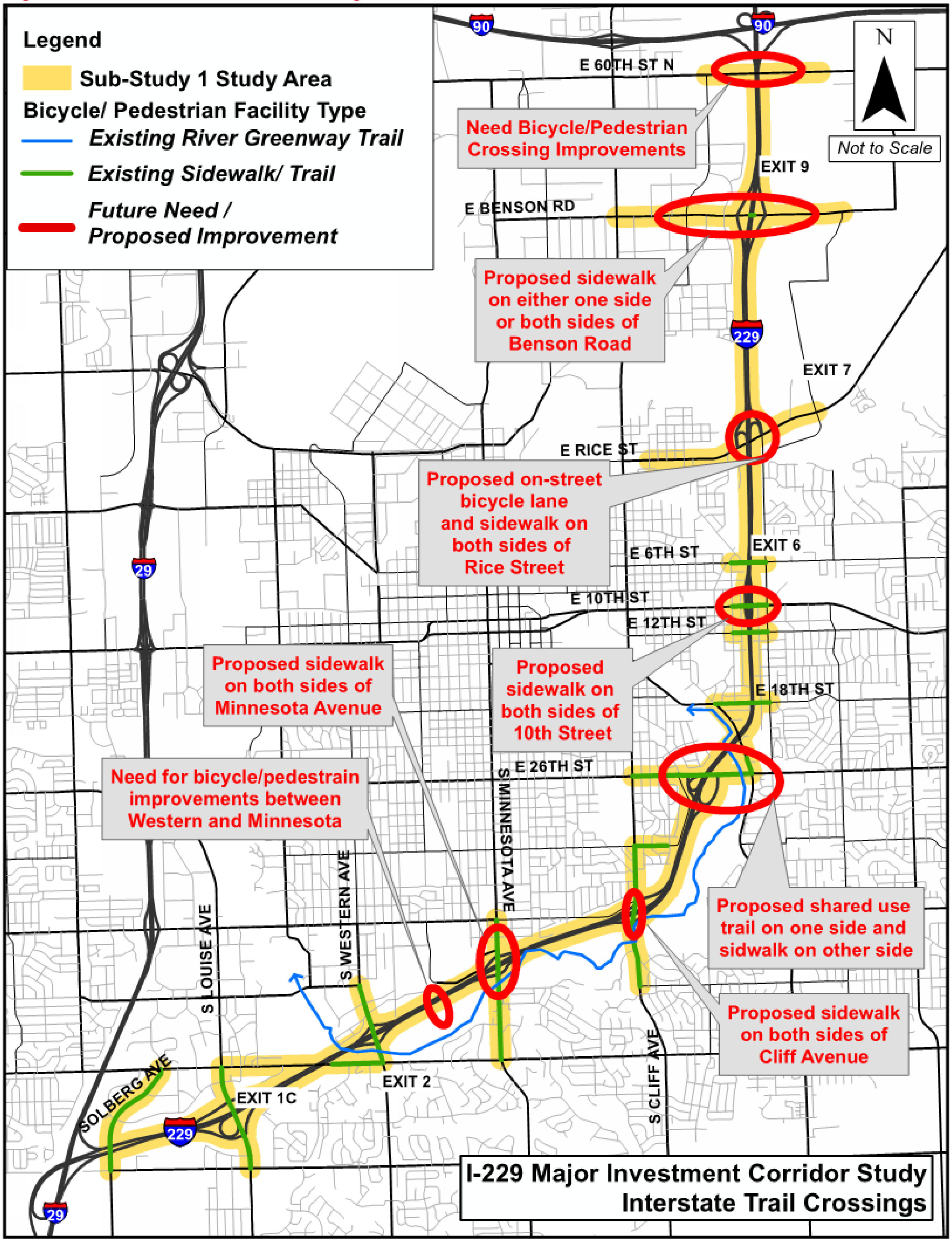
- 57th Street/Louise Avenue – crashes were evenly split between rear-end and angle types and occurred mostly in the intersection. Many drivers were cited for being distracted and following too closely. Intersection experiences long queues during peak demand periods. *Reduce congestion.*
- I-229 southbound/Louise Avenue – crashes were primarily on Louise Avenue and were 57% rear-end and 34% angle types. Many drivers were cited for being distracted and following too closely. Intersection experiences long queues during peak demand periods. *Reduce congestion.*
- I-229 northbound/26th Street – crashes were almost all rear-end type on 26th Street. *I-229/26th St. (Exit 5) Corridor Study has identified the need for interchange improvements.*
- I-229/10th Street – crashes were primarily rear-end type and occurred most frequently on the westbound-to-southbound left turn and the northbound-to-eastbound right turn. *Reduce congestion.*
- 10th Street/Cleveland Avenue – crashes were primarily on Cleveland Avenue and included a mix of crash types. Previous studies have recommended intersection improvements. *Reduce congestion.*
- 6th Street/Cleveland Avenue – crashes were primarily on 6th Street and were 53% angle and 38% rear-end types. *Review sight distance and intersection clearance times.*
- Benson Road/Cliff Avenue – crashes were primarily in the intersection and were 48% angle and 33% rear-end types. Intersection has been within a construction work zone during the monitoring period. *Review crash statistics at later date.*

Additional information regarding the safety analysis can be found in ***APPENDIX F2. EXISTING CONDITIONS SAFETY ASSESSMENT***.

Section 3.7 - Bicycle and Pedestrian Facilities

Bicycle and pedestrian facilities that cross over the I-229 interstate in the Sub-Study 1 corridor area were identified as shown in ***FIGURE 16***. This figure illustrates existing sidewalks/trails, the River Greenway Trail, and areas needing future bicycle/pedestrian improvements.

Figure 16. Interstate Trail Crossings



CHAPTER 4 - Incident, Weather, and Special Event Analysis

I-229 is a key transportation corridor for the Sioux Falls region on a daily basis. When unforeseen incidents occur, such as those due to weather, construction or special events, the roadway system is affected. An assessment of these impacts was conducted as part of this study in order to assist in identifying the best methods to safely manage traffic during incidents.

Section 4.1 - Origin-Destination Data Analysis

Origin-destination (O-D) data was gathered as a part of this study using cell phone technology by AirSage as described in ***Appendix C. Origin-Destination Data Collection***.

In order to assess the changes in travel patterns for non-typical days, a comparison was conducted to determine the changes in trips during a weather related incident and a construction incident. Both the winter weather incident event day and the construction incident event day were found to have quantities of trips similar to the average weekday.

Weather Related Incident

On Friday, February 22, 2013, the reported snowfall was 6 inches, and schools remained open. Inspection of trip-making totals by day of week shows that Friday is consistently the day of the week with the most total trips. Since Fridays were shown to consistently produce more total trips compared to other days of the week, the net effect of the weather incident on trip making patterns was greatly varied, with some zones showing more trips and some zones showing less trips.

Construction Incident

On February 13, 2013, an I-229 southbound lane was closed in the morning due to guardrail work at Cliff Avenue (Exit 4) and 10th Street (Exit 6). The lane closure appeared to have slightly increased trip activity adjacent to Bahnson Avenue, and slightly decreased trip activity south and west of Southeastern Avenue. For the construction incident day vs. the average weekday comparison, most zones had variances of +/- 10 to 50 percent trips.

Additional detail regarding the weather and construction related incidents can be found in ***Appendix C. Origin-Destination Data Collection***.

Section 4.2 - Special Event Analysis

Travel time data was conducted during the evening hours of Friday July 19 and Saturday July 20, 2013 during Jazz Fest. A comparison of average travel times and speeds can be made between the average weekday travel time runs (conducted in March 2013) to those made during Jazz Fest. This comparison shows that the average speeds did not significantly vary for I-229 mainline during this special event. Additional detail regarding the travel time runs for this special event can be found in ***Appendix B. Traffic Data Collection***.

Section 4.3 - ITS Assessment

Intelligent transportation systems (ITS) are a set of technologies applied to transportation infrastructure and vehicles to improve their performance. ITS offers state and local transportation agencies advanced technology measures to reduce traffic congestion, increase mobility and increase roadway safety without having to spend large sums of money on new transportation infrastructure.

Components of the ITS assessment as part of this study are included in ***APPENDIX G1. ITS ASSESSMENT***. This memorandum includes a detailed listing of potential ITS solutions and service packages, as well as cost estimates for potential ITS solutions using general planning level unit costs.

ITS SERVICE PACKAGES

A list of ITS service packages from the national ***ITS Architecture 7.0*** were reviewed with stakeholders in this study. Service Packages represent the collection of one or more ITS solutions that work together to deliver a given ITS service. The service packages identified for consideration in this study include:

- Traveler Information
- Traffic Management
- Emergency Management
- Maintenance & Construction Management

POTENTIAL ITS SOLUTIONS

Potential ITS solutions were identified in order to deliver the Service Packages identified during stakeholder workshops. The potential ITS solutions that were identified may support more than one Service Package. ITS solutions identified for consideration in this study include:

- CCTV Cameras
- Traffic Detectors
- Adaptive Signal Control Technology
- Dynamic Message Signs
- Highway Advisory Radio
- Traffic Management Center
- 511/Advanced Traveler Information System (ATIS)
- Variable Speed Limit Signs
- Road Weather Information Systems
- Dynamic Road Warning Signs
- Roadway Service Patrol Vehicles

- Automated Vehicle Location
- Automated Work Zone

Stakeholder Feedback

A questionnaire was sent to local public agencies and private companies inquiring about current traffic operations and incident management in the area. The questionnaire can be found in Appendix G2. Summary of the Current ITS Operations Questionnaire. Feedback from this questionnaire was discussed with stakeholders as part of the Preliminary Range of Concepts Workshop on December 17th-18th, 2014.

Potential Placement of ITS Devices

Preliminary locations for ITS devices related to the study area can be found in Appendix G3. Potential Placement of ITS Devices. This map shows prospective location of adaptive signal controls, CCTV cameras, dynamic message signs, dynamic warning signs and traffic detectors.

Section 4.4 - Detour Route Considerations

The incident management portion of this study includes a high-level outline of feasible routes to direct mainline traffic during construction or maintenance activities that require the closure of a complete directional set of lanes for each I-229 corridor link between interchanges and at each interchange.

The goal of this portion of the study is to develop base mapping for detours along I-229 and begin discussions on local agency coordination activities. Agencies partnered with incident management activities include law enforcement, fire and rescue, medical services, public safety communications, traffic information media, SDDOT, City of Sioux Falls and others.

Potential local and regional detour routes for consideration were developed for each directional I-229 mainline segment between interchanges and at interchanges from I-29 to I-90. The detour routes were determined subjectively, primarily based on proximity to I-229, routes remaining on major/arterial streets, avoiding routes that cross the interstate, and avoiding left-turns at the ramp terminals.

The I-229 corridor includes a low percentage of regional traffic (according to the AirSage data, as described in Section 2.2 - Origin-Destination Data Analysis). Given the low percentage of regional traffic on the I-229 corridor, an incident management plan would likely target more local traffic who is familiar with the roadway system and will likely detour according to local knowledge. Local traffic may choose to take a different route than what is indicated for each closure's detour, especially at peak times of the day.

Detour route maps developed in this study can be found in Appendix H. Incident Management Actions and Detour Routes. Detailed traffic incident management procedures and maps should be developed in a coordinated effort with the traffic incident management group.

CHAPTER 5 - CONCEPT DEVELOPMENT AND ANALYSIS

The transportation deficiencies identified in the Existing Conditions and 2035 No-Build Conditions analysis were taken into consideration along with input from the Study Advisory Team (SAT) in order to develop potential roadway improvement projects. A multi-step process was used to develop, analyze and refine potential concepts in order to identify the recommended concepts for future consideration.

The deficiencies were addressed in the individual sub-studies. The initial sub-studies that were identified are as follows:

- *I-229 Corridor Study*
- *I-229 Exit 3 (Minnesota Avenue) Crossroad Corridor Study*
- *I-229 Exit 6 (10th Street) Crossroad Corridor Study*
- *I-229 Exit 9 (Benson Road) Crossroad Corridor Study*

The Cliff Avenue and Rice Street crossroad corridors were originally a part of the I-229 Corridor Study. During the development of the analysis of the potential concepts, it was determined to separate these corridors into their own sub-studies. The rest of this chapter will focus primarily on the I-229 mainline.

Note: *Some of the detailed information contained in the appendices includes information related to the Cliff Avenue and Rice Street corridors since the documentation was developed prior to separating these into their own sub-studies.*

Section 5.1 - Preliminary Concept Development

Prior to development of the preliminary concepts, a Public Open House was held October 30th, 2013 to introduce and receive feedback regarding the I-229 MIS. The Public Open House discussed the needs and goals for each individual corridor study and received feedback from the public. A summary of the public involvement process and meeting notes can be found in ***APPENDIX M. PUBLIC INVOLVEMENT***.

The first step in the concept development phase was to identify preliminary concepts to potentially address the deficiencies identified in the Existing Conditions and 2035 No-Build Conditions analysis.

These concepts were developed with SAT input during concept workshops in December 2014 and July 2015. Preliminary concepts for the I-229 corridor included:

I-229 Corridor

- ***I229-C1.*** I-229 6 Lanes from 26th St to 10th St
- ***I229-C2.*** I-229 6 Lanes from 26th St to 10th St + 65 mph Improved Curves

Preliminary Concept figures are shown in ***APPENDIX I1. PRELIMINARY CONCEPT FIGURES***.

Section 5.2 - Preliminary Concept Comparisons

The preliminary concepts were evaluated through a screening process in order to identify concepts to be carried forward in the study and further refined and analyzed. Each of the preliminary concepts was evaluated using criteria in four categories. The four category types evaluated for each preliminary concept identified for further consideration included Property Impacts, Traffic Operations, Environmental Review and Construction Costs as described in the next sections. Additional detail may be found in ***APPENDIX I2. PRELIMINARY CONCEPTS TECH MEMO.***

PROPERTY IMPACTS

An approximate footprint for each preliminary concept was developed by setting impact limits. The portion of each property parcel intersected by the impact limits that was inside of the impact limit was assumed to be an acquisition. If an acquisition impacted a structure, or rendered a parcel unusable in the opinion of the consultant (e.g. a large part of a parking lot was acquired), the entire structure or parcel was assumed to be an acquisition.

A unit price of $5 per square foot of acquisition area was applied to estimate the cost of property impacts. The total estimated cost of property impacts for a concept is the total impacted area multiplied by $5 per square foot plus the assessed value of structures impacted (from the Minnehaha County Assessor's website) multiplied by 1.5 (to estimate the fair market value of impacts).

TRAFFIC OPERATIONS

The traffic operations assessment for each preliminary concept was developed using output from model runs of the Dynamic Traffic Assignment (DTA) model. The 2012 Existing Conditions calibrated DTA model was updated to reflect 2035 No-Build conditions and used as a baseline model to which output from each preliminary concept run was compared.

The Measures of Effectiveness (MOEs) from each concept run were compared to the No-Build MOEs and a percent change calculated between each concept and No-Build. The following MOEs were used to compare the concepts:

- Queues
- Delay
- Travel Time
- Throughput

MOEs were categorized by interchange areas where appropriate. Graphics highlighting these interchange areas, along with the DTA model subarea, can be found in ***APPENDIX I3. DTA MODEL INTERCHANGE AND MODEL SUBAREAS***.

Environmental Review

A desktop review of available data was analyzed against the preliminary concepts. Items that could require further analysis at the time of future project initiation were identified for issues that separate project concepts. Later phases in potential project corridor planning will require environmental documentation if federal funds are used, and would require analysis of additional resources such as environmental justice and noise. The environmental review included the following elements:

- Archaeological and Historical Resources
- Wetlands and Waters
- Threatened and Endangered Species
- Section 4(f) and Section 6(f) Properties
- Floodplain
- Regulated Materials

Appendix I4. Environmental Constraints Maps identify constraints in the study area such as schools, bike trails, rivers, wetlands, parks, and floodplain.

Construction Costs

Pavement area costs are assumed to include curb, shoulder, median, sidewalk, and drainage items. For cost estimating purposes, all retaining walls were assumed to have a constant height of 12 feet over their entire estimated length. Relocation costs are not included in the ROW cost estimates.

The comparative assessment of the preliminary concepts is summarized in ***Table 3***.

Table 3. Preliminary Concepts Composite Comparative Assessment

PRELIMINARY CONCEPT		TRAFFIC ASSESSMENT				ENVIRONMENTAL IMPACT	COST	ROW (acre)
		QUEUES	DELAY	TRAVEL TIME	THROUGHPUT			
I229-C1	6-Lanes, From 26th St to 10th St	*n/a*	**Poor**	Neutral	Neutral	Medium/ potential 4(f)	$27,620,000	0
I229-C2	6-Lanes, From 26th St to 10th St + 65 mph improved horizontal curves, 18th St to SE Ave	*n/a*	**Poor**	Neutral	Neutral	Medium/ potential 4(f)	$27,980,000	0

PRELIMINARY CONCEPT COMPARISON

The preliminary concepts and the concept evaluation were presented at a Public Open House on June 2nd, 2015. A summary of the public involvement process and meeting notes can be found in ***APPENDIX M. PUBLIC INVOLVEMENT***.

Based on the preliminary concept comparison and public feedback, the concepts were screened through a workshop with the SAT in July 2015 to determine which concepts should be selected for further development. The concepts selected for further development are as follows:

- *I229-C1.* I-229 6 Lanes from 26th St to 10th St
- *I229-C2.* I-229 6 Lanes from 26th St to 10th St + 65 mph Improved Curves

Section 5.3 - Analysis of Alternative Scenarios

The alternative scenarios carried forward were evaluated through a screening process in order to identify alternatives recommended to be considered in future studies. Each of the alternative scenarios were evaluated using additional evaluation criteria including:

- Predictive Crash
- Year of Failure
- Noise

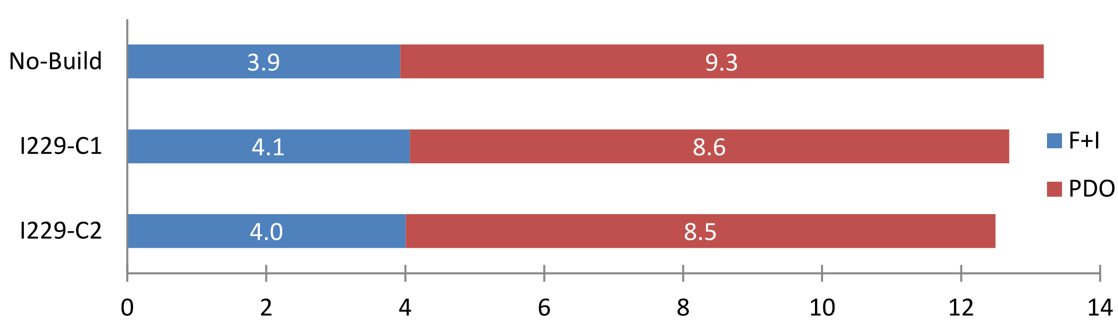
PREDICTIVE CRASH ANALYSIS

Predictive crash analysis was conducted for the freeway segments between the 26th Street and 10th Street interchanges. The predictive safety analysis was based on principles and methods of the ***Highway Safety Manual (HSM)***.

A comparative analysis of the predicted crashes anticipated between the Existing (Year 2012) condition and the Future No-Build (Year 2035) condition, as well as a comparative analysis between No-Build and Build alternatives was developed.

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***TABLE 4*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 4. I-229 Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 5***.

Table 5. I-229 Corridor Planning Horizon Crash Cost Savings

ALTERNATIVE	TOTAL USER COST[1]	USER COST SAVINGS[2]
No-Build	$ 24,600,000	$ -
I229-C1	$ 25,200,000	$ (600,000)
I229-C2	$ 24,900,000	$ (300,000)

[1]Total User Cost – The discounted, monetized safety cost from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Additional detail from the Predictive Crash Analysis can be found in ***Appendix J. Predictive Safety Analysis***.

Year of Failure Analysis

A year of failure analysis was conducted for two interchanges that do not have their own sub-study (Louise Avenue and Western Avenue) in order to identify the year beyond the Future / Design year (2035) when traffic operations fail to meet acceptable criteria. Projected traffic volumes beyond year 2035 were developed using straight line extrapolation between year 2012 adjusted peak hour volumes and year 2035 adjusted peak hour volumes. Potential years of failure were evaluated in 5-year increments up to the identified year of failure.

In cases where traffic operations will meet acceptable criteria 30 years beyond the Future / Design year (2065), the year of failure was identified as “beyond 2065”. No additional traffic analysis has been conducted for years beyond 2065.

The resulting year of failure analysis for I-229 Corridor Study is shown in ***Table 6***.

Table 6. I-299 Corridor Year of Failure

ALTERNATIVE	YEAR OF FAILURE
Louise-NB	Beyond 2065
Western-NB	2040

Additional detail from the Year of Failure Analysis can be found in ***Appendix K. Year of Failure Analysis***.

Noise Analysis

A traffic noise analysis was conducted along the I-229 corridor’s area of influence for the two alternative scenarios. The analysis included traffic noise monitoring and modeling. HDR used the ***FHWA Traffic Noise Model (TNM), Version 2.5***, to evaluate projected traffic noise levels under both existing conditions and "Build" alternatives. Basic model inputs are:

- Existing and Preliminary project concept and geometry
- 2012 and 2035 traffic volumes in the study area
- The operational speed for I-229: 65 miles per hour (mph); arterial streets: 30-45 mph

Traffic noise impacts were identified in accordance with SDDOT Noise Analysis and Abatement Guidance (July 13, 2011), which is intended to supplement FHWA traffic noise and abatement regulations and guidance. The Guidance provides procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria, and to establish requirements for traffic noise information to be given to those officials who have planning and zoning authority.

Noise abatement measures are considered when predicted traffic noise levels approach or exceed the Noise Abatement Criteria (NAC), or when the predicted traffic noise levels substantially exceed existing noise levels. As shown in *TABLE 7*, there are 271 impacts predicted under the Existing Alternative and 452 impacts predicted under Future Build Alternatives C1 and C2. The difference in noise levels can primarily be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry.

Table 7. Noise Impact Summary

ALTERNATIVE	APPROACH/ EXCEED NAC	SUBSTANTIALLY EXCEED	TOTAL RECEPTORS AFFECTED
Existing	271	0	271
I229-C1	452	0	452
I229-C2	452	0	452

Potential noise abatement measures could be considered for both alternatives. Further investigation into the feasibility and reasonability (noise reduction goal, cost-effectiveness, viewpoints of benefited receptors) would need to occur once a preferred alternative is selected.

A detailed technical memorandum describing the noise analysis can be found in *APPENDIX L. SUB-STUDY 1 NOISE STUDY TECHNICAL REPORT*. This memo includes a discussion of the conceptual feasibility of noise mitigation options in areas where future noise levels exceed state and federal criteria.

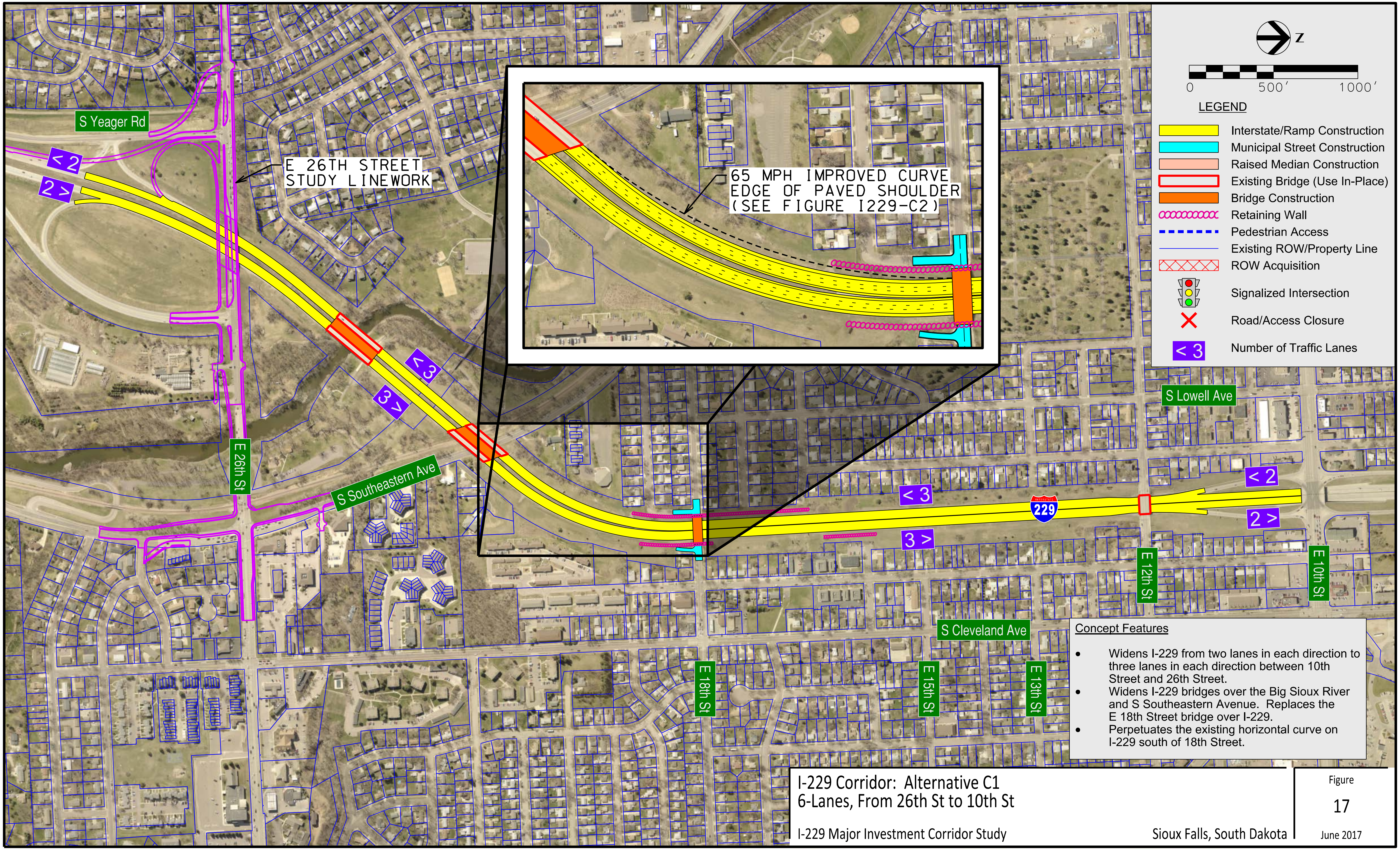
Section 5.4 - Recommendation of Alternatives for Future Consideration

Based on the evaluation, two (2) alternatives are recommended to advance for future studies along with No-Build. In addition to the two (2) alternatives, the potential ITS solutions identified for the I-229 corridor are recommended to advance.

The alternative scenarios identified to advance are as follows:

- ***I229-C1.*** I-229 6 Lanes from 26th St to 10th St
- ***I229-C2.*** I-229 6 Lanes from 26th St to 10th St + 65 mph Improved Curves
- ***I229-ITS.*** Potential ITS Solutions

FIGURES 17 AND 18 illustrate the alternative scenarios recommended to advance.



<u>Concept Features</u>

- Widens I-229 from two lanes in each direction to three lanes in each direction between 10th Street and 26th Street.
- Widens I-229 bridges over the Big Sioux River and S Southeastern Avenue. Replaces the E 18th Street bridge over I-229.
- Perpetuates the existing horizontal curve on I-229 south of 18th Street.

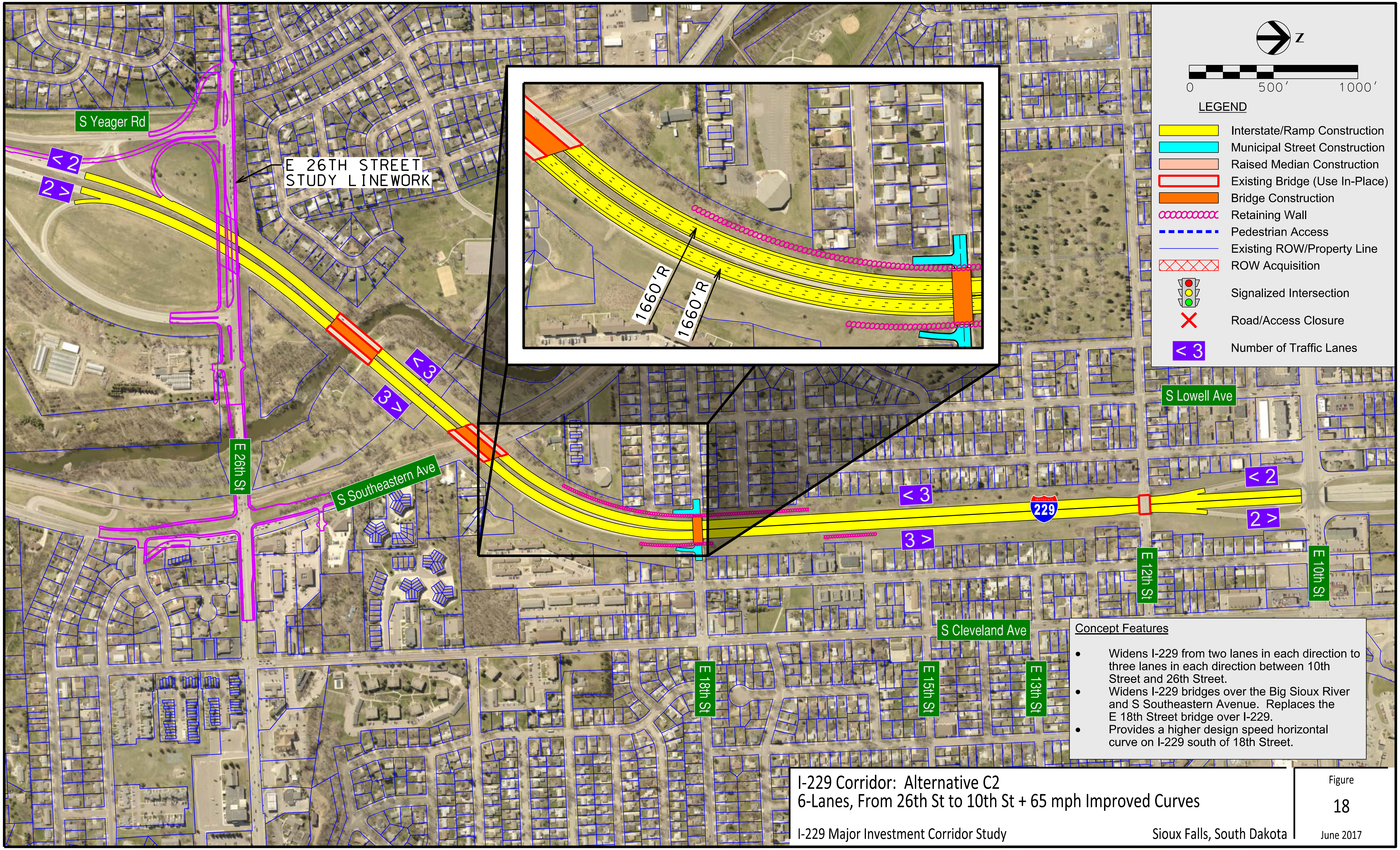
I-229 Corridor: Alternative C1
6-Lanes, From 26th St to 10th St

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 17

June 2017



Concept Features

- Widens I-229 from two lanes in each direction to three lanes in each direction between 10th Street and 26th Street.
- Widens I-229 bridges over the Big Sioux River and S Southeastern Avenue. Replaces the E 18th Street bridge over I-229.
- Provides a higher design speed horizontal curve on I-229 south of 18th Street.

I-229 Corridor: Alternative C2
6-Lanes, From 26th St to 10th St + 65 mph Improved Curves

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 18

June 2017

CHAPTER 6 - PRIORITIZATION AND NEXT STEPS

Section 6.1 - Sub-Studies Identified Alternatives

Each of the individual I-229 sub-studies has identified alternatives for further consideration in future studies. The following is a summary of for each sub-study:

I-229 Corridor Study

- ***I229-C1.*** I-229 6 Lanes from 26th St to 10th St
- ***I229-C2.*** I-229 6 Lanes from 26th St to 10th St + 65 mph Improved Curves
- ***I229-ITS.*** Potential ITS Solutions

I-229 Exit 3 (Minnesota Avenue) Crossroad Corridor Study

- ***Minn-2C.*** 5/4-Lane Divided Corridor with NE Quadrant Loop and NE Ramp Aligned with 49th Street
- ***Minn-2D.*** 6/4-Lane Divided Corridor with NE Quadrant Loop and NE Ramp Aligned with 49th Street
- ***Minn-9D.*** 6/4-Lane Divided Corridor with SPUI and NE Ramp Aligned with 49th Street

I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study

- ***Cliff-1.*** NB Cliff to SB I-229 Loop Ramp
- ***Cliff-6.*** SPUI, 41st Street Realigned
- ***Cliff-7.*** SPUI, SB I-229 Off-Ramp Thru & Rights at 41st Street

I-229 Exit 6 (10th Street) Crossroad Corridor Study

- ***10th-2B.*** SPUI + 4-Lane Divided
- ***10th-2C.*** SPUI + 5-Lane
- ***10th-5B.*** DDI + 4-Lane Divided
- ***10th-5C.*** DDI + 5-Lane

I-229 Exit 7 (Rice Street) Crossroad Corridor Study

- ***Rice-2.*** 6-Lane Divided
- ***Rice-2A.*** 6-Lane Divided, Shifted North to Avoid Railroad ROW
- ***Rice-3C.*** 4-Lane Divided, Cleveland Realigned

- ***Benson-1A.*** NE Quadrant Loop with 3-Lane SB On-Ramp
- ***Benson-1B.*** NE Quadrant Loop with 2-Lane SB On-Ramp
- ***Benson-4.*** DDI

Section 6.2 - Prioritization of Corridors

Each corridor was evaluated using three criteria in order to prioritize the corridors. The three criteria evaluated for each corridor included Timeframe of Traffic Failure, Safety Cost Savings and DTA Modeling.

- Timeframe of Traffic Failure – is the anticipated time range when one or more of the corridor intersections fails to meet the acceptable LOS criteria.
- Safety Cost Savings – is the range of predicted costs savings from the predictive crash analysis.
- DTA Modeling – was used to identify vehicle delay affecting I-229 and cross street corridors under scenarios where investments were made on multiple interchanges and corridors identified for the I-229 study area. Interchanges and corridors that were left unimproved could not handle the expected traffic growth and that traffic growth then spread to alternate routes along the street network. Top tier interchanges / corridors were the locations that when left unimproved showed the highest delay on the street network.

The corridor prioritization evaluation matrix for the I-229 MIS is shown in ***TABLE 8***.

Table 8. I-229 MIS Corridor Prioritization Evaluation Matrix

CORRIDOR	TIMEFRAME OF TRAFFIC FAILURE	SAFETY COST SAVINGS RANGE (M$)	DTA MODELING PRIORITY
I-229 Mainline	2025 - 2035	(\$0.6) - (\$0.3)	Low
Minnesota Ave - Exit 3	2015 - 2020	\$29.0 - \$32.6	High
Cliff Ave - Exit 4	2025 - 2035	\$3.8 - \$10.4	High
10th Street - Exit 6 (Interchange)	2015 - 2020	(\$2.0) - \$10.9	Highest
10th Street – Exit 6 (Corridor)	2025 - 2030	Not Available	Lowest
Rice Street – Exit 7 (Interchange)	2025 - 2035	\$10.4 - \$10.8[1]	Low
Rice Street – Exit 7 (Realigned Cleveland Ave)	2025 - 2035		Medium
Benson Road – Exit 9	2020 - 2025; 2015 – 2020 if east side develops	\$5.8 - \$27.8	Highest

Notes:
[1]*Safety cost does not include safety benefit of grade separation of the railroad in Concept Rice-3C.*

In addition to evaluating the concepts based on the above criteria, supplemental information was compiled for each corridor. The supplemental information was not used to prioritize the corridors, but was provided as information to be used to assist the SDDOT and City of Sioux Falls in programming the corridor projects. The corridor supplemental information for the I-229 MIS is shown in ***TABLE 9***.

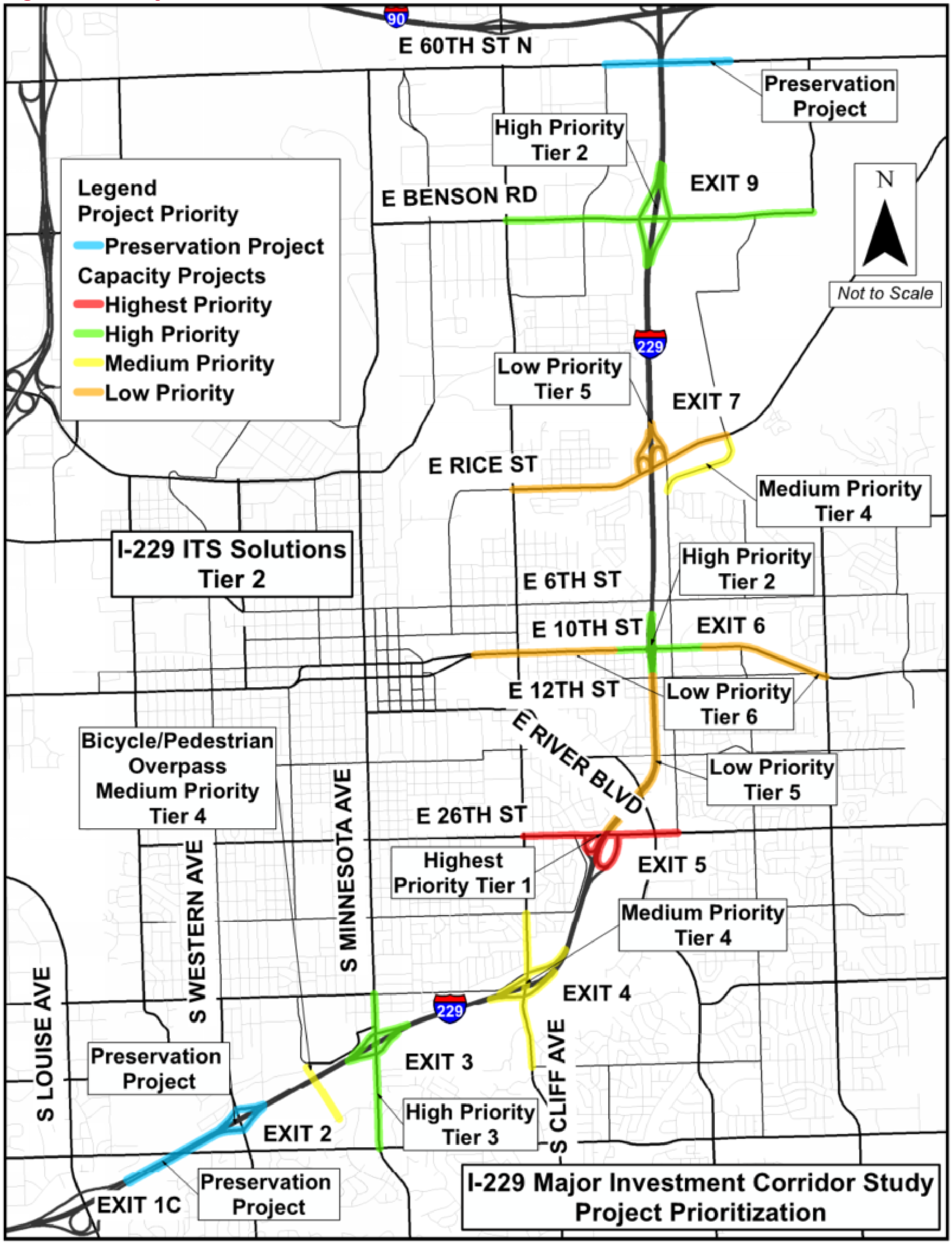
Table 9. I-229 MIS Corridor Supplemental Information

CORRIDOR	COST RANGE (M$)	PAVEMENT CONDITION INDEX / RELATIVE LIFE [1,2]	BRIDGE CONDITION[3]
I-229 Mainline	$27.6 - $28.0	2.75 - 4.20[1] 15 Years	Deck Preservation 2030
Minnesota Ave - Exit 3	$37.5 - $41.4	58 - 71[2] 10 - 15 Years	Replace 2030
Cliff Ave - Exit 4	$11.6 - $25.0	41 - 64[2] 7 - 12 Years	Replace 2025 - 2030
10th Street - Exit 6 (Interchange)	$21.8 - $27.1	48 - 64[2] 7 - 12 Years	Deck Preservation 2025 - 2030
10th Street – Exit 6 (Corridor)	$2.8 - $27.3	63 - 91[2] 10 - 20 Years	
Rice Street – Exit 7 (Interchange)	$37.0 - $70.7	69 - 83[2] 12 - 20 Years	Deck Preservation 2030
Rice Street – Exit 7 (Realigned Cleveland Ave)			
Benson Road – Exit 9	$31.9 - $37.9	55 - 72[2] 10 - 15 Years	Deck Preservation 2025 - 2030

Notes:
[1]*SDDOT Pavement Management System*
[2]*City of Sioux Falls Pavement Management Analysis Report*
[3]*SDDOT Bridge Management Data*

The corridor prioritization evaluation table was used to develop project priority levels for the I-229 MIS. The projects were separated into six tiers with tier 1 being the highest priority and tier 6 being the lowest priority. In addition to the projects shown in the evaluation matrix, three other projects were incorporated into the project prioritization including the 26th Street - Exit 5 (currently programmed) project, ITS solutions project and the bicycle/pedestrian I-229 overpass (west of Minnesota Avenue). The project prioritization is displayed graphically on **FIGURE 19**.

Figure 19. Project Prioritization



The project prioritization was presented to the public to receive feedback at a Public Open House on December 6, 2016. A summary of the public involvement process and meeting notes can be found in ***APPENDIX M. PUBLIC INVOLVEMENT.***

Section 6.3 - Next Steps

The I-229 MIS:

- Identified existing and future traffic and safety issues and needs on the Study Area roadways.
- Developed reasonable improvement concept options and alternative scenarios to address the traffic and safety needs.
- Evaluated the benefits and drawbacks of each of the concept options and alternative scenarios.
- Identified alternative scenarios for further consideration in future studies. The alternative scenarios are as follows:
    - ***I229-C1.*** I-229 6 Lanes from 26th St to 10th St
    - ***I229-C2.*** I-229 6 Lanes from 26th St to 10th St + 65 mph Improved Curves
    - ***I229-ITS.*** Potential ITS Solutions

These are the anticipated next steps for the projects associated with the I-229 Corridor Study:

- Refine the implementation timeframe and funding responsibility. The I-229 Corridor (26th Street to 10th Street) was identified as a low priority in the overall I-229 MIS.
- Add projects, as necessary, to the MPO fiscally constrained Long Range Transportation Plan.
- Fund individual projects in the State 8-year Improvement Program or City 5-year Improvement Program.
- Prepare Interchange Modification Reports for the I-229 interchange projects.
- Prepare an environmental document for each project in accordance with National Environmental Policy Act and other applicable federal and state regulations. This step includes further design refinement and in-depth analysis of each option. The No-Build option will be considered as well as all of the options identified in this Corridor Study.
- Select a preferred option for each project.
- Acquire right-of-way (where necessary).
- Complete final design plans.
- Construct project.

The SDDOT and Sioux Falls MPO have identified I-229 projects and placed them into the tentative 2018-2021 Statewide Transportation Improvement Program (STIP) and 2022-2025 Developmental Program. The projects are shown in ***Table 10.***

Table 10. Tentative I-229 Programmed Projects

STIP Projects				
Year	**PCN**	**Project Location**	**Project Improvement**	**Funding (Current Year M$)**
2019	032L	Solberg-Tallgrass Overpass	Approach Slabs to Structure	$0.3
2019	4778	26th Street – Exit 5 Interchange	Interchange Modification	$12.9
2021	062U	I-229 Corridor	Median Lighting	$2.0
2021	01QA	60th Street North Overpass	Replace Structure	$4.0
2021	03RD	I-229 Corridor	ITS Improvements	$5.3
Developmental Projects				
Year	**PCN**	**Project Location**	**Project Improvement**	**Funding (Current Year M$)**
2022	067Q	I-229 – Western Avenue (Exit 2) to Benson Road (Exit 9)	Crossover Improvements	$0.5
2023	04XK	Benson Road – Exit 9	Interchange Modification	$25.9
2024	000S	Minnesota Avenue – Exit 3	Interchange Modification	$21.5
2025	05HN	Cliff Avenue – Exit 4	Interchange Modification	$18.7
LR	06CF	Western Avenue – Exit 2	Ramp Improvement - NB On Ramp	TBD
LR	020Z/0210	I-29 / I-229 69th Street Overpass	New Structures	$19.0

APPENDICES

APPENDIX A. METHODS AND ASSUMPTIONS FOR SUB-STUDY 1

APPENDIX B. TRAFFIC DATA COLLECTION

APPENDIX C. ORIGIN-DESTINATION DATA COLLECTION

APPENDIX D. DTA MODEL VALIDATION REPORT

APPENDIX E1. TRAFFIC CAPACITY ANALYSIS METHODOLOGIES

APPENDIX E2. EXISTING HCS 2010 REPORTS

APPENDIX E3. YEAR 2035 FUTURE VOLUMES

APPENDIX E4. 2035 NO-BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM

APPENDIX F1. EXISTING CONDITIONS CRASH RATES

APPENDIX F2. EXISTING CONDITIONS SAFETY ASSESSMENT

APPENDIX G1. ITS ASSESSMENT

APPENDIX G2. SUMMARY OF THE CURRENT ITS OPERATIONS QUESTIONNAIRE

APPENDIX G3. POTENTIAL PLACEMENT OF ITS DEVICES

APPENDIX H. INCIDENT MANAGEMENT ACTIONS AND DETOUR ROUTES

APPENDIX I1. PRELIMINARY CONCEPT FIGURES

APPENDIX I2. PRELIMINARY CONCEPTS TECH MEMO

APPENDIX I3. DTA MODEL INTERCHANGE AND MODEL SUBAREAS

APPENDIX I4. ENVIRONMENTAL CONSTRAINTS MAPS

APPENDIX J. PREDICTIVE SAFETY ANALYSIS

APPENDIX K. YEAR OF FAILURE ANALYSIS

APPENDIX L. SUB-STUDY 1 NOISE STUDY TECHNICAL REPORT

APPENDIX M. PUBLIC INVOLVEMENT

Appendix A -

Methods and Assumptions Document

- **M&A Amendment #2**
- **Appendices**
    - **Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp**
    - **M&A Amendment #1**
    - **Original M&A**

Methods & Assumptions Meeting Documentation Amendment #2

1. Methods and Assumptions Cover Page

I-229 Major Investment Corridor Study: Sub-Study #1- Amendment 2

To:	Study Advisory Team (SDDOT, FHWA, City of Sioux Falls)		
From:	Brian Ray, HDR Courtney Sokol, HDR Jon Markt, HDR	Project:	I-229 Major Investment Corridor Study
CC:	File		
Date:	November 4, 2015	Job No:	207030

Methods and Assumptions Document

The original Methods and Assumptions document was developed as a summation of the Methods and Assumptions Meeting held on April 30, 2013 with representatives from the South Dakota Department of Transportation (SDDOT), Federal Highway Administration (FHWA), City of Sioux Falls, Sioux Falls MPO, and HDR.

Amendment 1 includes changes to accommodate updated schedule, SAT team members, traffic forecasting methodology, and right-turn on red volumes, as discussed at the SAT meeting held on August 13, 2014.

Amendment 2 includes changes related to updated schedule, addition of Sub-Study 5 (Exit 7: Rice Street), year of failure analysis, and crash prediction (safety) analysis as discussed at the SAT meeting held on November 2, 2015. This document is intended to serve as a historical record of the process, dates, and decisions made by the study team representatives for the ***I-229 Major Investment Corridor Study: Sub-Study #1***.

2. Stakeholder Acceptance Page

The undersigned parties concur with Amendment 2 to this document.

SDDOT:	FHWA:
Signature	Signature
Planning Engineer	Planning/Civil Rights Specialist
Title	Title
11-10-2015	11/9/15
Date	Date

Notes:

(1) Participation on the Study Advisory Team and/or signing of this document does not constitute approval of the ***I-229 Major Investment Corridor Study: Sub-Study #1*** Final Report or conclusions.

(2) All members of the Study Advisory Team will accept this document as a guide and reference as the study progresses through the various stages of development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the signatories.

Amendment Notes

Meeting Minutes

Project: I-229 Major Investment Study (MIS)

Subject: Study Advisory Team (SAT) Meeting # 13

Date: Monday, November 2, 2015

Location: Online Meeting

Attendees

Mike Behm – SDDOT	Travis Dressen, SDDOT
Craig Smith – SDDOT	Joel Gengler, SDDOT
Scott Jansen - SDDOT	Shannon Ausen – City of Sioux Falls
Jeff Brosz – SDDOT	Heath Hoftiezer – City of Sioux Falls
Kevin Goeden – SDDOT	Amber Gibson – SECOG/Sioux Falls MPO
Pete Longman - SDDOT	Jason Kjenstad - HDR
Andy Vandel – SDDOT	Jon Markt - HDR
Paul Nikolas – SDDOT	Dave Meier - HDR
Steve Gramm – SDDOT	Courtney Sokol- HDR
Brad Remmich – SDDOT	Brian Ray - HDR
Christina Bennett – SDDOT	
Ron McMahon - FHWA	
Mark Hoines, FHWA	

Online Meeting

SAT meeting #13 served the primary purpose of reviewing SAT comments on Methods and Assumptions updates pertaining to the Highway Safety Analysis and to review comments on a draft M&A document for Sub-Study 5 (Rice Street Corridor Study). The consultant team provided the M&A documents (Updates to Sub-studies 1-4, original for Sub-study 5) for SAT review on October 26th.

The four existing M&A documents (Sub-Studies 1-4) were primarily updated to reflect:

- An updated project schedule
- Addition of Sub-Study 5 (Exit 7: Rice Street)
- Addition of year of failure analysis
- Addition of crash prediction (safety) analysis

The original M&A for Sub-Study 5 addresses the Exit 7: Rice Street area in a similar manner as the Sub-Study 3 M&A addresses 10th Street and the Sub-Study 4 M&A addresses Benson Road, including the above bullet list of updates. The Sub-Study 5 M&A varies slightly from the Sub Study 3 & 4 M&A documents in section 8. Travel Forecast, which outlines changes that will be made in the Sub-Study 1-4 model based on direction from the City of Sioux Falls to support volume development along Rice Street.

Portions of the five M&A documents were highlighted in green to signify changes.

HDR

	Action Items	Responsibility
1	Submit SS1-5 Methods and Assumptions documents for signature	HDR
2	Update project website to include Sub-Study 5 and to identify study concepts eliminated from further consideration by SAT	HDR
3	Email blast to public meeting participants/stakeholders calling attention to updated website	HDR
4	Press Release	SDDOT
5	Add Year of Failure for No-Build at Louise and Cliff to Sub-Study 1 M&A	HDR
6	Update Sub-Study maps to improve street labeling and background local road legibility	HDR
7	Modify M&A documents to change reference to SD 100 to Veterans Memorial Parkway	HDR
8	Provide estimated staff-hours to correspond with supplemental scope previously provided to SDDOT	HDR/HR Green

1. Introductions
2. Review of Sub-Study 1, Amendment 2 M&A
    - HDR provided overview of Amendment 2 updates to the project schedule
    - City of Sioux Falls inquired about how to address the public, who is expecting updates from the study in late 2015 / early 2016.
        i. HDR noted that the public is not yet formally aware of the new Rice Street Sub-Study #5. Need to communicate to the public SAT desire to focus on Sub-Study #5 to "catch up" to status of other sub-studies, to conclude all sub-studies together.
        ii. SDDOT requested that the project website be updated to address this and an email blast to those in the project contact database.
        iii. City of Sioux Falls requested that SDDOT also send out a formal press release.
    - SDDOT requested the map on page 9 to be modified to include a label for Solberg Avenue.
    - Crash Prediction / Highway Safety Analysis
        i. FHWA inquired about the gap in mile markers.
            1. HDR clarified it excludes portion of I-229 between 26th Street ramps. This analysis applies to locations where there are proposed improvements. Similar rationale for why only Cliff southbound is identified - since there are no improvements recommended for northbound direction.
    - Data collection - no comments
    - Traffic operations - no comments
    - Travel forecasts - no comments

- Safety
    - i. SDDOT asked about breakdown of crash type and severity.
        1. HDR will add bullet for defaults from HSM for crash type prediction. Defaults are not applicable to DDI and SPUI - these configurations will only have qualitative review.
    - ii. No other comments from the SAT.
- SDDOT requested that the Year of Failure Analysis be added for No-Build at Louise and Cliff in the Sub-Study #1 M&A document.

3. Review of Sub-Study 2-4, Amendment 2 M&A
    - SDDOT requested that intersections that are to be analyzed in the individual sub-studies are labeled on the maps provided in the M&A documents.
    - SDDOT noted that reference to SD 100 is no longer valid and needs to be changed to Veterans Memorial Parkway. HDR will update in the M&A document(s).
4. Review of Sub-Study 5 M&A
    - Original Methods and Assumptions document.
    - SDDOT noted the error on page 7 – change "Benson" to "Rice".
    - FHWA requested the Sub-Study 5 map be adjusted to darken the local street line weights.
    - Need for the study:
        - i. City of Sioux Falls advised that the need for the study should include noting the geographical constraints, including the rail line and its proximity to Rice Street improvements.
        - ii. SDDOT added that the need for the study should include that pressure on this interchange will increase as development continues to the northeast related to construction of Veterans Memorial Parkway.
    - City of Sioux Falls asked if the DTA model has the Russell to Rice connection. HDR to confirm this connection is included. (Note: the 2035 DTA model will not be used in Sub-Study 5, but the question remains valid for confirmation of this connection in the 2035 macro model). ***– HDR confirmed that this connection is included in the DTA model.***
    - SDDOT noted that reference to SD 100 is no longer valid and needs to be changed to Veterans Memorial Parkway. HDR will update in the M&A document(s).
5. Other
    - SDDOT requested an estimate of staff-hours for review with the supplemental scope of services previously submitted by the consultant team.
    - City of Sioux Falls requested that the study website be updated before Thanksgiving. Website will identify concepts that were eliminated from further consideration by the SAT.

HDR

6. Next Steps:
   - Submit SS1-5 Methods and Assumptions documents for signature. Items addressed include:
      i. Add Year of Failure for No-Build at Louise and Cliff to Sub-Study 1 M&A.
      ii. Update Sub-Study maps to add more street labels and improve the legibility of background local roads.
      iii. Modify M&A documents to change reference to SD 100 to Veterans Memorial Parkway.
      iv. Add bullet for defaults from HSM for crash type prediction.
      v. Sub-Study #5: Error on page 7 – changed "Benson" to "Rice".
      vi. Fix double-period errors in documents
   - Update project website to include Sub-Study 5 (HDR).
   - Email blast to public meeting participants/stakeholders (HDR).
   - Press Release (SDDOT).
   - HDR to provide estimated staff-hours associated with supplemental scope to SDDOT.

3. Introduction and Project Description

Project Background and Understanding

Sub-Study 1 will analyze existing and future conditions along the entire I-229 corridor, service interchanges, and crossroads, assess the impact on the transportation system, determine feasible solutions to those impacts, and prioritize a list of recommendations that will maximize the efficiency of the corridor. The study will fulfill the following objectives:

1. Complete a traffic level of service analysis for both existing and future (2035) no-build conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions.
6. Create final products for use by the SDDOT which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

Location

The I-229 corridor is located east of I-29 in the Sioux Falls metropolitan area. The mainline interstate study limits include a 10.5 mile section from the Solberg Avenue overpass (currently under construction) to the 60th Street North overpass. Eight service interchanges are located on I-229 within the study area, including:

- Exit 1: Louise Avenue
- Exit 2: Western Avenue
- Exit 3: Minnesota Avenue
- Exit 4: Cliff Avenue
- Exit 5: 26th Street
- Exit 6: 10th Street
- Exit 7: Rice Street
- Exit 9: Benson Road

A subset of the arterial street network that connects to the I-229 corridor is included in the study area as well, including the following crossroad corridors:

- Solberg Avenue from 69th Street to 57th Street
- Louise Avenue from 69th Street to 57th Street

- 57th Street from Louise Avenue to Western Avenue
- Western Avenue from 57th Street to 49th Street
- Minnesota Avenue from 57th Street to 41st Street
- Cliff Avenue from 49th Street to 33rd Street
- 26th Street from Cliff Avenue to Southeastern Drive
- 33rd Street from Cliff Avenue to Yeager Road
- Yeager Road from 33rd Street to 26th Street
- Southeastern Avenue from 18th Street to 26th Street
- 18th Street from Southeastern Drive to Cleveland Avenue
- 12th Street from Lowell Avenue to Cleveland Avenue
- 10th Street from Jessica Avenue to Bahnson Avenue
- 6th Street from Lowell Avenue to Cleveland Avenue
- Rice Street from Wayland Avenue to Bahnson Avenue
- Benson Road from Cliff Avenue to Sycamore Avenue
- 60th Street North from Lewis Avenue to Bahnson Avenue (Proposed)

An illustration of the Sub-Study 1 study area is shown in Section 4 (Study Area) of this report.

Need for Study

The study team has determined the following needs for this specific study (for future Year 2035 AM, PM, and Off-Peak periods representing average weekday traffic conditions):

- Mainline Level of Service (LOS) of C or better throughout the I-229 corridor
- Ramp merge/diverge LOS of C or better for all interchange ramps through the I-229 corridor
- Ramp terminal intersection LOS of D or better for all interchanges throughout the I-229 corridor
- Identification of areas not in compliance with current Interstate design standards.
- Incident management planning is also needed to identify methods for handling mainline traffic during incidents, weather, and special events.

Study Schedule

Date	Task/Event
March 2013	Notice to Proceed, Kickoff Meeting
April 2013	Methods & Assumptions Documentation
April 2013-August 2013	Baseline Conditions Analysis/ Data Collection
August 2013-December 2014	Existing Traffic and Operations Analysis Incident, Weather, and Special Event Analysis Future Needs Analysis (No Build) Safety Analysis ITS Assessment **Public Meeting #1** (Project Kickoff/ Existing Analysis Stage) **(October 2013)**
October 2014-June 2015	Noise Analysis Identification of Solutions **Public Meeting #2** (Scenario Building Stage) **(June 2015)** **MPO Meeting (Scenario Building Presentation)**
June 2015 – April 2016*	Analysis of Solutions
May 2016-November 2016*	Project Recommendations Sub-Study 1 Report Documentation **Public Meeting #3 (Draft Report Stage)** **MPO Meeting (Final Recommendations Presentation)**

*Schedule controlled by Sub-Study 5 schedule

Facilities Affected by the Study

Given the regional context of the I-229 corridor, modifications to I-229 mainline, service interchanges or crossroad corridors may impact transportation facilities throughout the metropolitan area. Modifications at service interchanges would have the potential to affect adjacent interstate ramp terminal intersections and/or arterial street corridors. The large study area defined in Sub-Study 1 is intended to provide a comprehensive assessment of interstate, ramp, and arterial streets such that facilities affected by the study recommendations are included in the analysis.

Previous Studies

The following previous studies will be reviewed during the course of this study:

- Direction 2035, Sioux Falls MPO Long-Range Transportation Plan (LRTP)
  - http://www.siouxfalls.org/~/media/Documents/planning/long-range/lrtp/2035_lrtp/adopted_lrtp_rev120210.pdf
- Sioux Falls Comprehensive Development Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/shape_sf/chapters-maps/Chapter_1_r112111.pdf
- Sioux Falls Transit Development Plan 2011- 2015
  - http://www.siouxfalls.org/~/media/Documents/planning/long-

range/2011_2015_Transit_Development_Plan.pdf

- 2007 Sioux Falls Bicycle Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/transportation/bicycle/Bicycle_Plan_Final.pdf
- The Sioux Falls MPO Multi-Use Trail Study
  - http://www.siouxfallsmpo.org/documents/MPO/Planning_Documents/SiouxFallsMUTCS.pdf
- 60th Street North Planning and Feasibility Study
  - http://www.siouxfalls.org/~/media/Documents/publicworks/engineering/projects/60th-st-feasibility-report-may-12/60th-St-North-Study-Fina-Report-May-2012.pdf
- Sioux Falls Major Street and Access Management Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/transportation/long-range/majorstreetplanmediumfinal%20pdf.pdf
- I-229 Exit 5 (26th Street) Crossroad Corridor Study
  - http://26thstreetcorridorstudy.com/

- Interstate 90/ Interstate 229 Access Modification Request (Draft)
- Northeast Transportation Network Feasibility Study
- 2010 Decennial Interstate Corridor Study and 2000 Decennial Interstate Study
- N. Bahnson Avenue Feasibility Study
- Cleveland Avenue Study
- SIMPCO Incident Management Plan
- ITS Studies from City of Sioux Falls and SDDOT

Study Advisory Team Members

A Study Advisory Team has been formed to guide the study through completion. The Study Advisory Team is comprised of representative parties of the SDDOT, FHWA and City of Sioux Falls. Members of the Study Advisory Team are:

Shannon Ausen	City of Sioux Falls – Public Works
Mike Behm	SDDOT – Project Development
Christina Bennett	SDDOT – Operations Support
Jeff Brosz	SDDOT – Transportation Inventory Management
Andy Vandel	SDDOT – Project Development (Safety)
Joel Gengler	SDDOT – Right of Way
Amber Gibson	Sioux Falls MPO
Kevin Goeden	SDDOT – Bridge Design
Steve Gramm	SDDOT – Project Development (Planning)
Heath Hoftiezer	City of Sioux Falls – Public Works
Mark Hoines	FHWA
Dave Huft	SDDOT – Research
Bruce Hunt	FHWA
Scott Jansen	SDDOT – Mitchell Region
Captain Alan Welsh	South Dakota Highway Patrol
Ryan Kerkvliet	Sioux Falls MPO – Citizens Advisory Committee
Tom Lehmkuhl	SDDOT – Project Development (Environmental)
Pete Longman	SDDOT – Road Design
Ron McMahon	FHWA
Paul Nikolas	SDDOT – Road Design
Brad Remmich	SDDOT – Project Development (Planning)
Craig Smith	SDDOT – Mitchell Region

Additional team members may be added as the study progresses.

4. Study Area

The study area for Sub-Study 1 was defined by the Study Advisory Team and is illustrated in this report for documentation. The study area contains I-229 freeway segments and junctions from east of the I-29/I-229 systems interchange to south of the I-90/I-229 systems interchange. The study area also contains ramp terminal intersections at each interchange along I-229 and intersections adjacent to those ramp terminal intersections. The following graphic shows the study area and identifies each of the study intersections.

Sub-Study 1 Study Area

Study Intersections:

- Solberg Avenue Intersections
    - Solberg Avenue & 57th Street
    - Solberg Avenue & 69th Street
- Louise Avenue (Exit 1C) Intersections
    - Louise Avenue & 57th Street*
    - Louise Avenue & 59th Street*
    - Louise Avenue & I-229 Southbound Ramps*
    - Louise Avenue & I-229 Northbound Ramps*
    - Louise Avenue & 69th Street*
- Western Avenue (Exit 2) Intersections
    - Western Avenue & 49th Street
    - Western Avenue & I-229 Southbound Ramps
    - Western Avenue & I-229 Northbound Ramps
    - Western Avenue & 57th Street
- Minnesota Avenue (Exit 3) Intersections
    - Minnesota Avenue & 41st Street*
    - Minnesota Avenue & 49th Street*
    - Minnesota Avenue & I-229 Southbound Ramps*
    - Minnesota Avenue & I-229 Northbound Ramps*
    - Minnesota Avenue & 57th Street*
- Cliff Avenue (Exit 4) Intersections
    - Cliff Avenue & 33rd Street*
    - Cliff Avenue & I-229 Southbound Ramps*
    - Cliff Avenue & I-229 Northbound Ramps*
    - Cliff Avenue & 49th Street*
- 26th Street (Exit 5) Intersections
    - 26th Street & Cliff Avenue
    - 26th Street & Van Eps Avenue
    - 26th Street & Yeager Road
    - Yeager Road & I-229 Southbound Ramps
    - 26th Street & I-229 Northbound Ramps
    - 26th Street & Southeastern Avenue
- 18th Street Intersections
    - 18th Street & Southeastern Avenue
    - 18th Street & Cleveland Avenue
- 12th Street Intersections
    - 12th Street & Lowell Avenue
    - 12th Street & Cleveland Avenue
- 10th Street (Exit 6) Intersections
    - 10th Street & Lowell Avenue*

  - 10th Street & I-229 Southbound/Northbound Ramps (Single-Point) *
  - 10th Street & Cleveland Avenue*
- 6th Street Intersections
  - 6th Street & Lowell Avenue*
  - 6th Street & Cleveland Avenue*
- Rice Street (Exit 7) Intersections
  - Rice Street & Wayland Avenue*
  - Rice Street & I-229 Southbound Ramps*
  - Rice Street & I-229 Northbound Ramps*
  - Rice Street& Bahnson Avenue*
- Benson Road (Exit 9) Intersections
  - Benson Road & Cliff Avenue*
  - Benson Road & Lewis Avenue*
  - Benson Road & I-229 Southbound Ramps*
  - Benson Road & I-229 Northbound Ramps*
  - Benson Road & Hall Avenue*
  - Benson Road & Sycamore Avenue
- 60th Street North Intersections
  - 60th Street North & Lewis Avenue
  - 60th Street North & Bahnson Avenue (Proposed)

* Intersections denoted with an asterisk will be included in year of failure analysis.

Study Basic Freeway Areas (*See also Note 1 below for designated analysis areas as potential Freeway Weave Areas for segments including auxiliary lanes*):
- I-229 Northbound
  - Segment between I-29 Northbound (Exit 1B) and Louise Avenue (Exit 1C) [1]
  - Segment between Louise Avenue (Exit 1C) and Western Avenue (Exit 2) [1]
  - Segment between Western Avenue (Exit 2) and Minnesota Avenue (Exit 3) [1]
  - Segment between Minnesota Avenue (Exit 3) and Cliff Avenue (Exit 4) [1]
  - Segment between Cliff Avenue (Exit 4) and 26th Street (Exit 5) [1]
  - Segment between 26th Street (Exit 5) and 10th Street (Exit 6)
  - Segment between 10th Street (Exit 6) and Rice Street (Exit 7) [1]
  - Segment between Rice Street (Exit 7) and Benson Road (Exit 9) [1]
  - Segment between Benson Road (Exit 9) and I-90 Eastbound (Exit 10A)
- I-229 Southbound
  - Segment between I-90 Eastbound (Exit 10A) and Benson Road (Exit

9)

- Segment between Benson Road (Exit 9) and Rice Street (Exit 7) [1]
- Segment between Rice Street (Exit 7) and 10th Street (Exit 6) [1]
- Segment between 10th Street (Exit 6) and 26th Street (Exit 5)
- Segment between 26th Street (Exit 5) and Cliff Avenue (Exit 4) [1]
- Segment between Cliff Avenue (Exit 4) and Minnesota Avenue (Exit 3) [1]
- Segment between Minnesota Avenue (Exit 3) and Western Avenue (Exit 2) [1]
- Segment between Western Avenue (Exit 2) and Louise Avenue (Exit 1C) [1]
- Segment between Louise Avenue (Exit 1C) and I-29 Northbound (Exit 1B)

[1] *Segment will be evaluated using Highway Capacity Manual (HCM) 2010 procedures to determine if the segment meets the criteria for a weave segment. If the segment meets the weave segment criteria the segment will be analyzed as a Freeway Weave Area and not a Basic Freeway Area.*

Study Ramp Junctions (*See also Note 2 below for designated analysis areas as potential Freeway Weave Areas*):

- I-229 Northbound
  - Diverge to Louise Avenue (Exit 1C) [2]
  - Merge from Louise Avenue Northbound (Exit 1C)
  - Merge from 26th Street (Exit 5)
  - Diverge to 10th Street (Exit 6)
  - Merge from Benson Road (Exit 9)
- I-229 Southbound
  - Diverge to Benson Road (Exit 9)
  - Merge from 10th Street (Exit 6)
  - Diverge to 26th Street (Exit 5)
  - Merge from Louise Avenue (Exit 1C)

[2] *Basic freeway segment upstream will be evaluated using HCM 2010 procedures to determine if the upstream segment meets the criteria for a weave segment. If the upstream segment meets the weave segment criteria the segment will be analyzed as a Freeway Weave Area and the Diverge Ramp Junction analysis would not apply.*

Study Mainline Freeway Areas (Crash Prediction)

- I-229 Northbound & Southbound
  - Between mile marker 2.5 and mile marker 4.25
  - Between mile marker 5 and mile marker 10

Study Service Interchange Areas (Crash Prediction)

- Exit 3: Minnesota Avenue
- Exit 4: Cliff Avenue*
- Exit 6: 10th Street
- Exit 7: Rice Street
- Exit 9: Benson Road

*I-229 Southbound on-ramp(s) and southbound ramp terminal intersection only

Study Intersections (Crash Prediction)

- Minnesota Avenue & I-229 Northbound Ramps*
- Minnesota Avenue & I-229 Southbound Ramps*
- Minnesota Avenue & 49th Street*
- Cliff Avenue & I-229 Southbound On-Ramp*
- Cliff Avenue & I-229 Southbound Off-Ramp / 41st Street*
- 10th Street & I-229 Northbound & Southbound Ramps (Single Point Urban Interchange)*
- 6th Street & I-229 Southbound Ramp / Access Road**
- 6th Street & I-229 Northbound Ramp / Access Road**
- Rice Street & I-229 Southbound Ramps
- Rice Street & I-229 Northbound Ramps / Cleveland Avenue*
- Benson Road & I-229 Southbound Ramps
- Benson Road & I-229 Northbound Ramps

*Intersection is combined with adjacent intersections or split from a single intersection to form multiple intersections in some build alternatives
**Two roads do not intersect in some build alternatives

5. Analysis Years/Periods

This study will evaluate traffic during and for the following time periods:

Existing Conditions – Existing conditions analyses will be conducted for year 2012 volume conditions. Turning movement counts were collected at several study area intersections in 2012. Intersections that do not already have recent count data from 2012 will be counted by the City of Sioux Falls or HDR as part of this study as described in Section 6. For existing conditions the following time periods will be evaluated:

- Existing Conditions (Year 2012) – AM Peak Period (7:00 to 9:00 AM)
- Existing Conditions (Year 2012) – PM Peak Period (4:00 to 6:00 PM)

Future/ Design Conditions – Future/ Design conditions analyses will be conducted for year 2035 conditions. This horizon year matches the planning horizon of the current Sioux Falls LRTP. The Travel Demand Model was calibrated and updated in year 2009 for a base year 2008 and planning horizon of year 2035. Projected traffic volumes from the Sioux Falls MPO Travel Demand Model will be utilized to establish year 2035 volumes. For the design conditions the following time periods will be evaluated:

- Future/Design Conditions (Year 2035) – AM Peak Period (7:00 to 9:00 AM)
- Future/Design Conditions (Year 2035) – PM Peak Period (4:00 to 6:00 PM)

Interim Conditions – No interim conditions will be evaluated as part of this study.

Year of Failure Conditions Analysis

Year of failure analysis will be conducted (for denoted study area intersections) to identify the year beyond the Future / Design year (2035) when traffic operations fail to meet acceptable criteria. Projected traffic volumes beyond year 2035 will be developed using straight line extrapolation between year 2012 adjusted peak hour volumes and year 2035 adjusted peak hour volumes. Potential years of failure will be evaluated in 5-year increments up to the identified year of failure. Should traffic operations still meet acceptable criteria 30 years beyond the Future / Design year (2065), the year of failure will be identified as beyond 2065, but no additional traffic analysis will be conducted for years beyond 2065.

- Year of Failure Conditions (Year determined by analysis) – AM Peak Hour
- Year of Failure Conditions (Year determined by analysis) – PM Peak Hour

6. Data Collection

Data Collection is one of the most important items during any transportation planning study. The data collection efforts are documented below:

Existing Arterial Intersection Turning Movement Count Data

Turning movement counts define actual traffic at the study intersections during the course of a typical weekday. The most recent turning movement counts provided by the City of Sioux Falls were conducted in year 2012 and were deemed suitable for use in this study. These counts include volume data in 15-minute intervals. Study area intersections with counts older than year 2012 will be collected in the spring of 2013 to capture conditions for an existing conditions average weekday. These intersections will be collected by either HDR or the City, as outlined in the table below. These turning movement counts will be collected during the AM and PM peak periods in 15-minute intervals.

For some of the intersections listed in this table, their operational analysis results will not be reported in Sub-Study 1, but instead in subsequent Sub Studies. In an effort to streamline data collection efforts in anticipation of these future sub studies, they are included in the data collection effort of Sub Study 1.

TURNING MOVEMENT COUNTS				SUB-STUDY FOR ANALYSIS
LOCATION	LATEST COUNT	NEW COUNT NEEDED?	COUNT RESPONSIBILITY	
60TH ST. N./LEWIS AVE.	4/18/2011	YES	HDR	1
60TH ST. N./BAHNSON AVE.	n/a, Intersection does not currently exist			1

BENSON RD./I-229 SB	5/8/2012	NO		1, 4
BENSON RD./I-229 NB	5/8/2012	NO		1, 4
BENSON RD./CLIFF AVE.	5/24/2011	YES	HDR	1, 4
BENSON RD./LEWIS AVE.	5/10/2012	NO		1, 4
BENSON RD./POTSDAM AVE.	5/9/2012	NO		4
BENSON RD./HALL AVE.	5/9/2012	NO		1, 4
BENSON RD./SYCAMORE AVE.	n/a, Intersection does not currently exist			4
RICE ST./I-229 SB	6/14/2012	NO		1, 5
RICE ST./I-229 NB/CLEVELAND AVE.	6/18/2012	NO		1, 5
RICE ST./WAYLAND AVE.	6/14/2012	NO		1, 5
RICE ST./BAHNSON AVE.	n/a	YES	HDR	1, 5
RICE ST./CLIFF AVE	9/1/2015	NO		5
RICE ST./LOWELL AVE.	9/2/2015	NO		5
6TH ST./LOWELL AVE.	n/a	YES	HDR	1
6TH ST./CLEVELAND AVE.	6/26/2012	NO		1
10TH ST./I-229	1/9/2012	YES	CITY	1, 3
10TH ST./FRANKLIN AVE.	12/1/2011	YES	CITY	3
10TH ST./FAIRFAX AVE.	12/1/2011	YES	CITY	3
10TH ST./CLIFF AVE.	1/4/2012	YES	CITY	3
10TH ST./BLAUVELT AVE.	11/30/2011	YES	CITY	3
10TH ST./JESSICA AVE.	11/29/2011	YES	HDR	3
10TH ST./LOWELL AVE.	6/30/2011	YES	HDR	1, 3
10TH ST./CONKLIN AVE.	n/a	YES	CITY	3
10TH ST./BLAINE AVE.	n/a	YES	CITY	3
10TH ST./CLEVELAND AVE.	7/5/2011	YES	HDR	1, 3
10TH ST./CAMBELL'S & HY-VEE	7/6/2011	YES	CITY	3
10TH ST./BAHNSON AVE.	2008	YES	CITY	3
10TH ST./SYCAMORE AVE.	8/23/2011	YES	CITY	3
12TH ST./LOWELL AVE.	n/a	YES	HDR	1
12TH ST./CLEVELAND AVE.	8/15/2011	YES	CITY	1
18TH ST./SOUTHEASTERN AVE.	5/3/2012	NO		1
18TH ST./CLEVELAND AVE.	5/2/2012	NO		1
26TH ST./I-229 SB/YEAGER RD.	10/24/2012	NO		1
26TH ST./I-229 NB	4/30/2012	NO		1
26TH ST./CLIFF AVE.	4/26/2012	NO		1
26TH ST./VAN EPS AVE.	4/30/2012	NO		1
26TH ST./SOUTHEASTERN AVE.	9/5/2012	NO		1
CLIFF AVE./I-229 SB	5/3/2012	NO		1
CLIFF AVE./I-229 NB	10/11/2012	NO		1
CLIFF AVE./33RD ST.	8/20/2012	NO		1
CLIFF AVE./49TH ST.	5/7/2012	NO		1
MINNESOTA AVE./I-229 SB	10/16/2012	NO		1, 2

MINNESOTA AVE./I-229 NB	10/16/2012	NO		1, 2
MINNESOTA AVE./41ST ST.	8/30/2012	NO		1, 2
MINNESOTA AVE./43RD ST.	n/a	YES	CITY	2
MINNESOTA AVE./YANKTON TRL PARK	n/a	YES	CITY	2
MINNESOTA AVE./LOTTA ST.	n/a	YES	CITY	2
MINNESOTA AVE./BATCHELLER LN.	n/a	YES	CITY	2
MINNESOTA AVE./49TH ST.	5/24/2012	NO		1, 2
MINNESOTA AVE./57TH ST.	9/10/2012	NO		1, 2
WESTERN AVE./I-229 SB	12/6/2011	YES	CITY	1
WESTERN AVE./I-229 NB	12/6/2011	YES	CITY	1
WESTERN AVE./49TH ST.	12/7/2011	YES	CITY	1
WESTERN AVE./57TH ST.	12/8/2011	YES	CITY	1
LOUISE AVE./I-229 SB	5/3/2010	YES	CITY	1
LOUISE AVE./I-229 NB	5/3/2010	YES	CITY	1
LOUISE AVE./57TH ST.	1/4/2012	NO		1
LOUISE AVE./59TH ST.	5/3/2010	YES	CITY	1
LOUISE AVE./69TH ST.	5/6/2010	YES	CITY	1
SOLBERG AVE./57TH ST.	3/4/2009	YES	CITY	1
TALLGRASS AVE./69TH ST.	n/a	YES	CITY	1

Note: Sub-Study 2 includes an interchange options study for Exit 3: Minnesota Avenue. Sub-Study 3 includes a crossroad corridor study for Exit 6: 10th Street. Sub-Study 4 includes an interchange options study for Exit 9: Benson Road. Sub-Study 5 includes an interchange options study for Exit 7: Rice Street.

In addition, Automated Traffic Recorded (ATR) data was provided at SDDOT Station #605, which is located on 10th Street –between Chicago Ave. and St. Paul Avenue. Hourly ATR data at Station #605 will be reviewed to determine an annual average representation of existing traffic volume.

Existing Freeway Data

Automated Traffic Recorded (ATR) data was provided for SDDOT Station #610, which is located between Exit 2 (Western Avenue) and Exit 3 (Minnesota Avenue). The ATR included hourly directional mainline I-229 freeway volumes from Sept 2012 to February 2013. In addition, ATR at Station #610 was provided in 15-minute increments from March 6 to April 21, 2013.

SDDOT supplied hourly ramp volume data from year 2012. Study intersection turning movement counts will be used to determine existing AM and PM peak hour ramp volumes at the other I-90 interchanges within the study area and then smoothed/balanced along the corridor.

Additional Data Supplied by SDDOT and/or City of Sioux Falls

- Vehicle Classification Samples on I-229 Interstate
    - Supplied by SDDOT
- Crash History Geodatabase

  - Supplied by SDDOT
  - Includes crash records dated January 2008 to December 2012 (5 years)
- Roadway Design Standards
  - available online at: http://www.sddot.com/business/design/forms/roaddesign/Default.aspx
- Construction Plans for I-229
  - Supplied by SDDOT
- GIS Base Mapping Data (parcels, parks, streets, rail, plats)
  - Supplied by City of Sioux Falls
- 2012 Aerial SID files
  - Supplied by City of Sioux Falls
- Traffic Impact Studies for Key Proposed Developments
  - Costco TIS supplied by City of Sioux Falls
- MPO Travel Demand Model Files in Cube Voyager (Existing and Future)
  - Supplied by City of Sioux Falls
- Average daily traffic counts
  - Supplied by City of Sioux Falls

Additional Data Collection Needed

Additional data collection is needed to complete project tasks. Additional data needs include items outlined below:

- Incident Management Plans
- ITS Architecture Plans, including Research Studies on Traffic Operations Centers
- Intersection Traffic Counts
  - Additional intersection counts to be collected in Spring 2013 as identified in previous section
- Trails Map - preferably in GIS format if available
- Sidewalk Inventory- preferably in GIS format if available
- Transit Map- preferable in GIS format if available
- Signal Timing Data (or City/Corridor/Study Area Synchro existing conditions Synchro file, if available)
- Interstate Segments Speeds/ Travel time runs
  - Travel time data will be gathered for each I-229 link between interchanges in the AM Peak, PM Peak, and Off-Peak times. Travel time runs will be conducted during the specified time periods using the average car technique with a sample size yielding 95% confidence level, as specified in the ITE Manual of Traffic

Engineering Studies. Data will be reported as travel times and average speeds for each interstate segment.
  - (8 runs each for AM, PM, Off-Peak). Off-Pk Complete
- O-D Data
  - Origin-Destination data will be conducted using wireless phone location data, provided by AirSage. Data will be obtained using Verizon Wireless data for any month after May 2012. This data can be used to accurately determine the location and movement of the cell phones on the network in real-time. This data will be used to populate a daily trip matrix among study area zones, then refined to AM and PM periods for use in the meso-scale model.
  - AirSage data to be gathered for 1-month time period from February 12, 2013 to March 13, 2013.
  - AirSage data for two specific days within 1-month period
    1. Feb 13, 2013 - traffic issues were experienced on I229 SB near 18th Street due to guardrail work)
    2. February 22, 2013- winter weather event
  - AirSage will supply trip matrices that will include:
    - Average Weekday (based on data for Tues-Thursday)
    - Average Weekend Day
    - Two Specific Days
    - Summarized Days by parts: Morning (6-10 AM), Mid-day (10 AM-3 PM), Afternoon (3-7 PM), Evening (7 PM-12 AM), Night (12 AM-6 AM)
    - Summarized Days by trip purpose: Home-based Work, Home-based Other, Other-based Other
- Spot Speed Profile from 100 Vehicle Sample, 1 per I-229 segment.
  - This will be used to determine the free-flow speed of traffic on I-229 mainline.
- City-wide Synchro Files [1].
  - This model may be used for intersection-level data on corridors outside of the Sub-Study 1 study area that can be input into the Cube Avenue meso-scale model.

<u>Data Collection Techniques</u>
All data was collected and will be collected using standard field practices which consist of using cameras, digital count boards or tube counters.

[1] City-wide Synchro files will be utilized for informational purposes when editing the Cube Avenue meso-scale model. Synchro files will not be used for analyzing traffic conditions.

7. Traffic Operations Analysis

Traffic Operations Analysis (Existing and Future No-Build)

1. Software
   a. Signalized Intersections
      i. Highway Capacity Software (HCS) Release 6.5 (currently in beta) (2010 HCM Methodology) Streets Module
         1. Ramp terminal intersections meeting the interchange types defined in HCM Chapter 22 (Interchange Ramp Terminals) will be analyzed with the Interchanges section of the Streets Module
   b. Basic Freeway, Ramp Junctions and Weave Areas
      i. HCS Release 6.5 (currently in beta) (2010 HCM Methodology)
2. Operational Analysis Results
   a. Level of Service (LOS)
      i. Signalized Ramp Terminal Intersections
         1. Overall intersection LOS will be reported for Existing and Future No-Build conditions
      ii. Arterial Intersections
         1. Overall intersection LOS will be reported for Existing and Future No-Build conditions
      iii. Basic Freeway, Ramp Junctions and Weave Areas
         1. LOS will be reported for Existing and Future No-Build conditions
3. Variables
   a. Peak Hour Factor (PHF)
      i. Existing (year 2012) conditions analysis will use calculated PHFs from existing counts with a maximum value of 0.93.
      ii. Design year (year 2035) conditions analysis will use existing PHFs rounded up to the nearest 0.05 with a maximum value of 0.93
         1. The increase in the PHF is to account for traffic growth that is likely to be spread throughout the peak periods
   b. Saturation Flow Rate
      i. SDDOT Design Manual (Page 24, Chapter 15) requires the use of 1,800 vph in Sioux Falls. This value will be used for the signalized intersections and freeway locations within the study area.
   c. Traffic Signal Controllers
      i. Operational analysis will allow for both actuated and coordinated controllers
   d. Left-Turn Phasing
      i. Protected, Permitted / Protected or Split Phasing will be allowed at intersections
   e. Heaviest Lane Volume (Lane Utilization)
      i. Default HCS Streets Values used for ramp terminal/ arterial intersections
   f. Heavy Vehicle Percentage
      i. Study Intersections
         1. Use existing turning movement counts that included truck counts to determine arterial truck percentages.

ii. Ramp Junctions and Weave Areas
   1. Use existing freeway counts that included truck counts to determine freeway truck percentages.

g. Phase Change Intervals
   i. Existing (Year 2012) Conditions
      1. Existing signal timings will be used for phase change intervals during existing conditions
   ii. Future No-Build (Year 2035) Conditions
      1. Existing signal timings will be used for phase change intervals of phases that exist at intersections that have no geometric change from existing conditions
      2. Phase change intervals will be calculated for the following locations:
         a. New phases added at an intersection where geometry is unchanged from existing conditions
         b. All phases at an intersection where geometry is changed from existing conditions

      The calculated values will be based on methodologies presented in the *Institution of Transportation Engineers (ITE) Traffic Engineering Handbook.* The methodologies presented in the handbook use vehicle length and speed and the distance needed to track through the intersection to calculate phase change intervals.

h. Speeds
   i. Arterials – Use posted speeds
   ii. Freeway – Use 85th percentile of collected spot speed data

i. Right Turn on Red Volume
   i. Existing (Year 2012) Conditions
      1. The number of vehicles turning right on red will be assumed to be zero for all locations initially based on the guidance in the 2010 Highway Capacity Manual.
      2. Intersections reporting LOS E or worse potentially related to right turn on red volume will be identified and presented to the SAT to decide if a right turn on red count is necessary.
      3. If a right turn on red count is deemed necessary, video recordings of existing peak hour traffic at the locations of interest will be used to count the number of vehicles turning right on red and incorporated into the HCS analysis at these locations.
   ii. Future No-Build (Year 2035) Conditions
      1. The number of vehicles turning right on red will be assumed to be zero for all locations that were not counted for right turn on red movements.
      2. For locations that were counted for right turn on red movements, the percentage of right turn on red volume of the total volume for the right turn movement in the existing condition will be multiplied by the future forecast right turn movement for each

approach and incorporated into the HCS analysis at these locations.

3. Intersections reporting LOS E or worse potentially related to right turn on red volume will be identified and presented to the SAT to decide if a right turn on red count is necessary.
4. If a right turn on red count is deemed necessary, video recordings of existing peak hour traffic at the locations of interest will be used to count the number of vehicles turning right on red.
5. Step 2 will be repeated for all locations where a right turn on red count was added by the SAT based on a projected future operating condition of LOS E or worse.

8. Travel Forecast

a. Existing (Year 2012) Conditions
   i. Existing counts will be utilized for existing conditions, based on the intersection, interstate mainline, and ramp data described in the Data Collection portion of this document.
   ii. 2-hour AM and PM peak period volumes will be smoothed/balanced between study intersections and free-flow locations to eliminate any additions or subtractions (sources/sinks) in traffic volumes between study intersections and freeway ramps.
   iii. The 2-hour peak period volumes will be divided into 15-minute time intervals based on flow profiles taken from the mainline ATR, and ramps at the Minnesota, 10th St, and Benson interchanges.
   iv. The peak hour volumes will be determined as the maximum four 15-minute volume intervals based on the average of the flow profiles. For the AM peak hour this equates to intervals 2, 3, 4, and 5 (7:15-8:15am), or 62.9% of the 2-hour period, and for the PM peak hour this equates to intervals 3, 4, 5 and 6 (4:30-5:30pm), or 54.4% of the 2-hour period.

b. Future (Year 2035) No Build Conditions
   i. The Sioux Falls MPO Travel Demand Model (Macro/Static Model) will be utilized for the basis of future year no-build volume development
   ii. The travel demand model was created by the Sioux Falls MPO using Cube Voyager
   iii. The model base year is 2008
   iv. The model was last updated in 2009, next update will be in 2014. Traffic volume projections in Sub-Studies 1, 2, 3, and 4 will not be revised based on the MPO's release of an updated base year Cube Voyager model, set to be released by the MPO in 2014.
   v. The Model future year is 2035 to match the current LRTP for year 2035
      1. The 2035 No-Build model includes:
         a. Fiscally constrained projects in the LRTP
         b. No Illustrative Projects
      2. Time intervals in the model include:
         a. Volumes in the travel demand model reflect average weekday

conditions

b. AM and PM 2-hr peak period volumes and daily volumes
c. AM Peak hour volumes, calculated globally as 58% of the AM Peak Period
d. PM Peak hour volumes, calculated globally as 55% of the PM Peak Period

vi. Sub-Area Refinement

1. The Cube Voyager models (both existing base year and future 2035) will be reviewed and modified as needed for validation at a project-corridor level within the study area. Refinements to the model may include network and socio-economic data refinement, a review of trip generation rates, trip length frequency distribution and statistical assignment checks.
2. The No-Build 2035 conditions shall assume the implementation of all fiscally constrained planned projects from the LRTP not on the I-229 corridor. Improvements at the I-229 Exit 5 (26th Street) will be included, based on results from the I-229 Exit 5 (26th Street) Crossroad Corridor Study.
3. The model may be adjusted based on the O-D data gathered from AirSage

vii. Post-Processing Techniques

1. Raw travel demand model outputs will be adjusted using a post-processing technique based on NCHRP 255 that addresses the use of direct raw outputs from a travel model by accounting for the variance in forecasts from the base year model compared to actual count data.
2. Macro model AM and PM peak period (2-hr) volume outputs will be post-processed based on the existing conditions peak period (2-hr) volumes.
3. Macro model daily volume outputs will be post-processed based on existing conditions average daily traffic volumes.
4. Peak hour volumes will be calculated based on the AM and PM peak hour/period (1 hour to 2 hour) proportion determined in the existing conditions analysis.
5. The full set of 2035 No-Build forecasts will be developed by smoothing and balancing volumes between study intersections and free-flow locations to eliminate any additions or subtractions (sources/sinks) in traffic volumes between study intersections and freeway ramps.

c. Future (Year 2035) Concept Level Screening

A Meso-Scale Dynamic Traffic Assignment (DTA) model in Cube Avenue format will be utilized to provide a high level screening comparison for future year build scenarios and report measures of effectiveness at an aggregate level. In order to use this future DTA model, an existing base year model, as well as a future year 2035 model, will be constructed.

1. Existing (Year 2012) Conditions DTA Model
   a. The DTA model will include the I-229 corridor study area, all service interchange ramps, and selected major regional facilities outside of the I-229 corridor that may carry diverted traffic during incidents (including I-29 and I-90). Corridors outside of the Sub-Study 1 study area that will be included in the DTA model will be

defined based on proximity to the study area, functional classification, and availability of intersection-level data (such as counts, signal timings, and intersection geometrics).

b. The I-229 MIS DTA model utilizes data at multiple spatial and temporal scales to represent traffic flow and traffic operations in the I-229 corridor study area. The I-229 MIS DTA model processes sequentially through three resolutions: the macro-scale, regional meso-scale, and sub-area meso-scale. Each resolution provides an opportunity to analyze a different aspect of changes to the Sioux Falls network. The I-229 MIS model starts by analyzing 2-hour AM and PM peak periods for the entire region at the macro-scale, and then refines the traffic demand on the network to hourly demand for use in the regional meso-scale simulation. In the sub-area meso-scale simulation, the model network is reduced in size to just the I-229 area of influence and the hourly demand volumes are refined to fifteen minute intervals. This refinement uses an origin-destination matrix estimation (ODME) procedure to leverage counts when developing the fifteen minute levels of demand. The ODME also utilizes AirSage cell phone origin-destination trip tables as seed matrices. Input from the macro-model is not part of the process in developing base year traffic demand.

c. The output volumes for the AM and PM peak hours will be compared to actual traffic counts to calculate goodness of fit for calibration purposes.

d. The volume outputs from the Existing Conditions DTA model will not be used directly for this study.

e. Alternative modes of transportation included in the Cube Avenue Model

   i. Bus

      a. Includes buses in the peak hours on Sioux Area Metro (SAM) routes 2, 4, 5, 7, & 9

      b. Buses will be pre-loaded into the model based on bus stop location and scheduling data

   ii. Pedestrian/Bicycle modes will not be modeled in the meso-scale model as determined with the Study Advisory Team at the Kick-off meeting

   iii. Rail crossings in the study area will not be included in the meso-scale model due to the infrequent usage during the peak periods (4 trains per day on Rice Street; 3 trains per day on 26th Street).

f. FHWA Resources Center staff will have the opportunity for review and comment on the base year DTA model calibration and application to the study.

2. Future (Year 2035) DTA Model

   a. A future 2035 conditions DTA model will be constructed by adjusting the base year O-D matrix to future year based on growth factors from the Cube Voyager models 2008 and 2035.

b. Alternative modes of transportation (transit) will be modeled for future year the same as existing conditions
c. The No-Build 2035 conditions shall assume the implementation of all fiscally constrained planned projects from the LRTP not on the I-229 corridor. Improvements at the I-229 Exit 5 (26th Street) will be included, based on results from the I-229 Exit 5 (26th Street) Crossroad Corridor Study.
d. Speeds, delay and queuing results directly out of the meso-scale model should be treated with a lower level of scrutiny compared to HCM 2010 analysis. All metrics from the DTA Model should be treated comparatively between scenarios rather than in an absolute manner. Model results should be utilized at an aggregate level for interchange evaluation.
e. Following the establishment of a 2035 No-Build DTA model, alternatives for the I-229 MIS study area will be tested with the I-229 MIS DTA multi-resolution model. A full set of AM and PM peak hour volumes will not be provided for each screening alternative– rather, these alternatives will be compared to each other using Measures of Effectiveness (MOE's) that summarize the modeling results and allow for comparison in a relative manner. These MOE's may include:
    i. Interchange area AM and PM Peak Period total queue length
        - Interchange area to include ramps and roadway segments adjacent to ramp terminal intersections
    ii. Off-ramp queue to length ratio (15-min traffic queue)
        - Reported relative to the base year model
    iii. AM and PM Peak Period Travel Time between key origin-destination pairs
        - Select up to 5 pairs for comparison
    iv. Interchange area AM and PM Peak Period delay
    v. Sub-Area level AM and PM Peak Period Overall System Delay

9. Safety Issues

Crash data will be reviewed for the study area based on the Crash Geodatabase which includes crashes between January 2008 and December 2012. SDDOT's database will be the only database used in the calculation of crash rates and critical crash rates. The following information will be provided as a result of the crash analysis:

- Segment and Intersection Crash Rates
- Segment and Intersection Critical Crash Rates (per Highway Safety Manual)
- Crash Trends
- Potential Mitigation Measures to Improve Locations Above Critical Crash Rates

Predictive crash analysis will be conducted for freeway segments, freeway ramps, ramp terminal intersections, and some arterial intersections within the limits described in the Sub-Study 1 Methods and Assumptions document. Predictive crash analysis will be conducted using the following standard procedures / tools:

- All analysis types
  - For existing conditions:
    - Geometric information will be estimated from aerial photography using tools built in to Google Earth.
    - Average daily traffic counts, described in the data collection section of this document, will be utilized.
  - For build conditions:
    - Geometric information available from design files will be utilized. Geometric information not available at this level of design will be assumed to match existing conditions where practical.
    - Projected future daily volumes, described in the travel forecasting section of this document, will be utilized.
  - Calibration factors or South Dakota-specific Safety Performance Functions will not be used in place of default equations from the Enhanced Interchange Safety Analysis Tool (ISATe).
  - Existing crash data (2008 – 2012) will be used when forecasting expected crash frequency for the Existing and the Future No-Build Conditions using the Empirical Bayes method.
  - Existing crash data will not be used as a factor when predicting crash frequency for Future No-Build and Build Alternative Conditions for comparing these scenarios.
  - Computed crash prediction frequencies will be reported by crash type using default distributions included in the Highway Safety Manual where applicable.
- Freeway segments, freeway ramps, and traditional ramp terminal intersections
  - ISATe Build 06.10 will be used.
- Non-traditional ramps and ramp terminal intersections
  - Analysis will follow the methodology outlined in the 'Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp' memorandum, found in the Appendix of this document.
- Arterial intersections
  - Methods from Chapter 12 of the Highway Safety Manual will be used.

Predictive crash analysis will forecast crash frequencies for Existing (Year 2012, for comparison to actual crashes), Future No-Build (Year 2035) and Future Build Alternative (Year 2035) conditions.

10. Selection of Measures of Effectiveness (MOE)

The main goals of this study are as follows:

1. Complete a traffic level of service analysis for both existing and future (2035) conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges, and crossroads.
3. Complete a predictive safety analysis of I-229 mainline, interchanges, and crossroads to be impacted by potential build alternatives.
4. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
5. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
6. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions. The recommended projects will be prioritized by primary and secondary groups of improvements.
7. Conduct interchange options feasibility study on select interchanges. *Will be addressed in subsequent sub-studies.*
8. Create final products for use by the SDDOT which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

To satisfy the study objective, the following MOEs will be used to evaluate and compare the concepts based on the Cube Avenue modeling:

- i. Interchange area AM and PM Peak Period total queue length
- ii. Off-ramp queue to length ratio (15-min traffic queue)
- iii. AM and PM Peak Period Travel Time between key origin-destination pairs
- iv. Interchange area AM and PM Peak Period delay
- v. Sub-Area level AM and PM Peak Period Overall System Delay

These statements are made assuming that the geometric improvements identified meet all AASHTO, SDDOT, and City of Sioux Falls guidelines.

An evaluation on the MOE significance thresholds will be conducted when future scenario results are available and used to establish prioritization.

11. FHWA Interstate Access Modification Policy Points

An Interchange Modification Justification Report (IMJR) will not be developed for interchanges as part of this project. The level of detail for addressing each of the eight (8) FHWA policy points regarding modifications to Interstate access will be determined outside of this study.

12. Deviations/Justifications

No deviations from standards are currently known. If it is determined during the study that deviations are required, the methods and assumptions document will be amended prior to proceeding.

13. Conclusion

All sections contained in this document will guide the traffic data collection and traffic assessment for this study.

14. Appendices

The appendix includes the following:

- Methods and Assumptions Study Team Meeting Minutes (November 2, 2015)
- Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), Two-Lane Loop Ramp

APPENDIX

Memo

Date: Wednesday, November 04, 2015

Project:

To: File

From: Rob Frazier, P.E.
Jon Markt, EIT

Subject: **RE: Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp**

Introduction

This document presents proposed methodologies for performing crash prediction for a Diverging Diamond Interchange (DDI), a Single-Point Urban Interchange (SPUI), and a two-lane loop ramp. The American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) provides a standard practice for safety analysis over a project's full life-cycle. The HSM can be faithfully implemented by a variety of tools including the Federal Highway Administration's (FHWA) Enhanced Interchange Safety Analysis Tool (ISATe). However, neither the HSM nor ISATe currently address the DDI, SPUI, or two-lane loop ramp configurations. In response to these shortcomings, a synthesis of recent and on-going research yielded these proposed methodologies to address crash prediction for the DDI, SPUI, and two-lane loop ramp.

Crash Prediction

Crash prediction is a method of assessing safety by applying a combination of Safety Performance Functions (SPFs) and Crash Modification Factors (CMFs) to a roadway facility to predict the number of crashes that are statistically likely to occur in an average year. Crash prediction relies on roadway and roadside geometry, traffic volumes, traffic control, and other safety related factors to forecast crash frequency. Crash prediction can be performed at the site level or at the project level. Site level crash prediction involves the use of SPFs or CMFs to predict crash frequency for an individual roadway segment or intersection. Project level crash prediction involves the use of a CMF to estimate the change in crash frequency for a group of sites that make up the project area. For example, consider the conversion of an at-grade intersection to a grade-separated interchange. The site level analysis would involve calculating crash frequency for the existing intersection and adjacent roadway segments and the calculation of crash frequency for the proposed roadway segments, ramps, and ramp terminal intersections related to the interchange. For a project level analysis of the same example, a single project level CMF would be used to estimate predicted crash frequency at the interchange, based on the existing crash frequency at the intersection.

In general, a project level assessment is more simple and easier to implement. Site level analyses provide greater detail and flexibility in both the analysis and presentation of the results.

The proposed methodology applies site level analysis where possible, using project level analysis only when necessary.

Diverging Diamond Interchange (DDI)

DDIs have only been in operation in North America since 2009. Considering that HSM methods rely on observed crash data for the development of SPFs and CMFs, the newness of the DDI has been a major factor in its absence from the HSM and consequently ISATe. Recently however, researchers have completed several in-depth safety evaluations of DDIs in Missouri. As an early adopter of DDIs, Missouri provides a good source for DDI crash data. The research has addressed both project level and site level analyses. Based on these studies, the proposed methodology is as follows:

1. Develop crash predictions for the freeway mainline for the No-Build and Build (DDI) conditions
2. Develop crash predictions for theoretical traditional diamond interchanges for the locations of the proposed DDI interchanges (predicted crashes for ramps and ramp terminals).
3. Develop site level crash predictions for the ramp and ramp terminals for the proposed DDI designs.
    a. Ramps – The ramp crash predictions will be based on the ramp geometry and will only be adjusted if specifically indicated by the research.
    b. Ramp Terminal Intersections – The ramp terminal crash predictions will be developed by applying CMFs from the research to the diamond ramp terminal predictions. Preliminary CMFs are:
        i. $CMF_{Fatal\&Injury} = 0.63$
        ii. $CMF_{PropertyDamageOnly} = 0.51$
4. As a check on the site level predictions, a project level analysis will also be prepared. This will use the project level research CMFs to modify the entire diamond interchange crash prediction to estimate the entire DDI interchange crash frequency. This value will be compared with the site level results before finalizing the crash predictions.

Crash type frequency will not be quantitatively predicted for the DDI ramp terminal intersections. A qualitative assessment will be provided for the trends in crash type associated with the DDI.

Single-Point Urban Interchange (SPUI)

The SPUI has a much longer history compared to the DDI, but a similarly limited research base pertaining to predictive safety. Research has begun on NCHRP Project 17-68 to develop SPFs and CMFs directly applicable to SPUIs, but the project is still on-going. The NCHRP Project 17-68 will have a significant crash data set (~100 intersections) to develop SPFs and CMFs. Investigations into other research concerning SPUIs and crash prediction have not produced any additional studies. However, some data concerning SPUIs has been made available by SDDOT (before and after study data for conversion from a traditional diamond interchange to a SPUI). Based on these studies, the proposed methodology is as follows:

1. Should NCHRP Project 17-68 results become available prior to March 2016

   a. Analyze the SPUI ramp terminal intersection based on methods / equations from NCHRP Project 17-68.
2. Should NCHRP Project 17-68 results not be available
   a. Perform crash prediction for a traditional diamond interchange with similar freeway mainline segment, freeway ramp segment, and ramp terminal interchange characteristics as the proposed SPUI.
   b. Combine site predicted crashes for the traditional diamond interchange to develop a project level estimate of crashes.
   c. Multiply the project level estimate of crashes for the traditional diamond by a project level CMF based on the available SDDOT data. The preliminary CMF is 0.63 for conversion of a traditional diamond interchange to a SPUI.

Should NCHRP Project 17-68 results not be available, crash type frequency will not be quantitatively predicted for the SPUI ramp terminal intersection. A qualitative assessment will be provided for the trends in crash type associated with the SPUI. Should NCHRP Project 17-68 results be available, recommendations from that project will be utilized to determine how to provide crash type frequency information.

Two-Lane Loop Ramp

Single-lane loop ramp safety is addressed at both the ramp segment and ramp terminal intersection level by the Highway Safety Manual, and most loop ramps are single-lane loop ramps. The previous reasoning may explain why developing SPFs and / or CMFs for two-lane loop ramps has not been a primary research direction based on our literature review. However, NCHRP Project 03-105 is on-going research and will attempt to improved roadway design guidance for single-lane and two-lane loop ramps. The project research plan was to collect safety data for single-lane and two-lane loop ramps, there may be an opportunity to use results of this project to address crash prediction for two-lane loop ramps. Based on this review of available research, the proposed methodology is as follows:

1. Should NCHRP Project 03-105 results become available prior to March 2016
   a. Analyze the two-lane loop ramp terminal intersection based on data, methods, equations, and findings from NCHRP Project 03-105.
2. Should NCHRP Project 03-105 results not be available
   a. Perform crash prediction for a two-lane ramp segment with tight curvature.
   b. Confirm that the crash prediction for a two-lane ramp segment with tight curvature produces reasonable crash prediction results. This will involve comparing the predicted number of single-vehicle and multi-vehicle crashes for the tight curvature ramp with a standard one-lane loop ramp. If comparison crash data is available for two-lane loop ramps that will also be considered.

M&A Amendment #1

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Methods & Assumptions Meeting Documentation Amendment #1

1. Methods and Assumptions Cover Page

I-229 Major Investment Corridor Study: Sub-Study #1 - Amendment 1

To:	Study Advisory Team (SDDOT, FHWA, City of Sioux Falls)		
From:	Brian Ray, HDR Courtney Sokol, HDR	Project:	I-229 Major Investment Corridor Study
CC:	File		
Date:	August 28, 2014	Job No:	207030

Methods and Assumptions Document

The original Methods and Assumptions document was developed as a summation of the Methods and Assumptions Meeting held on April 30, 2013 with representatives from the South Dakota Department of Transportation (SDDOT), Federal Highway Administration (FHWA), City of Sioux Falls, Sioux Falls MPO, and HDR.

Amendment 1 includes changes to accommodate updated schedule, SAT team members, traffic forecasting methodology, and right-turn on red volumes, as discussed at the SAT meeting held on August 13, 2014. This document is intended to serve as a historical record of the process, dates, and decisions made by the study team representatives for the ***I-229 Major Investment Corridor Study: Sub-Study #1***.

2. Stakeholder Acceptance Page

The undersigned parties concur with Amendment 1 to this document.

SDDOT:

Signature

Data Analysis Engineer

Title

Sept. 3, 2014

Date

FHWA:

Signature

Planning/Civil Rights Specialist

Title

9/5/14

Date

Notes:

(1) Participation on the Study Advisory Team and/or signing of this document does not constitute approval of the ***I-229 Major Investment Corridor Study: Sub-Study #1*** Final Report or conclusions.

(2) All members of the Study Advisory Team will accept this document as a guide and reference as the study progresses through the various stages of development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the signatories.

Amendment Notes

Meeting Minutes

Project: I-229 MIS

Subject: Study Advisory Meeting #6, M&A SS1-SS4 Amendment 1

Date: Wednesday, August 13, 2014

Location: Web Meeting / Conference Call

Attendees:
Dave Meier, HDR
Courtney Sokol, HDR
Jon Markt, HDR
Jason Kjenstad, HDR
Brian Ray, HDR
Rich Laughlin, HDR
Ross Harris, HR Green
Jon Wiegand, HR Green
Shannon Ausen, City of Sioux Falls
Heath Hoftiezer, City of Sioux Falls
Amber Gibson, Sioux Falls MPO
Christina Bennett, SDDOT
Jeff Brosz, SDDOT
Joel Gengler, SDDOT
Kevin Goeden, SDDOT
Steve Gramm, SDDOT
Pete Longman, SDDOT
Paul Nikolas, SDDOT
Ron McMahon, FHWA
Mark Hoines, FHWA

	Topic	*Facilitator*
1	Introductions	Brian Ray
2	Dynamic Traffic Assignment (DTA) Model Review with FHWA	Jon Markt
3	Review Updated M&A Documents	Brian Ray
4	Next Steps	Brian Ray

	Action Items	*Responsibility*
1	Revise Methods and Assumptions Documents	HDR
2	Circulate Methods and Assumptions Documents	SDDOT
3	Develop Future Year 2035 No-Build Traffic Volumes	HDR
4	Analyze Future Year 2035 No-Build Traffic Volumes	HDR
5	Complete Future Year No-Build DTA Modeling	HDR
6	Start Identifying Solutions/ Conduct Solutions Development Workshop	HDR
7	Draft schedule/dates for concept workshop	HDR
8	Update website and send out postcards	HDR

1. Introductions (HDR, HR Green, City of Sioux Falls, Sioux Falls MPO, SDDOT, FHWA)
2. Dynamic Traffic Assignment (DTA) Model Review with FHWA
   - Recent DTA Model Updates

- HDR discussed the model development effort that had transpired since the previous SAT meeting and summarized the 2 sub-committee confrence calls with FHWA Resource Center.
  - First Meeting, May 22, 2014
    a. Discussed the study goals and framework
    b. Discussed details of Cube Avenue Model
    c. Discussed volume development (existing and future 2035 No Build)
    d. Action Items:
       i. Validation of queuing patterns in the base year model
       ii. Add discussion on convergence in the validation report
       iii. Start future year DTA modeling for 2035 No Build
  - Second Meeting, July 25, 2014
    a. Discussed update to the DTA model
    b. Discussed updates to the validation report
    c. Discussed future 2035 No Build volume development
    d. Action Items:
       i. Revise Method and Assumptions (M&A) Documents
       ii. Review model directionality assumptions
       iii. Circulate M&A Documents
       iv. Schedule SAT Meeting
- FHWA was in agreement with HDR that the development of the existing conditions DTA model had reached completion.
- Future no-build DTA modeling was initiated and networks and trip tables are currently under fine tuning.

3. Review Updated M&A Documents
   - Sub-Study 1
     - SDDOT noted the format of the Amended M&A needs to be modified so that it is not confused with original M&A
     - Study Schedule
       - Schedule shifted to extend Future Needs Analysis
       - SDDOT corrected the Public Meeting #1 date of October 2013 (not 2014)
     - Study Advisory Team Members
       - Updated based on edits received via SDDOT email on 8/5/14
     - Right Turn on Red Volume

        - HDR summarized the procedure utilized for estimating Right Turn on Red volumes used in the HCS analysis.
    - Travel Forecast
        - HDR summarized the process used to balance existing turning movement volumes, and the revised process to generate peak hour turning movement forecasts for the 2035 No Build (to be analyzed in HCS), including a traditional post-processing of macro model outputs (Cube Voyager), instead of DTA model outputs. FHWA Resource Center is in agreement with this process.
            a. SDDOT inquired about the peak hour percentage differences (existing conditions vs. macro model), and HDR clarified that the 2035 No Build peak hour volumes will be based on the peak hour/period (1 hour/2 hour) proportions from the existing conditions analysis.
        - The DTA model will be used for concept level screening, which matches the original study intent.
            a. City of Sioux Falls inquired about the use of AirSage data in the DTA model. HDR confirmed that the AirSage data is only used as a seed matrix for Origin-Destination estimation in the meso-scale modeling process.
    - Measures of Effectiveness
        - MOE's from the DTA model to be used in the concept level screening analysis will allow for alternative comparison in a relative manner.
- Sub-Study 2,3 and 4
    - Schedule
        - Similar revisions to those outlined and discussed in SS1.
    - Study Advisory Team Members
        - Similar revisions to those outlined and discussed in SS1.
    - Analysis Years/Periods
        - Similar revisions to those outlined and discussed in SS1.
        - SDDOT and FHWA confirmed that SS2, SS3, SS4 M&A documents may still refernce SS1 M&A, as the orignal had.
    - Right Turn on Red
        - Similar revisions to those outlined and discussed in SS1.

4. Next Steps
    - Updated M&A Documents (SS1, SS2, SS3, SS4)
    - Circulate M&A Documents for Signature

HDR

- Develop Future Year 2035 No-Build Traffic Volumes
- Analyze Future Year 2035 No-Build Traffic Volumes
- Complete Future Year No-Build DTA Modeling
    - Will involve addressing additional questions in the macro (static) model as pointed out by the FHWA Resource Center, and supplying an updated DTA Model Validation Report.
- Start Identifying Solutions
- Conduct Solutions Development Workshop
    - Additional SAT discussion regarding Stakeholder Meetings scheduled following the completion of the 2035 No-Build analysis. Target date for Stakeholder meetings is November 2014, ideally on a Monday/Tuesday, followed by Concept Workshop on Wednesday.
        - Conflict dates: November 18, 19, 20 (MPO meetings), November 11 (state holiday), and November 27, 28 (Thanksgiving)
        - HDR to provide draft schedule for concept workshop and potential dates
    - Additional SAT discussion regarding the next Public Meeting. SDDOT requested an update to the website informing the public that the next public meeting is targeted for "Early 2015". HDR will also send out postcards as a project update, explaining the long delay since the last public meeeting.

5. Adjourn

3. Introduction and Project Description

Project Background and Understanding

Sub-Study 1 will analyze existing and future conditions along the entire I-229 corridor, service interchanges, and crossroads, assess the impact on the transportation system, determine feasible solutions to those impacts, and prioritize a list of recommendations that will maximize the efficiency of the corridor. The study will fulfill the following objectives:

1. Complete a traffic level of service analysis for both existing and future (2035) no-build conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions.
6. Create final products for use by the SDDOT which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

Location

The I-229 corridor is located east of I-29 in the Sioux Falls metropolitan area. The mainline interstate study limits include a 10.5 mile section from the Solberg Avenue overpass (currently under construction) to the 60th Street North overpass. Eight service interchanges are located on I-229 within the study area, including:

- Exit 1: Louise Avenue
- Exit 2: Western Avenue
- Exit 3: Minnesota Avenue
- Exit 4: Cliff Avenue
- Exit 5: 26th Street
- Exit 6: 10th Street
- Exit 7: Rice Street
- Exit 9: Benson Road

A subset of the arterial street network that connects to the I-229 corridor is included in the study area as well, including the following crossroad corridors:

- Solberg Avenue from 69th Street to 57th Street
- Louise Avenue from 69th Street to 57th Street

- 57th Street from Louise Avenue to Western Avenue
- Western Avenue from 57th Street to 49th Street
- Minnesota Avenue from 57th Street to 41st Street
- Cliff Avenue from 49th Street to 33rd Street
- 26th Street from Cliff Avenue to Southeastern Drive
- 33rd Street from Cliff Avenue to Yeager Road
- Yeager Road from 33rd Street to 26th Street
- Southeastern Avenue from 18th Street to 26th Street
- 18th Street from Southeastern Drive to Cleveland Avenue
- 12th Street from Lowell Avenue to Cleveland Avenue
- 10th Street from Jessica Avenue to Bahnson Avenue
- 6th Street from Lowell Avenue to Cleveland Avenue
- Rice Street from Wayland Avenue to Bahnson Avenue
- Benson Road from Cliff Avenue to Sycamore Avenue
- 60th Street North from Lewis Avenue to Bahnson Avenue (Proposed)

An illustration of the Sub-Study 1 study area is shown in Section 4 (Study Area) of this report.

Need for Study

The study team has determined the following needs for this specific study (for future Year 2035 AM, PM, and Off-Peak periods representing average weekday traffic conditions):

- Mainline Level of Service (LOS) of C or better throughout the I-229 corridor
- Ramp merge/diverge LOS of C or better for all interchange ramps through the I-229 corridor
- Ramp terminal intersection LOS of D or better for all interchanges throughout the I-229 corridor
- Identification of areas not in compliance with current Interstate design standards.
- Incident management planning is also needed to identify methods for handling mainline traffic during incidents, weather, and special events.

Study Schedule

Date	Task/Event
March 2013	Notice to Proceed, Kickoff Meeting
April 2013	Methods & Assumptions Documentation
April 2013- August 2013	Baseline Conditions Analysis/ Data Collection
August 2013- December 2014	Existing Traffic and Operations Analysis Incident, Weather, and Special Event Analysis Future Needs Analysis (No Build) Safety Analysis ITS Assessment **Public Meeting #1** (Project Kickoff/ Existing Analysis Stage) **(October 2013)**
October 2014- June 2015	Noise Analysis Identification of Solutions **Public Meeting #2** (Scenario Building Stage) **(Jan/Feb 2015)** **MPO Meeting (Scenario Building Presentation)** Analysis of Solutions Project Recommendations
May 2015- September 2015	Sub-Study 1 Report Documentation **Public Meeting #3 (Draft Report Stage)** **MPO Meeting (Final Recommendations Presentation)**

Facilities Affected by the Study

Given the regional context of the I-229 corridor, modifications to I-229 mainline, service interchanges or crossroad corridors may impact transportation facilities throughout the metropolitan area. Modifications at service interchanges would have the potential to affect adjacent interstate ramp terminal intersections and/or arterial street corridors. The large study area defined in Sub-Study 1 is intended to provide a comprehensive assessment of interstate, ramp, and arterial streets such that facilities affected by the study recommendations are included in the analysis.

Previous Studies

The following previous studies will be reviewed during the course of this study:

- Direction 2035, Sioux Falls MPO Long-Range Transportation Plan (LRTP)
  - http://www.siouxfalls.org/~/media/Documents/planning/long-range/lrtp/2035_lrtp/adopted_lrtp_rev120210.pdf
- Sioux Falls Comprehensive Development Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/shape_sf/chapters-maps/Chapter_1_r112111.pdf
- Sioux Falls Transit Development Plan 2011- 2015
  - http://www.siouxfalls.org/~/media/Documents/planning/long-range/2011_2015_Transit_Development_Plan.pdf
- 2007 Sioux Falls Bicycle Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/transportation/bicycle/Bicycle_Plan_Final.pdf
- The Sioux Falls MPO Multi-Use Trail Study
  - http://www.siouxfallsmpo.org/documents/MPO/Planning_Documents/SiouxFallsMUTCS.pdf
- 60th Street North Planning and Feasibility Study
  - http://www.siouxfalls.org/~/media/Documents/publicworks/engineering/projects/60th-st-feasibility-report-may-12/60th-St-North-Study-Fina-Report-May-2012.pdf
- Sioux Falls Major Street and Access Management Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/transportation/long-range/majorstreetplanmediumfinal%20pdf.pdf
- I-229 Exit 5 (26th Street) Crossroad Corridor Study
  - http://26thstreetcorridorstudy.com/

- Interstate 90/ Interstate 229 Access Modification Request (Draft)
- Northeast Transportation Network Feasibility Study
- 2010 Decennial Interstate Corridor Study and 2000 Decennial Interstate Study
- N. Bahnson Avenue Feasibility Study
- Cleveland Avenue Study
- SIMPCO Incident Management Plan
- ITS Studies from City of Sioux Falls and SDDOT

Study Advisory Team Members

A Study Advisory Team has been formed to guide the study through completion. The Study Advisory Team is comprised of representative parties of the SDDOT, FHWA and City of Sioux Falls. Members of the Study Advisory Team are:

Shannon Ausen	City of Sioux Falls – Public Works
Mike Behm	SDDOT – Project Development
Christina Bennett	SDDOT – Operations Support
Jeff Brosz	SDDOT – Transportation Inventory Management
Andy Vandel	SDDOT – Project Development (Safety)
Joel Gengler	SDDOT – Right of Way
Amber Gibson	Sioux Falls MPO
Kevin Goeden	SDDOT – Bridge Design
Steve Gramm	SDDOT – Project Development (Planning)
Heath Hoftiezer	City of Sioux Falls – Public Works
Mark Hoines	FHWA
Dave Huft	SDDOT – Research
Bruce Hunt	FHWA
Scott Jansen	SDDOT – Mitchell Region
Captain Alan Welsh	South Dakota Highway Patrol
Ryan Kerkvliet	Sioux Falls MPO – Citizens Advisory Committee
Tom Lehmkuhl	SDDOT – Project Development (Environmental)
Pete Longman	SDDOT – Road Design
Ron McMahon	FHWA
Paul Nikolas	SDDOT – Road Design
Brad Remmich	SDDOT – Project Development (Planning)
Craig Smith	SDDOT – Mitchell Region

Additional team members may be added as the study progresses.

4. Study Area

The study area for Sub-Study 1 was defined by the Study Advisory Team and is illustrated in this report for documentation. The study area contains I-229 freeway segments and junctions from east of the I-29/I-229 systems interchange to south of the I-90/I-229 systems interchange. The study area also contains ramp terminal intersections at each interchange along I-229 and intersections adjacent to those ramp terminal intersections. The following graphic shows the study area and identifies each of the study intersections.

Sub-Study 1 Study Area

Study Intersections:

- Solberg Avenue Intersections
  - Solberg Avenue & 57th Street
  - Solberg Avenue & 69th Street
- Louise Avenue (Exit 1C) Intersections
  - Louise Avenue & 57th Street
  - Louise Avenue & 59th Street
  - Louise Avenue & I-229 Southbound Ramps
  - Louise Avenue & I-229 Northbound Ramps
  - Louise Avenue & 69th Street
- Western Avenue (Exit 2) Intersections
  - Western Avenue & 49th Street
  - Western Avenue & I-229 Southbound Ramps
  - Western Avenue & I-229 Northbound Ramps
  - Western Avenue & 57th Street
- Minnesota Avenue (Exit 3) Intersections
  - Minnesota Avenue & 41st Street
  - Minnesota Avenue & 49th Street
  - Minnesota Avenue & I-229 Southbound Ramps
  - Minnesota Avenue & I-229 Northbound Ramps
  - Minnesota Avenue & 57th Street
- Cliff Avenue (Exit 4) Intersections
  - Cliff Avenue & 33rd Street
  - Cliff Avenue & I-229 Southbound Ramps
  - Cliff Avenue & I-229 Northbound Ramps
  - Cliff Avenue & 49th Street
- 26th Street (Exit 5) Intersections
  - 26th Street & Cliff Avenue
  - 26th Street & Van Eps Avenue
  - 26th Street & Yeager Road
  - Yeager Road & I-229 Southbound Ramps
  - 26th Street & I-229 Northbound Ramps
  - 26th Street & Southeastern Avenue
- 18th Street Intersections
  - 18th Street & Southeastern Avenue
  - 18th Street & Cleveland Avenue
- 12th Street Intersections
  - 12th Street & Lowell Avenue
  - 12th Street & Cleveland Avenue
- 10th Street (Exit 6) Intersections
  - 10th Street & Lowell Avenue

  - 10th Street & I-229 Southbound/Northbound Ramps (Single-Point)
  - 10th Street & Cleveland Avenue
- 6th Street Intersections
  - 6th Street & Lowell Avenue
  - 6th Street & Cleveland Avenue
- Rice Street (Exit 7) Intersections
  - Rice Street & Wayland Avenue
  - Rice Street & I-229 Southbound Ramps
  - Rice Street & I-229 Northbound Ramps
  - Rice Street& Bahnson Avenue
- Benson Road (Exit 9) Intersections
  - Benson Road & Cliff Avenue
  - Benson Road & I-229 Southbound Ramps
  - Benson Road & I-229 Northbound Ramps
  - Benson Road & Hall Avenue
  - Benson Road & Lewis Avenue
- 60th Street North Intersections
  - 60th Street North & Lewis Avenue
  - 60th Street North & Bahnson Avenue (Proposed)

Study Basic Freeway Areas (*See also Note 1 below for designated analysis areas as potential Freeway Weave Areas for segments including auxiliary lanes*):

- I-229 Northbound
  - Segment between I-29 Northbound (Exit 1B) and Louise Avenue (Exit 1C) [1]
  - Segment between Louise Avenue (Exit 1C) and Western Avenue (Exit 2) [1]
  - Segment between Western Avenue (Exit 2) and Minnesota Avenue (Exit 3) [1]
  - Segment between Minnesota Avenue (Exit 3) and Cliff Avenue (Exit 4) [1]
  - Segment between Cliff Avenue (Exit 4) and 26th Street (Exit 5) [1]
  - Segment between 26th Street (Exit 5) and 10th Street (Exit 6)
  - Segment between 10th Street (Exit 6) and Rice Street (Exit 7) [1]
  - Segment between Rice Street (Exit 7) and Benson Road (Exit 9) [1]
  - Segment between Benson Road (Exit 9) and I-90 Eastbound (Exit 10A)
- I-229 Southbound
  - Segment between I-90 Eastbound (Exit 10A) and Benson Road (Exit 9)
  - Segment between Benson Road (Exit 9) and Rice Street (Exit 7) [1]
  - Segment between Rice Street (Exit 7) and 10th Street (Exit 6) [1]

- Segment between 10th Street (Exit 6) and 26th Street (Exit 5)
- Segment between 26th Street (Exit 5) and Cliff Avenue (Exit 4) [1]
- Segment between Cliff Avenue (Exit 4) and Minnesota Avenue (Exit 3) [1]
- Segment between Minnesota Avenue (Exit 3) and Western Avenue (Exit 2) [1]
- Segment between Western Avenue (Exit 2) and Louise Avenue (Exit 1C) [1]
- Segment between Louise Avenue (Exit 1C) and I-29 Northbound (Exit 1B)

[1] *Segment will be evaluated using Highway Capacity Manual (HCM) 2010 procedures to determine if the segment meets the criteria for a weave segment. If the segment meets the weave segment criteria the segment will be analyzed as a Freeway Weave Area and not a Basic Freeway Area.*

Study Ramp Junctions (*See also Note 2 below for designated analysis areas as potential Freeway Weave Areas*):

- I-229 Northbound
  - Diverge to Louise Avenue (Exit 1C) [2]
  - Merge from Louise Avenue Northbound (Exit 1C)
  - Merge from 26th Street (Exit 5)
  - Diverge to 10th Street (Exit 6)
  - Merge from Benson Road (Exit 9)
- I-229 Southbound
  - Diverge to Benson Road (Exit 9)
  - Merge from 10th Street (Exit 6)
  - Diverge to 26th Street (Exit 5)
  - Merge from Louise Avenue (Exit 1C)

[2] *Basic freeway segment upstream will be evaluated using HCM 2010 procedures to determine if the upstream segment meets the criteria for a weave segment. If the upstream segment meets the weave segment criteria the segment will be analyzed as a Freeway Weave Area and the Diverge Ramp Junction analysis would not apply.*

5. Analysis Years/Periods

This study will evaluate traffic during and for the following time periods:

Existing Conditions – Existing conditions analyses will be conducted for year 2012 volume conditions. Turning movement counts were collected at several study area intersections in 2012. Intersections that do not already have recent count data from 2012 will be counted by the City of Sioux Falls or HDR as part of this study as described in Section 6. For existing conditions the following time periods will be evaluated:

- Existing Conditions (Year 2012) – AM Peak Period (7:00 to 9:00 AM)
- Existing Conditions (Year 2012) – PM Peak Period (4:00 to 6:00 PM)

Future/ Design Conditions – Future/ Design conditions analyses will be conducted for year 2035 conditions. This horizon year matches the planning horizon of the current Sioux Falls LRTP. The Travel Demand Model was calibrated and updated in year 2009 for a base year 2008 and planning horizon of year 2035. Projected traffic volumes from the Sioux Falls MPO Travel Demand Model will be utilized to establish year 2035 volumes. For the design conditions the following time periods will be evaluated:

- Future/Design Conditions (Year 2035) – AM Peak Period (7:00 to 9:00 AM)
- Future/Design Conditions (Year 2035) – PM Peak Period (4:00 to 6:00 PM)

Interim Conditions – No interim conditions will be evaluated as part of this study.

6. Data Collection

Data Collection is one of the most important items during any transportation planning study. The data collection efforts are documented below:

Existing Arterial Intersection Turning Movement Count Data

Turning movement counts define actual traffic at the study intersections during the course of a typical weekday. The most recent turning movement counts provided by the City of Sioux Falls were conducted in year 2012 and were deemed suitable for use in this study. These counts include volume data in 15-minute intervals. Study area intersections with counts older than year 2012 will be collected in the spring of 2013 to capture conditions for an existing conditions average weekday. These intersections will be collected by either HDR or the City, as outlined in the table below. These turning movement counts will be collected during the AM and PM peak periods in 15-minute intervals.

For some of the intersections listed in this table, their operational analysis results will not be reported in Sub-Study 1, but instead in subsequent Sub Studies. In an effort to streamline data collection efforts in anticipation of these future sub studies, they are included in the data collection effort of Sub Study 1.

TURNING MOVEMENT COUNTS				SUB-STUDY FOR ANALYSIS
LOCATION	LATEST COUNT	NEW COUNT NEEDED?	COUNT RESPONSIBILITY	
60TH ST. N./LEWIS AVE.	4/18/2011	YES	HDR	1
60TH ST. N./BAHNSON AVE.	n/a, Intersection does not currently exist			1
BENSON RD./I-229 SB	5/8/2012	NO		1, 4
BENSON RD./I-229 NB	5/8/2012	NO		1, 4
BENSON RD./CLIFF AVE.	5/24/2011	YES	HDR	1, 4

BENSON RD./LEWIS AVE.	5/10/2012	NO		1, 4
BENSON RD./POTSDAM AVE.	5/9/2012	NO		4
BENSON RD./HALL AVE.	5/9/2012	NO		1, 4
BENSON RD./SYCAMORE AVE.	n/a, Intersection does not currently exist			4
RICE ST./I-229 SB	6/14/2012	NO		1
RICE ST./I-229 NB/CLEVELAND AVE.	6/18/2012	NO		1
RICE ST./WAYLAND AVE.	6/14/2012	NO		1
RICE ST./BAHNSON AVE.	n/a	YES	HDR	1
6TH ST./LOWELL AVE.	n/a	YES	HDR	1
6TH ST./CLEVELAND AVE.	6/26/2012	NO		1
10TH ST./I-229	1/9/2012	YES	CITY	1, 3
10TH ST./FRANKLIN AVE.	12/1/2011	YES	CITY	3
10TH ST./FAIRFAX AVE.	12/1/2011	YES	CITY	3
10TH ST./CLIFF AVE.	1/4/2012	YES	CITY	3
10TH ST./BLAUVELT AVE.	11/30/2011	YES	CITY	3
10TH ST./JESSICA AVE.	11/29/2011	YES	HDR	3
10TH ST./LOWELL AVE.	6/30/2011	YES	HDR	1, 3
10TH ST./CONKLIN AVE.	n/a	YES	CITY	3
10TH ST./BLAINE AVE.	n/a	YES	CITY	3
10TH ST./CLEVELAND AVE.	7/5/2011	YES	HDR	1, 3
10TH ST./CAMBELL'S & HY-VEE	7/6/2011	YES	CITY	3
10TH ST./BAHNSON AVE.	2008	YES	CITY	3
10TH ST./SYCAMORE AVE.	8/23/2011	YES	CITY	3
12TH ST./LOWELL AVE.	n/a	YES	HDR	1
12TH ST./CLEVELAND AVE.	8/15/2011	YES	CITY	1
18TH ST./SOUTHEASTERN AVE.	5/3/2012	NO		1
18TH ST./CLEVELAND AVE.	5/2/2012	NO		1
26TH ST./I-229 SB/YEAGER RD.	10/24/2012	NO		1
26TH ST./I-229 NB	4/30/2012	NO		1
26TH ST./CLIFF AVE.	4/26/2012	NO		1
26TH ST./VAN EPS AVE.	4/30/2012	NO		1
26TH ST./SOUTHEASTERN AVE.	9/5/2012	NO		1
CLIFF AVE./I-229 SB	5/3/2012	NO		1
CLIFF AVE./I-229 NB	10/11/2012	NO		1
CLIFF AVE./33RD ST.	8/20/2012	NO		1
CLIFF AVE./49TH ST.	5/7/2012	NO		1
MINNESOTA AVE./I-229 SB	10/16/2012	NO		1, 2
MINNESOTA AVE./I-229 NB	10/16/2012	NO		1, 2
MINNESOTA AVE./41ST ST.	8/30/2012	NO		1, 2
MINNESOTA AVE./43RD ST.	n/a	YES	CITY	2
MINNESOTA AVE./YANKTON TRL PARK	n/a	YES	CITY	2
MINNESOTA AVE./LOTTA ST.	n/a	YES	CITY	2

MINNESOTA AVE./BATCHELLER LN.	n/a	YES	CITY	2
MINNESOTA AVE./49TH ST.	5/24/2012	NO		1, 2
MINNESOTA AVE./57TH ST.	9/10/2012	NO		1, 2
WESTERN AVE./I-229 SB	12/6/2011	YES	CITY	1
WESTERN AVE./I-229 NB	12/6/2011	YES	CITY	1
WESTERN AVE./49TH ST.	12/7/2011	YES	CITY	1
WESTERN AVE./57TH ST.	12/8/2011	YES	CITY	1
LOUISE AVE./I-229 SB	5/3/2010	YES	CITY	1
LOUISE AVE./I-229 NB	5/3/2010	YES	CITY	1
LOUISE AVE./57TH ST.	1/4/2012	NO		1
LOUISE AVE./59TH ST.	5/3/2010	YES	CITY	1
LOUISE AVE./69TH ST.	5/6/2010	YES	CITY	1
SOLBERG AVE./57TH ST.	3/4/2009	YES	CITY	1
TALLGRASS AVE./69TH ST.	n/a	YES	CITY	1

Note: Sub-Study 2 includes an interchange options study for Exit 3: Minnesota Avenue. Sub-Study 3 includes a crossroad corridor study for Exit 6: 10th Street. Sub-Study 4 includes an interchange options study for Exit 9: Benson Road.

In addition, Automated Traffic Recorded (ATR) data was provided at SDDOT Station #605, which is located on 10th Street –between Chicago Ave. and St. Paul Avenue. Hourly ATR data at Station #605 will be reviewed to determine an annual average representation of existing traffic volume.

Existing Freeway Data

Automated Traffic Recorded (ATR) data was provided for SDDOT Station #610, which is located between Exit 2 (Western Avenue) and Exit 3 (Minnesota Avenue). The ATR included hourly directional mainline I-229 freeway volumes from Sept 2012 to February 2013. In addition, ATR at Station #610 was provided in 15-minute increments from March 6 to April 21, 2013.

SDDOT supplied hourly ramp volume data from year 2012. Study intersection turning movement counts will be used to determine existing AM and PM peak hour ramp volumes at the other I-90 interchanges within the study area and then smoothed/balanced along the corridor.

Additional Data Supplied by SDDOT and/or City of Sioux Falls

- Vehicle Classification Samples on I-229 Interstate
  - Supplied by SDDOT
- Crash History Geodatabase
  - Supplied by SDDOT
  - Includes crash records dated January 2008 to December 2012 (5 years)
- Roadway Design Standards
  - available online at:

http://www.sddot.com/business/design/forms/roaddesign/Default.aspx

- Construction Plans for I-229
  - Supplied by SDDOT
- GIS Base Mapping Data (parcels, parks, streets, rail, plats)
  - Supplied by City of Sioux Falls

- 2012 Aerial SID files
  - Supplied by City of Sioux Falls
- Traffic Impact Studies for Key Proposed Developments
  - Costco TIS supplied by City of Sioux Falls
- MPO Travel Demand Model Files in Cube Voyager (Existing and Future)
  - Supplied by City of Sioux Falls

Additional Data Collection Needed

Additional data collection is needed to complete project tasks. Additional data needs include items outlined below:

- Incident Management Plans
- ITS Architecture Plans, including Research Studies on Traffic Operations Centers
- Intersection Traffic Counts
  - Additional intersection counts to be collected in Spring 2013 as identified in previous section
- Trails Map - preferably in GIS format if available
- Sidewalk Inventory- preferably in GIS format if available
- Transit Map- preferable in GIS format if available
- Signal Timing Data (or City/Corridor/Study Area Synchro existing conditions Synchro file, if available)
- Interstate Segments Speeds/ Travel time runs
  - Travel time data will be gathered for each I-229 link between interchanges in the AM Peak, PM Peak, and Off-Peak times. Travel time runs will be conducted during the specified time periods using the average car technique with a sample size yielding 95% confidence level, as specified in the ITE Manual of Traffic Engineering Studies. Data will be reported as travel times and average speeds for each interstate segment.
  - (8 runs each for AM, PM, Off-Peak). Off-Pk Complete
- O-D Data
  - Origin-Destination data will be conducted using wireless phone

location data, provided by AirSage. Data will be obtained using Verizon Wireless data for any month after May 2012. This data can be used to accurately determine the location and movement of the cell phones on the network in real-time. This data will be used to populate a daily trip matrix among study area zones, then refined to AM and PM periods for use in the meso-scale model.

- AirSage data to be gathered for 1-month time period from February 12, 2013 to March 13, 2013.
- AirSage data for two specific days within 1-month period
  1. Feb 13, 2013 - traffic issues were experienced on I229 SB near 18th Street due to guardrail work)
  2. February 22, 2013- winter weather event
- AirSage will supply trip matrices that will include:
  - Average Weekday (based on data for Tues-Thursday)
  - Average Weekend Day
  - Two Specific Days
  - Summarized Days by parts: Morning (6-10 AM), Mid-day (10 AM-3 PM), Afternoon (3-7 PM), Evening (7 PM-12 AM), Night (12 AM-6 AM)
  - Summarized Days by trip purpose: Home-based Work, Home-based Other, Other-based Other

- Spot Speed Profile from 100 Vehicle Sample, 1 per I-229 segment.
  - This will be used to determine the free-flow speed of traffic on I-229 mainline.
- City-wide Synchro Files [1].
  - This model may be used for intersection-level data on corridors outside of the Sub-Study 1 study area that can be input into the Cube Avenue meso-scale model.

Data Collection Techniques

All data was collected and will be collected using standard field practices which consist of using cameras, digital count boards or tube counters.

7. Traffic Operations Analysis

Traffic Operations Analysis (Existing and Future No-Build)

1. Software
   a. Signalized Intersections

[1] City-wide Synchro files will be utilized for informational purposes when editing the Cube Avenue meso-scale model. Synchro files will not be used for analyzing traffic conditions.

i. Highway Capacity Software (HCS) Release 6.5 (currently in beta) (2010 HCM Methodology) Streets Module
   1. Ramp terminal intersections meeting the interchange types defined in HCM Chapter 22 (Interchange Ramp Terminals) will be analyzed with the Interchanges section of the Streets Module

b. Basic Freeway, Ramp Junctions and Weave Areas
   i. HCS Release 6.5 (currently in beta) (2010 HCM Methodology)

2. Operational Analysis Results
   a. Level of Service (LOS)
      i. Signalized Ramp Terminal Intersections
         1. Overall intersection LOS will be reported for Existing and Future No-Build conditions
      ii. Arterial Intersections
         1. Overall intersection LOS will be reported for Existing and Future No-Build conditions
      iii. Basic Freeway, Ramp Junctions and Weave Areas
         1. LOS will be reported for Existing and Future No-Build conditions

3. Variables
   a. Peak Hour Factor (PHF)
      i. Existing (year 2012) conditions analysis will use calculated PHFs from existing counts with a maximum value of 0.90.
      ii. Design year (year 2035) conditions analysis will use existing PHFs rounded up to the nearest 0.05 with a maximum value of 0.90
         1. The increase in the PHF is to account for traffic growth that is likely to be spread throughout the peak periods
   b. Saturation Flow Rate
      i. SDDOT Design Manual (Page 24, Chapter 15) requires the use of 1,800 vph in Sioux Falls. This value will be used for the signalized intersections and freeway locations within the study area.
   c. Traffic Signal Controllers
      i. Operational analysis will allow for both actuated and coordinated controllers
   d. Left-Turn Phasing
      i. Protected, Permitted / Protected or Split Phasing will be allowed at intersections
   e. Heaviest Lane Volume (Lane Utilization)
      i. Default HCS Streets Values used for ramp terminal/ arterial intersections
   f. Heavy Vehicle Percentage
      i. Study Intersections
         1. Use existing turning movement counts that included truck counts to determine arterial truck percentages.
      ii. Ramp Junctions and Weave Areas
         1. Use existing freeway counts that included truck counts to determine freeway truck percentages.
   g. Phase Change Intervals

i. Existing (Year 2012) Conditions
    1. Existing signal timings will be used for phase change intervals during existing conditions
ii. Future No-Build (Year 2035) Conditions
    1. Existing signal timings will be used for phase change intervals of phases that exist at intersections that have no geometric change from existing conditions
    2. Phase change intervals will be calculated for the following locations:
        a. New phases added at an intersection where geometry is unchanged from existing conditions
        b. All phases at an intersection where geometry is changed from existing conditions

    The calculated values will be based on methodologies presented in the *Institution of Transportation Engineers (ITE) Traffic Engineering Handbook*. The methodologies presented in the handbook use vehicle length and speed and the distance needed to track through the intersection to calculate phase change intervals.

h. Speeds
    i. Arterials – Use posted speeds
    ii. Freeway – Use 85th percentile of collected spot speed data
i. Right Turn on Red Volume
    i. Existing (Year 2012) Conditions
        1. The number of vehicles turning right on red will be assumed to be zero for all locations initially based on the guidance in the 2010 Highway Capacity Manual.
        2. Intersections reporting LOS E or worse potentially related to right turn on red volume will be identified and presented to the SAT to decide if a right turn on red count is necessary.
        3. If a right turn on red count is deemed necessary, video recordings of existing peak hour traffic at the locations of interest will be used to count the number of vehicles turning right on red and incorporated into the HCS analysis at these locations.
    ii. Future No-Build (Year 2035) Conditions
        1. The number of vehicles turning right on red will be assumed to be zero for all locations that were not counted for right turn on red movements.
        2. For locations that were counted for right turn on red movements, the percentage of right turn on red volume of the total volume for the right turn movement in the existing condition will be multiplied by the future forecast right turn movement for each approach and incorporated into the HCS analysis at these locations.

3. Intersections reporting LOS E or worse potentially related to right turn on red volume will be identified and presented to the SAT to decide if a right turn on red count is necessary.
4. If a right turn on red count is deemed necessary, video recordings of existing peak hour traffic at the locations of interest will be used to count the number of vehicles turning right on red.
5. Step 2 will be repeated for all locations where a right turn on red count was added by the SAT based on a projected future operating condition of LOS E or worse.

8. Travel Forecast

a. Existing (Year 2012) Conditions
   i. Existing counts will be utilized for existing conditions, based on the intersection, interstate mainline, and ramp data described in the Data Collection portion of this document.
   ii. 2-hour AM and PM peak period volumes will be smoothed/balanced between study intersections and free-flow locations to eliminate any additions or subtractions (sources/sinks) in traffic volumes between study intersections and freeway ramps.
   iii. The 2-hour peak period volumes will be divided into 15-minute time intervals based on flow profiles taken from the mainline ATR, and ramps at the Minnesota, 10th St, and Benson interchanges.
   iv. The peak hour volumes will be determined as the maximum four 15-minute volume intervals based on the average of the flow profiles. For the AM peak hour this equates to intervals 2, 3, 4, and 5 (7:15-8:15am), or 62.9% of the 2-hour period, and for the PM peak hour this equates to intervals 3, 4, 5 and 6 (4:30-5:30pm), or 54.4% of the 2-hour period.

b. Future (Year 2035) No Build Conditions
   i. The Sioux Falls MPO Travel Demand Model (Macro/Static Model) will be utilized for the basis of future year no-build volume development
   ii. The travel demand model was created by the Sioux Falls MPO using Cube Voyager
   iii. The model base year is 2008
   iv. The model was last updated in 2009, next update will be in 2014. Traffic volume projections in Sub-Studies 1, 2, 3, and 4 will not be revised based on the MPO's release of an updated base year Cube Voyager model, set to be released by the MPO in 2014.
   v. The Model future year is 2035 to match the current LRTP for year 2035
      1. The 2035 No-Build model includes:
         a. Fiscally constrained projects in the LRTP
         b. No Illustrative Projects
      2. Time intervals in the model include:
         a. Volumes in the travel demand model reflect average weekday conditions
         b. AM and PM 2-hr peak period volumes
         c. AM Peak hour volumes, calculated globally as 58% of the AM

Peak Period

d. PM Peak hour volumes, calculated globally as 55% of the PM Peak Period

vi. Sub-Area Refinement

1. The Cube Voyager models (both existing base year and future 2035) will be reviewed and modified as needed for validation at a project-corridor level within the study area. Refinements to the model may include network and socio-economic data refinement, a review of trip generation rates, trip length frequency distribution and statistical assignment checks.
2. The No-Build 2035 conditions shall assume the implementation of all fiscally constrained planned projects from the LRTP not on the I-229 corridor. Improvements at the I-229 Exit 5 (26^{th} Street) will be included, based on results from the I-229 Exit 5 (26^{th} Street) Crossroad Corridor Study.
3. The model may be adjusted based on the O-D data gathered from AirSage

vii. Post-Processing Techniques

1. Raw travel demand model outputs will be adjusted using a post-processing technique based on NCHRP 255 that addresses the use of direct raw outputs from a travel model by accounting for the variance in forecasts from the base year model compared to actual count data.
2. Macro model AM and PM peak period (2-hr) volume outputs will be post-processed based on the existing conditions peak period (2-hr) volumes.
3. Peak hour volumes will be calculated based on the AM and PM peak hour/period (1 hour to 2 hour) proportion determined in the existing conditions analysis.
4. The full set of 2035 No-Build forecasts will be developed by smoothing and balancing volumes between study intersections and free-flow locations to eliminate any additions or subtractions (sources/sinks) in traffic volumes between study intersections and freeway ramps.

c. Future (Year 2035) Concept Level Screening

A Meso-Scale Dynamic Traffic Assignment (DTA) model in Cube Avenue format will be utilized to provide a high level screening comparison for future year build scenarios and report measures of effectiveness at an aggregate level. In order to use this future DTA model, an existing base year model, as well as a future year 2035 model, will be constructed.

1. Existing (Year 2012) Conditions DTA Model
   a. The DTA model will include the I-229 corridor study area, all service interchange ramps, and selected major regional facilities outside of the I-229 corridor that may carry diverted traffic during incidents (including I-29 and I-90). Corridors outside of the Sub-Study 1 study area that will be included in the DTA model will be defined based on proximity to the study area, functional classification, and availability of intersection-level data (such as counts, signal timings, and intersection geometrics).
   b. The I-229 MIS DTA model utilizes data at multiple spatial and

temporal scales to represent traffic flow and traffic operations in the I-229 corridor study area. The I-229 MIS DTA model processes sequentially through three resolutions: the macro-scale, regional meso-scale, and sub-area meso-scale. Each resolution provides an opportunity to analyze a different aspect of changes to the Sioux Falls network. The I-229 MIS model starts by analyzing 2-hour AM and PM peak periods for the entire region at the macro-scale, and then refines the traffic demand on the network to hourly demand for use in the regional meso-scale simulation. In the sub-area meso-scale simulation, the model network is reduced in size to just the I-229 area of influence and the hourly demand volumes are refined to fifteen minute intervals. This refinement uses an origin-destination matrix estimation (ODME) procedure to leverage counts when developing the fifteen minute levels of demand. The ODME also utilizes AirSage cell phone origin-destination trip tables as seed matrices. Input from the macro-model is not part of the process in developing base year traffic demand.

c. The output volumes for the AM and PM peak hours will be compared to actual traffic counts to calculate goodness of fit for calibration purposes.
d. The volume outputs from the Existing Conditions DTA model will not be used directly for this study.
e. Alternative modes of transportation included in the Cube Avenue Model
    i. Bus
        a. Includes buses in the peak hours on Sioux Area Metro (SAM) routes 2, 4, 5, 7, & 9
        b. Buses will be pre-loaded into the model based on bus stop location and scheduling data
    i. Pedestrian/Bicycle modes will not be modeled in the meso-scale model as determined with the Study Advisory Team at the Kick-off meeting
    ii. Rail crossings in the study area will not be included in the meso-scale model due to the infrequent usage during the peak periods (4 trains per day on Rice Street; 3 trains per day on 26th Street).
f. FHWA Resources Center staff will have the opportunity for review and comment on the base year DTA model calibration and application to the study.

2. Future (Year 2035) DTA Model
    a. A future 2035 conditions DTA model will be constructed by adjusting the base year O-D matrix to future year based on growth factors from the Cube Voyager models 2008 and 2035.
    b. Alternative modes of transportation (transit) will be modeled for future year the same as existing conditions
    c. The No-Build 2035 conditions shall assume the implementation of

all fiscally constrained planned projects from the LRTP not on the I-229 corridor. Improvements at the I-229 Exit 5 (26th Street) will be included, based on results from the I-229 Exit 5 (26th Street) Crossroad Corridor Study.

d. Speeds, delay and queuing results directly out of the meso-scale model should be treated with a lower level of scrutiny compared to HCM 2010 analysis. All metrics from the DTA Model should be treated comparatively between scenarios rather than in an absolute manner. Model results should be utilized at an aggregate level for interchange evaluation.

e. Following the establishment of a 2035 No-Build DTA model, alternatives for the I-229 MIS study area will be tested with the I-229 MIS DTA multi-resolution model. A full set of AM and PM peak hour volumes will not be provided for each screening alternative– rather, these alternatives will be compared to each other using Measures of Effectiveness (MOE's) that summarize the modeling results and allow for comparison in a relative manner. These MOE's may include:
   i. Interchange area AM and PM Peak Period total queue length
      - Interchange area to include ramps and roadway segments adjacent to ramp terminal intersections
   ii. Off-ramp queue to length ratio (15-min traffic queue)
      - Reported relative to the base year model
   iii. AM and PM Peak Period Travel Time between key origin-destination pairs
      - Select up to 5 pairs for comparison
   iv. Interchange area AM and PM Peak Period delay
   v. Sub-Area level AM and PM Peak Period Overall System Delay

9. Safety Issues

Crash data will be reviewed for the study area based on the Crash Geodatabase which includes crashes between January 2008 and December 2012. SDDOT's database will be the only database used in the calculation of crash rates and critical crash rates. The following information will be provided as a result of the crash analysis:

- Segment and Intersection Crash Rates
- Segment and Intersection Critical Crash Rates (per Highway Safety Manual)
- Crash Trends
- Potential Mitigation Measures to Improve Locations Above Critical Crash Rates

10. Selection of Measures of Effectiveness (MOE)

The main goals of this study are as follows:

1. Complete a traffic level of service analysis for both existing and future (2035) conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges, and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions. The recommended projects will be prioritized by primary and secondary groups of improvements.
6. Conduct interchange options feasibility study on select interchanges. *Will be addressed in subsequent sub-studies.*
7. Create final products for use by the SDDOT which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

To satisfy the study objective, the following MOEs will be used to evaluate and compare the concepts based on the Cube Avenue modeling:

i. Interchange area AM and PM Peak Period total queue length
ii. Off-ramp queue to length ratio (15-min traffic queue)
iii. AM and PM Peak Period Travel Time between key origin-destination pairs
iv. Interchange area AM and PM Peak Period delay
v. Sub-Area level AM and PM Peak Period Overall System Delay

These statements are made assuming that the geometric improvements identified meet all AASHTO, SDDOT, and City of Sioux Falls guidelines.

An evaluation on the MOE significance thresholds will be conducted when future scenario results are available and used to establish prioritization.

11. FHWA Interstate Access Modification Policy Points

An Interchange Modification Justification Report (IMJR) will not be developed for interchanges as part of this project. The level of detail for addressing each of the eight (8) FHWA policy points regarding modifications to Interstate access will be determined outside of this study.

12. Deviations/Justifications

No deviations from standards are currently known. If it is determined during the study that deviations are required, the methods and assumptions document will be amended prior to proceeding.

13. Conclusion

All sections contained in this document will guide the traffic data collection and traffic assessment for this study.

14. Appendices

The appendix includes the Methods and Assumptions Study Team Meeting Minutes from April 30, 2013.

APPENDIX

HDR | ONE COMPANY *Many Solutions℠*

Meeting Notes

Subject:	Methods and Assumptions Meeting		
Client:	South Dakota Department of Transportation		
Project:	I-229 Major Investment Corridor Study	Project No:	PL 0100(87) 3616 P, PCN 044K Contract 410545, WO PD-02-13 HDR Project No. 207030 Dept 00135
Meeting Date:	April 30, 2013, 1:00-3:00PM	Meeting Location:	Online Meeting; SDDOT Pierre Headquarters; SDDOT Sioux Falls Area Office; HDR Omaha
Notes by:	David Meier, Courtney Sokol		

The Methods and Assumptions Meeting for the I-229 Major Investment Corridor Study was held on April 30, 2013. The purpose of the meeting was to review the Draft Methods and Assumptions document, dated April 17, 2013 that was supplied to the SAT prior to this meeting. Notes from the meeting are summarized below and discussion details follow. A list of participants is contained at the end of meeting notes.

Action Items

Item	Responsible
Revise Draft Methods and Assumptions Document	HDR

Comments Noted During Review of the Draft Methods and Assumptions Document:

1. **Methods and Assumptions Cover Page**
   - *Page 1:* Remove HRGreen and Highway Patrol from list of attendees
   - *Page 1:* Add Sioux Falls MPO to list of attendees
2. **Stakeholder Acceptance Page**
   - No comments noted.
3. **Introduction and Project Description**
   - *Section: Need for the Study (page 5)*- add a bullet for including incident management planning for I-229 Corridor
   - *Section: Facilities Affected by the Study (page 5)*- typo for the word "services"
   - *Section: Previous Studies (page 6)*- add a bullet for ITS studies from the City of Sioux Falls and SDDOT, Incident Management Plan
     - Note- Cleveland Avenue Study can be supplied by the City or HRGreen
4. **Study Area**
   - *Page 8 (Sub-Study 1 Study Area Figure)*- add study area dots for 57th/Oxbow and for Benson/Lewis, Change Dot Map AND Table List
5. **Analysis Years/Periods**
   - Discussion regarding whether to address intermediate year improvements in Sub-Study 1. These will be addressed in Sub-Studies 2, 3 and 4. No direction to change document.

6. **Data Collection**
    - Noted that the City of Sioux Falls has all background documents assembled and will send to HDR this week.
    - *Section: Existing Freeway Data (page 14)*- modify date range for 15-minute increment data to end date of April 21, 2013.
    - *Section: Additional Data Supplied by SDDOT and/or City of Sioux Falls (page 14)*- revise date range for crash records to include 5 year period from January 2008 to December 2012.
    - Noted that rationale on proposed O-D data collection dates was to avoid construction time periods.
    - Discussion for City to provide existing Transit Map (not future). No direction to change document.

7. **Traffic Operations Analysis**
    - *Section: Variables (page 17)*- typo/ remove the word "of" in first line of the Saturation Flow Rate text
    - *Section: Variables (page 17)*- Heaviest Lane Volume- note the default values are for ramp terminal/ arterial intersections.

8. **Travel Forecast**
    - *Section: Cube Voyager Travel Demand Model (page 18)*- add comment noting that the current model (2008) will be used for this study- and will not use the next model update in 2014. The study traffic volume projections will not be updated based on a new model version.
    - Discussion that the LRTP contains some "earmark" projects. No direction to change the document.
    - Noted that any revisions to improvements assumed in the future year 2035 Voyager model will need to be communicated to the study team within the next 2 weeks.
    - Discussion regarding the AirSage O-D data in relation to the Cube Voyager/macro-scale modeling. Much of the macro-scale modeling can be done without the AirSage data yet supplied. Once the AirSage data is available, it will be used to validate the macroscopic model at the daily level and can be used to adjust the Voyager model if needed. The time-of-day/peak period O-D data from AirSage will be used in the meso-scale Cube Avenue model.
    - Discussion regarding two proposed Wal-Mart's near 85th/Minnesota (south of study area). Noted that these developments will not impact the I-229 corridor enough to include in this study.
    - Discussion regarding corridors that will be included in the Meso-scale model, this will involve some preliminary testing and review of the City's Synchro model. SAT will be able to review and approve the proposed list of corridors once HDR begins this process.

9. **Safety Issues**
    - *Page 20*- adjust the Crash Geodatabase dates from January 2008 to December 2012.
    - Discussion regarding the definition of Critical Crash Rate. Note its definition based on the Highway Safety Manual.

10. **Selection of Measures of Effectiveness**
    - *Page 20*- Bullet 5 in describes the plan of recommended projects. Clarify the projects will be prioritized by primary and secondary groups of improvements.
    - *Page 21*- note that an evaluation of significance thresholds for future scenarios will be conducted when results are available and used to establish prioritization.

11. FHWA Interstate Access Modification Policy Points

- Noted no intent for any IJR from any of the Sub-Studies. No direction to change document.

Notes Regarding Next Steps:

- HDR will revise document and leave "Draft" notation on the cover
- Document will be provided in Microsoft Word with "Track Changes" turned on for Steve Gramm's review and acceptance prior to sending out to the SAT for review
- FHWA will share draft document with Resource Center and will not sign until complete

Attendees:

SDDOT- Central Office, Pierre		
Mark Hoines - FHWA	Steve Gramm – SDDOT	Nichole Frankl - SDDOT
Ron McMahon - FHWA	Kevin Goeden - SDDOT	Mike Behm- SDDOT
Bruce Hunt- FHWA	Joel Gengler - SDDOT	Jeff Brosz – SDDOT
	Brad Remmich - SDDOT	Don Martell- SDDOT
SDDOT- Sioux Falls		
Shannon Ausen – Sioux	Amber Gibson - SECOG	Rick Laughlin - HDR
Heath Hoftiezer – Sioux	Bruce Hunt- FHWA	Christina Bennett- SDDOT
HDR - Omaha		
Courtney Sokol - HDR	David Meier - HDR	Brian Ray - HDR
Mike Forsberg- HDR		

Original M & A

Methods & Assumptions Meeting Documentation

1. Methods and Assumptions Cover Page

I-229 Major Investment Corridor Study: Sub-Study #1

To:	Study Advisory Team (SDDOT, FHWA, City of Sioux Falls)		
From:	Brian Ray, HDR Courtney Sokol, HDR	Project:	I-229 Major Investment Corridor Study
CC:	File		
Date:	June 7, 2013	Job No:	207030

Methods and Assumptions Document

This Methods and Assumptions document was developed as a summation of the Methods and Assumptions Meeting held on April 30, 2013 with representatives from the South Dakota Department of Transportation (SDDOT), Federal Highway Administration (FHWA), City of Sioux Falls, Sioux Falls MPO, and HDR. This document is intended to serve as a historical record of the process, dates, and decisions made by the study team representatives for the ***I-229 Major Investment Corridor Study: Sub-Study #1***.

Original M & A

2. Stakeholder Acceptance Page

The undersigned parties concur with the Methods and Assumptions for the ***I-229 Major Investment Corridor Study: Sub-Study #1*** as presented in this document.

SDDOT:	FHWA:
Signature	Signature
Data Analysis Engineer	Planning/Civil Rights Specialist
Title	Title
6-10-2013	6/13/13
Date	Date

Notes:

(1) Participation on the Study Advisory Team and/or signing of this document does not constitute approval of the ***I-229 Major Investment Corridor Study: Sub-Study #1*** Final Report or conclusions.

(2) All members of the Study Advisory Team will accept this document as a guide and reference as the study progresses through the various stages of development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the signatories.

3. Introduction and Project Description

Project Background and Understanding

Sub-Study 1 will analyze existing and future conditions along the entire I-229 corridor, service interchanges, and crossroads, assess the impact on the transportation system, determine feasible solutions to those impacts, and prioritize a list of recommendations that will maximize the efficiency of the corridor. The study will fulfill the following objectives:

1. Complete a traffic level of service analysis for both existing and future (2035) no-build conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions.
6. Create final products for use by the SDDOT which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

Location

The I-229 corridor is located east of I-29 in the Sioux Falls metropolitan area. The mainline interstate study limits include a 10.5 mile section from the Solberg Avenue overpass (currently under construction) to the 60th Street North overpass. Eight service interchanges are located on I-229 within the study area, including:

- Exit 1: Louise Avenue
- Exit 2: Western Avenue
- Exit 3: Minnesota Avenue
- Exit 4: Cliff Avenue
- Exit 5: 26th Street
- Exit 6: 10th Street
- Exit 7: Rice Street
- Exit 9: Benson Road

A subset of the arterial street network that connects to the I-229 corridor is included in the study area as well, including the following crossroad corridors:

- Solberg Avenue from 69th Street to 57th Street
- Louise Avenue from 69th Street to 57th Street
- 57th Street from Louise Avenue to Western Avenue

- Western Avenue from 57th Street to 49th Street
- Minnesota Avenue from 57th Street to 41st Street
- Cliff Avenue from 49th Street to 33rd Street
- 26th Street from Cliff Avenue to Southeastern Drive
- 33rd Street from Cliff Avenue to Yeager Road
- Yeager Road from 33rd Street to 26th Street
- Southeastern Avenue from 18th Street to 26th Street
- 18th Street from Southeastern Drive to Cleveland Avenue
- 12th Street from Lowell Avenue to Cleveland Avenue
- 10th Street from Jessica Avenue to Bahnson Avenue
- 6th Street from Lowell Avenue to Cleveland Avenue
- Rice Street from Wayland Avenue to Bahnson Avenue
- Benson Road from Cliff Avenue to Sycamore Avenue
- 60th Street North from Lewis Avenue to Bahnson Avenue (Proposed)

An illustration of the Sub-Study 1 study area is shown in Section 4 (Study Area) of this report.

Need for Study

The study team has determined the following needs for this specific study (for future Year 2035 AM, PM, and Off-Peak periods representing average weekday traffic conditions):

- Mainline Level of Service (LOS) of C or better throughout the I-229 corridor
- Ramp merge/diverge LOS of C or better for all interchange ramps through the I-229 corridor
- Ramp terminal intersection LOS of D or better for all interchanges throughout the I-229 corridor
- Identification of areas not in compliance with current Interstate design standards.
- Incident management planning is also needed to identify methods for handling mainline traffic during incidents, weather, and special events.

Study Schedule

Date	Task/Event
March 2013	Notice to Proceed, Kickoff Meeting
April 2013	Methods & Assumptions Documentation
April 2013-August 2013	Baseline Conditions Analysis/ Data Collection
August 2013-October 2013	Existing Traffic and Operations Analysis Incident, Weather, and Special Event Analysis Future Needs Analysis (No Build) Safety Analysis ITS Assessment **Public Meeting #1** (Project Kickoff/ Existing Analysis Stage) **(October)**
October 2013-March 2014 [1]	Noise Analysis Identification of Solutions **Public Meeting #2** (Scenario Building Stage) **(Jan/Feb 2014)** **MPO Meeting (Scenario Building Presentation)** Analysis of Solutions Project Recommendations
April 2014-September 2014 [1]	Sub-Study 1 Report Documentation **Public Meeting #3 (Draft Report Stage)** **MPO Meeting (Final Recommendations Presentation)**

[1] *Dates may be subject to future review to adjust for data collection delay to date.*

Facilities Affected by the Study

Given the regional context of the I-229 corridor, modifications to I-229 mainline, service interchanges or crossroad corridors may impact transportation facilities throughout the metropolitan area. Modifications at service interchanges would have the potential to affect adjacent interstate ramp terminal intersections and/or arterial street corridors. The large study area defined in Sub-Study 1 is intended to provide a comprehensive assessment of interstate, ramp, and arterial streets such that facilities affected by the study recommendations are included in the analysis.

Previous Studies

The following previous studies will be reviewed during the course of this study:

- Direction 2035, Sioux Falls MPO Long-Range Transportation Plan (LRTP)
  - http://www.siouxfalls.org/~/media/Documents/planning/long-range/lrtp/2035_lrtp/adopted_lrtp_rev120210.pdf
- Sioux Falls Comprehensive Development Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/shape_sf/chapters-maps/Chapter_1_r112111.pdf
- Sioux Falls Transit Development Plan 2011- 2015
  - http://www.siouxfalls.org/~/media/Documents/planning/long-range/2011_2015_Transit_Development_Plan.pdf
- 2007 Sioux Falls Bicycle Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/transportation/bicycle/Bicycle_Plan_Final.pdf
- The Sioux Falls MPO Multi-Use Trail Study
  - http://www.siouxfallsmpo.org/documents/MPO/Planning_Documents/SiouxFallsMUTCS.pdf
- 60th Street North Planning and Feasibility Study
  - http://www.siouxfalls.org/~/media/Documents/publicworks/engineering/projects/60th-st-feasibility-report-may-12/60th-St-North-Study-Fina-Report-May-2012.pdf
- Sioux Falls Major Street and Access Management Plan
  - http://www.siouxfalls.org/~/media/Documents/planning/transportation/long-range/majorstreetplanmediumfinal%20pdf.pdf
- I-229 Exit 5 (26th Street) Crossroad Corridor Study
  - http://26thstreetcorridorstudy.com/

- Interstate 90/ Interstate 229 Access Modification Request (Draft)
- Northeast Transportation Network Feasibility Study
- 2010 Decennial Interstate Corridor Study and 2000 Decennial Interstate Study
- N. Bahnson Avenue Feasibility Study
- Cleveland Avenue Study
- SIMPCO Incident Management Plan
- ITS Studies from City of Sioux Falls and SDDOT

Study Advisory Team Members

A Study Advisory Team has been formed to guide the study through completion. The Study Advisory Team is comprised of representative parties of the SDDOT, FHWA and City of Sioux Falls. Members of the Study Advisory Team are:

Shannon Ausen	City of Sioux Falls – Public Works
Mike Behm	SDDOT – Project Development
Christina Bennett	SDDOT – Road Design
Jeff Brosz	SDDOT – Transportation Inventory Management
Joel Gengler	SDDOT – Right of Way
Amber Gibson	Sioux Falls MPO
Kevin Goeden	SDDOT – Bridge Design
Steve Gramm	SDDOT – Project Development (Planning)
Heath Hoftiezer	City of Sioux Falls – Public Works
Mark Hoines	FHWA
Dave Huft	SDDOT - Research
Bruce Hunt	FHWA
Scott Jansen	SDDOT – Mitchell Region
Captain Kevin Joffer	South Dakota Highway Patrol
Rick Kiley	Sioux Falls MPO – Citizens Advisory Committee
Tom Lehmkuhl	SDDOT – Project Development (Environmental)
Pete Longman	SDDOT – Road Design
Ron McMahon	FHWA
Brad Remmich	SDDOT – Project Development (Planning)
Craig Smith	SDDOT- Mitchell Region
Vacant	SDDOT – Project Development (Safety)

Additional team members may be added as the study progresses.

4. Study Area

The study area for Sub-Study 1 was defined by the Study Advisory Team and is illustrated in this report for documentation. The study area contains I-229 freeway segments and junctions from east of the I-29/I-229 systems interchange to south of the I-90/I-229 systems interchange. The study area also contains ramp terminal intersections at each interchange along I-229 and intersections adjacent to those ramp terminal intersections. The following graphic shows the study area and identifies each of the study intersections.

Sub-Study 1 Study Area

Study Intersections:

- Solberg Avenue Intersections
  - Solberg Avenue & 57th Street
  - Solberg Avenue & 69th Street
- Louise Avenue (Exit 1C) Intersections
  - Louise Avenue & 57th Street
  - Louise Avenue & 59th Street
  - Louise Avenue & I-229 Southbound Ramps
  - Louise Avenue & I-229 Northbound Ramps
  - Louise Avenue & 69th Street
- Western Avenue (Exit 2) Intersections
  - Western Avenue & 49th Street
  - Western Avenue & I-229 Southbound Ramps
  - Western Avenue & I-229 Northbound Ramps
  - Western Avenue & 57th Street
- Minnesota Avenue (Exit 3) Intersections
  - Minnesota Avenue & 41st Street
  - Minnesota Avenue & 49th Street
  - Minnesota Avenue & I-229 Southbound Ramps
  - Minnesota Avenue & I-229 Northbound Ramps
  - Minnesota Avenue & 57th Street
- Cliff Avenue (Exit 4) Intersections
  - Cliff Avenue & 33rd Street
  - Cliff Avenue & I-229 Southbound Ramps
  - Cliff Avenue & I-229 Northbound Ramps
  - Cliff Avenue & 49th Street
- 26th Street (Exit 5) Intersections
  - 26th Street & Cliff Avenue
  - 26th Street & Van Eps Avenue
  - 26th Street & Yeager Road
  - Yeager Road & I-229 Southbound Ramps
  - 26th Street & I-229 Northbound Ramps
  - 26th Street & Southeastern Avenue
- 18th Street Intersections
  - 18th Street & Southeastern Avenue
  - 18th Street & Cleveland Avenue
- 12th Street Intersections
  - 12th Street & Lowell Avenue
  - 12th Street & Cleveland Avenue
- 10th Street (Exit 6) Intersections
  - 10th Street & Lowell Avenue
  - 10th Street & I-229 Southbound/Northbound Ramps (Single-Point)

- 10th Street & Cleveland Avenue
- 6th Street Intersections
    - 6th Street & Lowell Avenue
    - 6th Street & Cleveland Avenue
- Rice Street (Exit 7) Intersections
    - Rice Street & Wayland Avenue
    - Rice Street & I-229 Southbound Ramps
    - Rice Street & I-229 Northbound Ramps
    - Rice Street& Bahnson Avenue
- Benson Road (Exit 9) Intersections
    - Benson Road & Cliff Avenue
    - Benson Road & I-229 Southbound Ramps
    - Benson Road & I-229 Northbound Ramps
    - Benson Road & Hall Avenue
    - Benson Road & Lewis Avenue
- 60th Street North Intersections
    - 60th Street North & Lewis Avenue
    - 60th Street North & Bahnson Avenue (Proposed)

Study Basic Freeway Areas (*See also Note 1 below for designated analysis areas as potential Freeway Weave Areas for segments including auxiliary lanes*):

- I-229 Northbound
    - Segment between I-29 Northbound (Exit 1B) and Louise Avenue (Exit 1C) [1]
    - Segment between Louise Avenue (Exit 1C) and Western Avenue (Exit 2) [1]
    - Segment between Western Avenue (Exit 2) and Minnesota Avenue (Exit 3) [1]
    - Segment between Minnesota Avenue (Exit 3) and Cliff Avenue (Exit 4) [1]
    - Segment between Cliff Avenue (Exit 4) and 26th Street (Exit 5) [1]
    - Segment between 26th Street (Exit 5) and 10th Street (Exit 6)
    - Segment between 10th Street (Exit 6) and Rice Street (Exit 7) [1]
    - Segment between Rice Street (Exit 7) and Benson Road (Exit 9) [1]
    - Segment between Benson Road (Exit 9) and I-90 Eastbound (Exit 10A)
- I-229 Southbound
    - Segment between I-90 Eastbound (Exit 10A) and Benson Road (Exit 9)
    - Segment between Benson Road (Exit 9) and Rice Street (Exit 7) [1]
    - Segment between Rice Street (Exit 7) and 10th Street (Exit 6) [1]
    - Segment between 10th Street (Exit 6) and 26th Street (Exit 5)
    - Segment between 26th Street (Exit 5) and Cliff Avenue (Exit 4) [1]

- Segment between Cliff Avenue (Exit 4) and Minnesota Avenue (Exit 3) [1]
- Segment between Minnesota Avenue (Exit 3) and Western Avenue (Exit 2) [1]
- Segment between Western Avenue (Exit 2) and Louise Avenue (Exit 1C) [1]
- Segment between Louise Avenue (Exit 1C) and I-29 Northbound (Exit 1B)

[1] *Segment will be evaluated using Highway Capacity Manual (HCM) 2010 procedures to determine if the segment meets the criteria for a weave segment. If the segment meets the weave segment criteria the segment will be analyzed as a Freeway Weave Area and not a Basic Freeway Area.*

Study Ramp Junctions (*See also Note 2 below for designated analysis areas as potential Freeway Weave Areas*):

- I-229 Northbound
  - Diverge to Louise Avenue (Exit 1C) [2]
  - Merge from Louise Avenue Northbound (Exit 1C)
  - Merge from 26th Street (Exit 5)
  - Diverge to 10th Street (Exit 6)
  - Merge from Benson Road (Exit 9)
- I-229 Southbound
  - Diverge to Benson Road (Exit 9)
  - Merge from 10th Street (Exit 6)
  - Diverge to 26th Street (Exit 5)
  - Merge from Louise Avenue (Exit 1C)

[2] *Basic freeway segment upstream will be evaluated using HCM 2010 procedures to determine if the upstream segment meets the criteria for a weave segment. If the upstream segment meets the weave segment criteria the segment will be analyzed as a Freeway Weave Area and the Diverge Ramp Junction analysis would not apply.*

5. Analysis Years/Periods

This study will evaluate traffic during and for the following time periods:

Existing Conditions – Existing conditions analyses will be conducted for year 2012 volume conditions. Turning movement counts were collected at several study area intersections in 2012. Intersections that do not already have recent count data from 2012 will be counted by the City of Sioux Falls or HDR as part of this study as described in Section 6. For existing conditions the following time periods will be evaluated:

- Existing Conditions (Year 2012) – AM Peak Period (7:00 to 9:00 AM)
- Existing Conditions (Year 2012) – PM Peak Period (4:00 to 6:00 PM)

Future/ Design Conditions – Future/ Design conditions analyses will be conducted for year 2035 conditions. This horizon year matches the planning horizon of the current Sioux Falls LRTP. The Travel Demand Model was calibrated and updated in year 2009 for a base year 2008 and planning horizon of year 2035. Projected traffic volumes from the Sioux Falls MPO Travel Demand Model will be utilized to establish year 2035 volumes. For the design conditions the following time periods will be evaluated:

- Future/Design Conditions (Year 2035) – AM Peak Period (7:00 to 9:00 AM)
- Future/Design Conditions (Year 2035) – PM Peak Period (4:00 to 6:00 PM)

Interim Conditions – No interim conditions will be evaluated as part of this study.

6. Data Collection

Data Collection is one of the most important items during any transportation planning study. The data collection efforts are documented below:

Existing Arterial Intersection Turning Movement Count Data

Turning movement counts define actual traffic at the study intersections during the course of a typical weekday. The most recent turning movement counts provided by the City of Sioux Falls were conducted in year 2012 and were deemed suitable for use in this study. These counts include volume data in 15-minute intervals. Study area intersections with counts older than year 2012 will be collected in the spring of 2013 to capture conditions for an existing conditions average weekday. These intersections will be collected by either HDR or the City, as outlined in the table below. These turning movement counts will be collected during the AM and PM peak periods in 15-minute intervals.

For some of the intersections listed in this table, their operational analysis results will not be reported in Sub-Study 1, but instead in subsequent Sub Studies. In an effort to streamline data collection efforts in anticipation of these future sub studies, they are included in the data collection effort of Sub Study 1.

TURNING MOVEMENT COUNTS				SUB-STUDY FOR ANALYSIS
LOCATION	LATEST COUNT	NEW COUNT NEEDED?	COUNT RESPONSIBILITY	
60TH ST. N./LEWIS AVE.	4/18/2011	YES	HDR	1
60TH ST. N./BAHNSON AVE.	n/a, Intersection does not currently exist			1
BENSON RD./I-229 SB	5/8/2012	NO		1, 4
BENSON RD./I-229 NB	5/8/2012	NO		1, 4
BENSON RD./CLIFF AVE.	5/24/2011	YES	HDR	1, 4
BENSON RD./LEWIS AVE.	5/10/2012	NO		1, 4
BENSON RD./POTSDAM AVE.	5/9/2012	NO		4
BENSON RD./HALL AVE.	5/9/2012	NO		1, 4
BENSON RD./SYCAMORE AVE.	n/a, Intersection does not currently exist			4
RICE ST./I-229 SB	6/14/2012	NO		1
RICE ST./I-229 NB/CLEVELAND AVE.	6/18/2012	NO		1

RICE ST./WAYLAND AVE.	6/14/2012	NO		1
RICE ST./BAHNSON AVE.	n/a	YES	HDR	1
6TH ST./LOWELL AVE.	n/a	YES	HDR	1
6TH ST./CLEVELAND AVE.	6/26/2012	NO		1
10TH ST./I-229	1/9/2012	YES	CITY	1, 3
10TH ST./FRANKLIN AVE.	12/1/2011	YES	CITY	3
10TH ST./FAIRFAX AVE.	12/1/2011	YES	CITY	3
10TH ST./CLIFF AVE.	1/4/2012	YES	CITY	3
10TH ST./BLAUVELT AVE.	11/30/2011	YES	CITY	3
10TH ST./JESSICA AVE.	11/29/2011	YES	HDR	3
10TH ST./LOWELL AVE.	6/30/2011	YES	HDR	1, 3
10TH ST./CONKLIN AVE.	n/a	YES	CITY	3
10TH ST./BLAINE AVE.	n/a	YES	CITY	3
10TH ST./CLEVELAND AVE.	7/5/2011	YES	HDR	1, 3
10TH ST./CAMBELL'S & HY-VEE	7/6/2011	YES	CITY	3
10TH ST./BAHNSON AVE.	2008	YES	CITY	3
10TH ST./SYCAMORE AVE.	8/23/2011	YES	CITY	3
12TH ST./LOWELL AVE.	n/a	YES	HDR	1
12TH ST./CLEVELAND AVE.	8/15/2011	YES	CITY	1
18TH ST./SOUTHEASTERN AVE.	5/3/2012	NO		1
18TH ST./CLEVELAND AVE.	5/2/2012	NO		1
26TH ST./I-229 SB/YEAGER RD.	10/24/2012	NO		1
26TH ST./I-229 NB	4/30/2012	NO		1
26TH ST./CLIFF AVE.	4/26/2012	NO		1
26TH ST./VAN EPS AVE.	4/30/2012	NO		1
26TH ST./SOUTHEASTERN AVE.	9/5/2012	NO		1
CLIFF AVE./I-229 SB	5/3/2012	NO		1
CLIFF AVE./I-229 NB	10/11/2012	NO		1
CLIFF AVE./33RD ST.	8/20/2012	NO		1
CLIFF AVE./49TH ST.	5/7/2012	NO		1
MINNESOTA AVE./I-229 SB	10/16/2012	NO		1, 2
MINNESOTA AVE./I-229 NB	10/16/2012	NO		1, 2
MINNESOTA AVE./41ST ST.	8/30/2012	NO		1, 2
MINNESOTA AVE./43RD ST.	n/a	YES	CITY	2
MINNESOTA AVE./YANKTON TRL PARK	n/a	YES	CITY	2
MINNESOTA AVE./LOTTA ST.	n/a	YES	CITY	2
MINNESOTA AVE./BATCHELLER LN.	n/a	YES	CITY	2
MINNESOTA AVE./49TH ST.	5/24/2012	NO		1, 2
MINNESOTA AVE./57TH ST.	9/10/2012	NO		1, 2
WESTERN AVE./I-229 SB	12/6/2011	YES	CITY	1
WESTERN AVE./I-229 NB	12/6/2011	YES	CITY	1
WESTERN AVE./49TH ST.	12/7/2011	YES	CITY	1
WESTERN AVE./57TH ST.	12/8/2011	YES	CITY	1

LOUISE AVE./I-229 SB	5/3/2010	YES	CITY	1
LOUISE AVE./I-229 NB	5/3/2010	YES	CITY	1
LOUISE AVE./57TH ST.	1/4/2012	NO		1
LOUISE AVE./59TH ST.	5/3/2010	YES	CITY	1
LOUISE AVE./69TH ST.	5/6/2010	YES	CITY	1
SOLBERG AVE./57TH ST.	3/4/2009	YES	CITY	1
TALLGRASS AVE./69TH ST.	n/a	YES	CITY	1

Note: Sub-Study 2 includes an interchange options study for Exit 3: Minnesota Avenue. Sub-Study 3 includes a crossroad corridor study for Exit 6: 10th Street. Sub-Study 4 includes an interchange options study for Exit 9: Benson Road.

In addition, Automated Traffic Recorded (ATR) data was provided at SDDOT Station #605, which is located on 10th Street –between Chicago Ave. and St. Paul Avenue. Hourly ATR data at Station #605 will be reviewed to determine an annual average representation of existing traffic volume.

Existing Freeway Data

Automated Traffic Recorded (ATR) data was provided for SDDOT Station #610, which is located between Exit 2 (Western Avenue) and Exit 3 (Minnesota Avenue). The ATR included hourly directional mainline I-229 freeway volumes from Sept 2012 to February 2013. In addition, ATR at Station #610 was provided in 15-minute increments from March 6 to April 21, 2013.

SDDOT supplied hourly ramp volume data from year 2012. Study intersection turning movement counts will be used to determine existing AM and PM peak hour ramp volumes at the other I-90 interchanges within the study area and then smoothed/balanced along the corridor.

Additional Data Supplied by SDDOT and/or City of Sioux Falls

- Vehicle Classification Samples on I-229 Interstate
  - Supplied by SDDOT
- Crash History Geodatabase
  - Supplied by SDDOT
  - Includes crash records dated January 2008 to December 2012 (5 years)
- Roadway Design Standards
  - available online at: http://www.sddot.com/business/design/forms/roaddesign/Default.aspx
- Construction Plans for I-229
  - Supplied by SDDOT
- GIS Base Mapping Data (parcels, parks, streets, rail, plats)
  - Supplied by City of Sioux Falls

- 2012 Aerial SID files
  - Supplied by City of Sioux Falls
- Traffic Impact Studies for Key Proposed Developments
  - Costco TIS supplied by City of Sioux Falls
- MPO Travel Demand Model Files in Cube Voyager (Existing and Future)
  - Supplied by City of Sioux Falls

Additional Data Collection Needed

Additional data collection is needed to complete project tasks. Additional data needs include items outlined below:

- Incident Management Plans
- ITS Architecture Plans, including Research Studies on Traffic Operations Centers
- Intersection Traffic Counts
  - Additional intersection counts to be collected in Spring 2013 as identified in previous section
- Trails Map - preferably in GIS format if available
- Sidewalk Inventory- preferably in GIS format if available
- Transit Map- preferable in GIS format if available
- Signal Timing Data (or City/Corridor/Study Area Synchro existing conditions Synchro file, if available)
- Interstate Segments Speeds/ Travel time runs
  - Travel time data will be gathered for each I-229 link between interchanges in the AM Peak, PM Peak, and Off-Peak times. Travel time runs will be conducted during the specified time periods using the average car technique with a sample size yielding 95% confidence level, as specified in the ITE Manual of Traffic Engineering Studies. Data will be reported as travel times and average speeds for each interstate segment.
  - (8 runs each for AM, PM, Off-Peak). Off-Pk Complete
- O-D Data
  - Origin-Destination data will be conducted using wireless phone location data, provided by AirSage. Data will be obtained using Verizon Wireless data for any month after May 2012. This data can be used to accurately determine the location and movement of the cell phones on the network in real-time. This data will be used to populate a daily trip matrix among study area zones, then refined to AM and PM periods for use in the meso-scale model.
  - AirSage data to be gathered for 1-month time period from February 12, 2013 to March 13, 2013.
  - AirSage data for two specific days within 1-month period

1. Feb 13, 2013 - traffic issues were experienced on I229 SB near 18th Street due to guardrail work)
2. February 22, 2013- winter weather event

- AirSage will supply trip matrices that will include:
  - Average Weekday (based on data for Tues-Thursday)
  - Average Weekend Day
  - Two Specific Days
  - Summarized Days by parts: Morning (6-10 AM), Mid-day (10 AM-3 PM), Afternoon (3-7 PM), Evening (7 PM-12 AM), Night (12 AM-6 AM)
  - Summarized Days by trip purpose: Home-based Work, Home-based Other, Other-based Other

- Spot Speed Profile from 100 Vehicle Sample, 1 per I-229 segment.
  - This will be used to determine the free-flow speed of traffic on I-229 mainline.
- City-wide Synchro Files [1].
  - This model may be used for intersection-level data on corridors outside of the Sub-Study 1 study area that can be input into the Cube Avenue meso-scale model.

Data Collection Techniques

All data was collected and will be collected using standard field practices which consist of using cameras, digital count boards or tube counters.

7. Traffic Operations Analysis

Traffic Operations Analysis (Existing and Future No-Build)

1. Software
   a. Signalized Intersections
      i. Highway Capacity Software (HCS) Release 6.5 (currently in beta) (2010 HCM Methodology) Streets Module
         1. Ramp terminal intersections meeting the interchange types defined in HCM Chapter 22 (Interchange Ramp Terminals) will be analyzed with the Interchanges section of the Streets Module
   b. Basic Freeway, Ramp Junctions and Weave Areas
      i. HCS Release 6.5 (currently in beta) (2010 HCM Methodology)
2. Operational Analysis Results
   a. Level of Service (LOS)
      i. Signalized Ramp Terminal Intersections
         1. Overall intersection LOS will be reported for Existing and Future No-Build conditions

[1] City-wide Synchro files will be utilized for informational purposes when editing the Cube Avenue meso-scale model. Synchro files will not be used for analyzing traffic conditions.

ii. Arterial Intersections
   1. Overall intersection LOS will be reported for Existing and Future No-Build conditions
iii. Basic Freeway, Ramp Junctions and Weave Areas
   1. LOS will be reported for Existing and Future No-Build conditions

3. Variables
   a. Peak Hour Factor (PHF)
      i. Existing (year 2012) conditions analysis will use calculated PHFs from existing counts with a maximum value of 0.90.
      ii. Design year (year 2035) conditions analysis will use existing PHFs rounded up to the nearest 0.05 with a maximum value of 0.90
         1. The increase in the PHF is to account for traffic growth that is likely to be spread throughout the peak periods
   b. Saturation Flow Rate
      i. SDDOT Design Manual (Page 24, Chapter 15) requires the use of 1,800 vph in Sioux Falls. This value will be used for the signalized intersections and freeway locations within the study area.
   c. Traffic Signal Controllers
      i. Operational analysis will allow for both actuated and coordinated controllers
   d. Left-Turn Phasing
      i. Protected, Permitted / Protected or Split Phasing will be allowed at intersections
   e. Heaviest Lane Volume (Lane Utilization)
      i. Default HCS Streets Values used for ramp terminal/ arterial intersections
   f. Heavy Vehicle Percentage
      i. Study Intersections
         1. Use existing turning movement counts that included truck counts to determine arterial truck percentages.
      ii. Ramp Junctions and Weave Areas
         1. Use existing freeway counts that included truck counts to determine freeway truck percentages.
   g. Phase Change Intervals
      i. Existing (Year 2012) Conditions
         1. Existing signal timings will be used for phase change intervals during existing conditions
      ii. Future No-Build (Year 2035) Conditions
         1. Existing signal timings will be used for phase change intervals of phases that exist at intersections that have no geometric change from existing conditions
         2. Phase change intervals will be calculated for the following locations:
            a. New phases added at an intersection where geometry is unchanged from existing conditions
            b. All phases at an intersection where geometry is changed from existing conditions

         The calculated values will be based on methodologies presented in the *Institution of Transportation Engineers (ITE)*

Traffic Engineering Handbook. The methodologies presented in the handbook use vehicle length and speed and the distance needed to track through the intersection to calculate phase change intervals.

h. Speeds
   i. Arterials – Use posted speeds
   ii. Freeway – Use 85th percentile of collected spot speed data

8. Travel Forecast

Cube Voyager Travel Demand Model- Macro Scale Modeling

1. The Sioux Falls MPO Travel Demand Model will be utilized for the purposes of this study
   a. The Travel Demand Model was created using Cube Voyager
   b. The Model base year is 2008
   c. The Model was last updated in 2009, next update will be in 2014. Traffic volume projections in Sub-Studies 1, 2, 3, and 4 will not be revised based on the MPO's release of an updated base year Cube Voyager model, set to be released by the MPO in 2014.
   d. The Model future year is 2035 to match the current LRTP for year 2035
      i. The Travel Demand Model forecasts include:
         1. Fiscally constrained projects in the LRTP
         2. No Illustrative Projects
   e. Time intervals in the model include:
      i. AM and PM 2-hr peak period volumes
      ii. AM Peak hour volumes, calculated globally as 58% of the AM Peak Period
      iii. PM Peak hour volumes, calculated globally as 55% of the PM Peak Period
   f. Volumes in the Travel Demand Model reflect average weekday conditions
2. Sub-Area Refinement
   a. The Cube Voyager models (both existing base year and future 2035) will be reviewed and modified as needed for validation at a project-corridor level within the study area. Refinements to the model may include network and socio-economic data refinement, a review of trip generation rates, trip length frequency distribution and statistical assignment checks.
   b. The model may be adjusted based on the O-D data gathered from AirSage.

Cube Avenue Dynamic Traffic Assignment - Meso Scale Modeling

a. Existing (Year 2012) Conditions
   i. A Mesoscopic dynamic traffic assignment (DTA) model of the I-229 corridor will be developed in Cube Avenue. The model will include the I-229 corridor study area, all service interchange ramps, and selected major regional facilities outside of the I-229 corridor that may carry diverted traffic during incidents (including I-29 and I-90). Corridors outside of the Sub-Study 1 study area that will be included in the DTA model will be defined based on proximity to the study area, functional classification, and availability of intersection-

level data (such as counts, signal timings, and intersection geometrics). Count data for intersections outside of the study area may not be available for year 2012/2013; however, for purposes of this study, counts within the last 4 years will be suitable. A Synchro file supplied by the City of Sioux Falls will be used for determining data availability at signalized intersections on other potential corridors. Once this data is reviewed, a proposed list of corridors will be supplied to the Study Advisory Team for approval.

ii. AM and PM Peak period sub-area flows from the Cube Voyager model will be input into to the Cube Avenue model.

iii. Existing counts will be utilized for existing conditions
   1. Intersection turning movement counts collected during 2012 and 2013 will be utilized to develop intersection turning movement volumes for the AM and PM peak hours.
   2. Freeway counts will be based on the ATR data at Station #610 on I-229 at one location within the study area. The existing volumes on study freeway ramps (based on the intersection turning movement counts at the ramp terminal intersections) will be used to determine AM and PM peak hour volumes for all other freeway segments within the study area.

iv. Volumes will be smoothed/balanced between study intersections and free-flow locations to eliminate any additions or subtractions (sources/sinks) in traffic volumes between study intersections and freeway ramps.

v. Network detail will be added to the Cube Avenue model including intersection data (type of control and intersection geometry).

vi. The Cube Avenue meso-scale model will be calibrated to replicate 15-minute traffic counts for the AM and PM peak periods.

vii. Alternative modes of transportation included in the Cube Avenue Model
   1. Transit
      a. Includes buses in the peak hours on 26th Street and 10th Street corridors
      b. Buses will be pre-loaded into the model based on bus stop location and scheduling data
   2. Rail
      a. Includes rail crossings in the study area at:
         i. Rice/Lowell
         ii. Rice/Cleveland.
         iii. Rice/Bahnson.
         iv. 26th Street, east of I-229 ramp terminal intersections
   3. Pedestrian and bicycle modes will **not** be modeled in the meso-scale model as determined with the Study Advisory Team at the Kick-off meeting.

b. Future Year (Year 2035) No-Build Conditions (Future Needs Analysis) and Alternative Testing (Identification of Solutions)

i. AM and PM Peak period sub-area flows from the Cube Voyager future travel demand model(s) will be assigned to the Cube Avenue model.
ii. Adjust network detail in the Cube Avenue model including intersection data (type of control and intersection geometry) to reflect future conditions.
iii. Alternative modes of transportation (transit and rail) will be modeled for future year the same as existing conditions.
iv. The No-Build conditions shall assume the implementation of all fiscally constrained planned projects from the LRTP not on the I-229 corridor. Improvements at the I-229 Exit 5 (26th Street) will be included, based on results from the I-229 Exit 5 (26th Street) Crossroad Corridor Study.
v. The Cube Avenue meso-scale model will produce 15-minute traffic volumes for the AM and PM peak periods.
vi. Meso-scale model will be used as a preliminary screening tool in the study. Measures of Effectiveness (MOE's) based on the Cube Avenue modeling will include the following:
    1. AM and PM Peak Period V/C by segment
    2. AM and PM Peak Period Travel Time
    3. AM and PM Link Delay
    4. AM and PM Overall System Delay

9. Safety Issues

Crash data will be reviewed for the study area based on the Crash Geodatabase which includes crashes between January 2008 and December 2012. SDDOT's database will be the only database used in the calculation of crash rates and critical crash rates. The following information will be provided as a result of the crash analysis:

- Segment and Intersection Crash Rates
- Segment and Intersection Critical Crash Rates (per Highway Safety Manual)
- Crash Trends
- Potential Mitigation Measures to Improve Locations Above Critical Crash Rates

10. Selection of Measures of Effectiveness (MOE)

The main goals of this study are as follows:

1. Complete a traffic level of service analysis for both existing and future (2035) conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges, and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic

conditions.

4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions. The recommended projects will be prioritized by primary and secondary groups of improvements.
6. Conduct interchange options feasibility study on select interchanges. *Will be addressed in subsequent sub-studies.*
7. Create final products for use by the SDDOT which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

To satisfy the study objective, the following MOEs will be used to evaluate and compare the concepts based on the Cube Avenue modeling:

- AM and PM Peak Period V/C by segment
- AM and PM Peak Period Travel Time
- AM and PM Link Delay
- AM and PM Overall System Delay

These statements are made assuming that the geometric improvements identified meet all AASHTO, SDDOT, and City of Sioux Falls guidelines.

An evaluation on the MOE significance thresholds will be conducted when future scenario results are available and used to establish prioritization.

11. FHWA Interstate Access Modification Policy Points

An Interchange Modification Justification Report (IMJR) will not be developed for interchanges as part of this project. The level of detail for addressing each of the eight (8) FHWA policy points regarding modifications to Interstate access will be determined outside of this study.

12. Deviations/Justifications

No deviations from standards are currently known. If it is determined during the study that deviations are required, the methods and assumptions document will be amended prior to proceeding.

13. Conclusion

All sections contained in this document will guide the traffic data collection and traffic assessment for this study.

14. Appendices

The appendix includes the following:

- Methods and Assumptions Study Team Meeting Minutes (April 30, 2013)

APPENDIX

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Meeting Notes

Subject:	Methods and Assumptions Meeting		
Client:	South Dakota Department of Transportation		
Project:	I-229 Major Investment Corridor Study	Project No:	PL 0100(87) 3616 P, PCN 044K Contract 410545, WO PD-02-13 HDR Project No. 207030 Dept 00135
Meeting Date:	April 30, 2013, 1:00-3:00PM	Meeting Location:	Online Meeting; SDDOT Pierre Headquarters; SDDOT Sioux Falls Area Office; HDR Omaha
Notes by:	David Meier, Courtney Sokol		

The Methods and Assumptions Meeting for the I-229 Major Investment Corridor Study was held on April 30, 2013. The purpose of the meeting was to review the Draft Methods and Assumptions document, dated April 17, 2013 that was supplied to the SAT prior to this meeting. Notes from the meeting are summarized below and discussion details follow. A list of participants is contained at the end of meeting notes.

Action Items

Item	Responsible
Revise Draft Methods and Assumptions Document	HDR

Comments Noted During Review of the Draft Methods and Assumptions Document:

1. **Methods and Assumptions Cover Page**
   - *Page 1:* Remove HRGreen and Highway Patrol from list of attendees
   - *Page 1:* Add Sioux Falls MPO to list of attendees

2. **Stakeholder Acceptance Page**
   - No comments noted.

3. **Introduction and Project Description**
   - *Section: Need for the Study (page 5)*- add a bullet for including incident management planning for I-229 Corridor
   - *Section: Facilities Affected by the Study (page 5)*- typo for the word "services"
   - *Section: Previous Studies (page 6)*- add a bullet for ITS studies from the City of Sioux Falls and SDDOT, Incident Management Plan
     - Note- Cleveland Avenue Study can be supplied by the City or HRGreen

4. **Study Area**
   - *Page 8 (Sub-Study 1 Study Area Figure)*- add study area dots for 57th/Oxbow and for Benson/Lewis, Change Dot Map AND Table List

5. **Analysis Years/Periods**
   - Discussion regarding whether to address intermediate year improvements in Sub-Study 1. These will be addressed in Sub-Studies 2, 3 and 4. No direction to change document.

6. **Data Collection**
   - Noted that the City of Sioux Falls has all background documents assembled and will send to HDR this week.
   - *Section: Existing Freeway Data (page 14)*- modify date range for 15-minute increment data to end date of April 21, 2013.
   - *Section: Additional Data Supplied by SDDOT and/or City of Sioux Falls (page 14)*- revise date range for crash records to include 5 year period from January 2008 to December 2012.
   - Noted that rationale on proposed O-D data collection dates was to avoid construction time periods.
   - Discussion for City to provide existing Transit Map (not future). No direction to change document.

7. **Traffic Operations Analysis**
   - *Section: Variables (page 17)*- typo/ remove the word "of" in first line of the Saturation Flow Rate text
   - *Section: Variables (page 17)*- Heaviest Lane Volume- note the default values are for ramp terminal/ arterial intersections.

8. **Travel Forecast**
   - *Section: Cube Voyager Travel Demand Model (page 18)*- add comment noting that the current model (2008) will be used for this study- and will not use the next model update in 2014. The study traffic volume projections will not be updated based on a new model version.
   - Discussion that the LRTP contains some "earmark" projects. No direction to change the document.
   - Noted that any revisions to improvements assumed in the future year 2035 Voyager model will need to be communicated to the study team within the next 2 weeks.
   - Discussion regarding the AirSage O-D data in relation to the Cube Voyager/macro-scale modeling. Much of the macro-scale modeling can be done without the AirSage data yet supplied. Once the AirSage data is available, it will be used to validate the macroscopic model at the daily level and can be used to adjust the Voyager model if needed. The time-of-day/peak period O-D data from AirSage will be used in the meso-scale Cube Avenue model.
   - Discussion regarding two proposed Wal-Mart's near 85th/Minnesota (south of study area). Noted that these developments will not impact the I-229 corridor enough to include in this study.
   - Discussion regarding corridors that will be included in the Meso-scale model, this will involve some preliminary testing and review of the City's Synchro model. SAT will be able to review and approve the proposed list of corridors once HDR begins this process.

9. **Safety Issues**
   - *Page 20*- adjust the Crash Geodatabase dates from January 2008 to December 2012.
   - Discussion regarding the definition of Critical Crash Rate. Note its definition based on the Highway Safety Manual.

10. **Selection of Measures of Effectiveness**
    - *Page 20*- Bullet 5 in describes the plan of recommended projects. Clarify the projects will be prioritized by primary and secondary groups of improvements.
    - *Page 21*- note that an evaluation of significance thresholds for future scenarios will be conducted when results are available and used to establish prioritization.

11. FHWA Interstate Access Modification Policy Points

- Noted no intent for any IJR from any of the Sub-Studies. No direction to change document.

Notes Regarding Next Steps:

- HDR will revise document and leave "Draft" notation on the cover
- Document will be provided in Microsoft Word with "Track Changes" turned on for Steve Gramm's review and acceptance prior to sending out to the SAT for review
- FHWA will share draft document with Resource Center and will not sign until complete

Attendees:

SDDOT- Central Office, Pierre		
Mark Hoines - FHWA	Steve Gramm – SDDOT	Nichole Frankl - SDDOT
Ron McMahon - FHWA	Kevin Goeden - SDDOT	Mike Behm- SDDOT
Bruce Hunt- FHWA	Joel Gengler - SDDOT	Jeff Brosz – SDDOT
	Brad Remmich - SDDOT	Don Martell- SDDOT
SDDOT- Sioux Falls		
Shannon Ausen – Sioux	Amber Gibson - SECOG	Rick Laughlin - HDR
Heath Hoftiezer – Sioux	Bruce Hunt- FHWA	Christina Bennett- SDDOT
HDR - Omaha		
Courtney Sokol - HDR	David Meier - HDR	Brian Ray - HDR
Mike Forsberg- HDR		

APPENDIX B. TRAFFIC DATA COLLECTION

Existing Arterial Intersection Turning Movement Count Data

Turning movement counts define actual traffic at the study intersections during the course of a typical weekday. The most recent turning movement counts provided by the City of Sioux Falls were conducted in year 2012. These counts include volume data in 15-minute intervals. Study area intersections with counts older than year 2012 were collected in the spring of 2013 to capture conditions for an existing conditions average weekday.

In addition, Automated Traffic Recorded (ATR) data was provided at SDDOT Station #605, which is located on 10th Street –between Chicago Ave. and St. Paul Avenue.

Crash History Geodatabase

This database was supplied by SDDOT, and includes crash records dated January 2008 to December 2012 (5 years).

GIS Base Mapping Data

GIS files were supplied by City of Sioux Falls, including 2012 Aerial image files.

Travel Demand Model Files

The Sioux Falls MPO supplied travel demand model files in Cube format. Model files were provided for both base year (2008) and future horizon year (2035).

Signal Timing Data

Signal timing data was provided in Synchro format for existing conditions, AM and PM peak hours.

Existing Freeway Data

Automated Traffic Recorded (ATR) data was provided for SDDOT Station #610, which is located between Exit 2 (Western Avenue) and Exit 3 (Minnesota Avenue). The ATR included hourly directional mainline I-229 freeway volumes from Sept 2012 to February 2013. In addition, ATR at Station #610 was provided in 15-minute increments from March 6 to April 21, 2013.

SDDOT supplied hourly ramp volume data from year 2012.

Interstate Vehicle Classifications

Classification counts were conducted on March 12, 13, and 14 of 2013 (Tuesday, Wednesday, Thursday) between 9 am and 4 pm. These counts determined the heavy vehicle percentages, by mainline interstate segment, on I-229. These heavy vehicle percentages are shown in **Table 1**.

Table 1. Vehicle Classification Percentages by I-229 Mainline Segment

I-229 Location	Total Vehicles	Heavy Vehicles	Heavy Vehicle Percentage
Between 60th St. N. and Benson Rd.	828	70	8.45%
Between Benson Rd. and Rice St.	848	57	6.72%
Between Rice St and 10TH St.	827	70	8.46%
Between 10th St. and 26th St.	807	70	8.67%
Between 26th St. and Cliff Ave.	843	53	6.29%
Between Cliff Ave. and Minnesota Ave.	831	41	4.93%
Between Minnesota Ave. and Western Ave.	833	43	5.16%
Between Western Ave. and Louise Ave.	816	48	5.88%
Between Louise Ave. and Solberg Ave.	828	86	10.39%

Source: HDR, (March 2013)

Arterial Street Vehicle Classification

The analysis procedures used for this study require heavy vehicle information for all facilities in the study area. The classification counts performed as a part of this study only cover the freeway mainline, as was shown in **Table 1**. Thus, additional data was needed to support the project team in developing reasonable assumptions. The classification counts listed below in **Table 2** were used to develop arterial and ramp heavy vehicle percentages.

Table 2. Arterial Classification Counts

Location	Total Vehicles	Heavy Vehicles	Heavy Vehicle Percentage
E. 10th St., East of Cleveland Ave.	806	51	6.33%
Cliff Ave., South of I-229	807	38	4.71%
E. 26th St., East of Village Square Place	823	20	2.43%
Cliff Ave., South of 14th St.	808	23	2.85%
Southeastern Ave., Between 18th and 26th St.	205	4	1.95%
Southeastern Ave., South of 26th St.	304	14	4.61%
Rice St., West of I-229 (@Jessica Ave.)	800	46	5.75%
Rice St., East of I-229 (@Great Bear)	508	8	1.57%
Western Ave., South of I-229	1185	18	1.52%

Source: HDR, (2012-2013)

Heavy vehicle percentages were calculated using flow conservation for the uncounted portions of the I-229 mainline using adjacent mainline segments and assumed percentages on ramps.

Right Turn on Red Traffic Counts

The City of Sioux Falls counted the number of right turn on red (RTOR) maneuvers at critical intersections in the study area. *TABLE 3* shows the intersections counted and the RTOR percentage (number of RTOR divided by total number of right turners) for each peak hour.

Table 3. Right Turn on Red Traffic Counts

Intersection	Movement	AM RTOR %	PM RTOR %
69th Street & Louise Avenue	EBR	40%	34%
	WBR	47%	47%
	NBR	51%	56%
	SBR	36%	28%
57th Street & Louise Avenue	EBR	25%	8%
	WBR	17%	10%
	NBR	26%	43%
	SBR	46%	14%
57th Street & Western Avenue	EBR	20%	16%
	WBR	13%	15%
	NBR	0%	29%
	SBR	44%	42%
41st Street & Minnesota Avenue	EBR	43%	23%
	WBR	26%	21%
	NBR	14%	19%
	SBR	18%	11%
49th Street & Cliff Avenue	WBR	26%	74%
	NBR	0%	16%
26th Street & I-229 NB Ramps	EBR	6%	9%
	NBR	64%	21%
26th Street & Southeastern Avenue	WBR	39%	38%
	NBR	3%	25%
	SBR	53%	36%
10th Street & Cliff Avenue	WBR	16%	2%
	SBR	41%	17%
10th Street & Cleveland Avenue	EBR	24%	12%
	WBR	2%	8%
	NBR	35%	18%
	SBR	32%	16%
Rice Street & NB I-229 ramps / Cleveland Ave	EBR	41%	32%
	WBR	16%	31%
	NBR	25%	31%
	SBR	56%	40%

Spot Speed Profile

A spot speed study was performed to capture individual vehicles speeds by segment between interchanges along the I-229 corridor. The study was conducted on Thursday, March 14, 2013. A minimum of 100 records were included in the sample for each segment . The 85th percentile spot speeds were used as the free-flow speeds for the I-229 mainline in the operational analysis.

A summary of the mean and 85th percentile speeds are shown by segment in TABLE 4.

Table 4. Spot Speed Profile Summary by I-229 Mainline Segment

MAINLINE SEGMENT	I-229 NB		I-229 SB	
	Mean Speed	85th % Speed	Mean Speed	85th % Speed
Solberg Ave. to Louise Ave.	65.8	69	62.9	67
Louise Ave. to Western Ave.	65.1	69	63.5	67
Western Ave. to Minnesota Ave.	66.2	70	64.9	69
Minnesota Ave. to Cliff Ave.	66.1	70	63.1	67
Cliff Ave. to 26th St.	66.0	69	64.2	69
26th St. to 10th St.	62.2	68	64.3	67
10TH St. to Rice St.	63.4	67	63.8	69
Rice St. to Benson Rd.	66.2	72	64.7	68
Benson Rd. to 60TH St. N.	66.8	70	65.0	69

Source: HDR, (March 2013)
Note: speeds shown in the table are miles per hour (mph).

Interstate Segments Speeds/ Travel time runs

Travel time data was gathered for each I-229 link between interchanges in the AM Peak, PM Peak, and Off-Peak times. Travel time runs were conducted during the specified time periods using the average car technique with a sample size yielding 95% confidence level, as specified in the ***ITE Manual of Traffic Engineering Studies***. Eight runs were completed for each AM, PM, and Off-Peak periods in March 2013. ***TABLE 5*** shows the travel times and average speeds for each interstate segment. Travel time runs were also conducted during the Jazz Fest on July 19, 2013, which can be compared to the average weekday speeds shown in *FIGURE 1* and *FIGURE 2*.

Table 5. Travel Time and Speed Summary by Time Period and Interstate Segment

I-229 Southbound						
	Travel Time (seconds)			Average Speed (mph)		
Segment	AM	PM	Off-Peak	AM	PM	Off-Peak
60th St. N. to Benson Rd.	58	54	54	65.2	66.8	66.3
Benson Rd. to Rice St.	90	90	86	65.7	66.4	67.1
Rice St to 10th St.	65	65	65	64.8	64.8	64.8
10th St. to 26th St.	72	72	72	65.3	66.5	66.4
26th St. to Cliff Ave.	65	65	61	65.9	65.4	66.8
Cliff Ave. to Minnesota Ave.	58	58	58	66.5	66.0	65.4
Minnesota Ave. to Western Ave.	54	58	58	66.5	66.0	65.5
Western Ave. to Louise Ave.	61	65	61	66.8	65.8	66.4
Louise Ave. to Solberg Ave.	50	50	50	65.5	66.6	66.0
Average All Southbound Segments				65.8	66.0	66.1
I-229 Northbound						
	Travel Time (seconds)			Average Speed (mph)		
Segment	AM	PM	Off-Peak	AM	PM	Off-Peak
Solberg Ave. to Louise Ave.	50	50	50	67.2	65.5	67.1
Louise Ave. to Western Ave.	65	65	65	65.8	65.7	64.8
Western Ave. to Minnesota Ave.	54	54	54	66.2	66.2	66.7
Minnesota Ave. to Cliff Ave.	58	58	58	66.8	66.4	65.8
Cliff Ave. to 26th St.	65	65	65	67.2	65.7	65.2
26th St. to 10th St.	72	72	72	66.7	65.8	66.3
10th St. to Rice St.	65	65	65	67.7	66.7	67.7
Rice St. to Benson Rd.	86	86	90	66.8	66.7	65.1
Benson Rd. to 60th St. N	58	58	58	64.7	65.8	65.2
Average all Northbound Segments				66.6	66.0	66.0

__FIGURE 1. I-229 SOUTHBOUND AVERAGE SPEEDS__

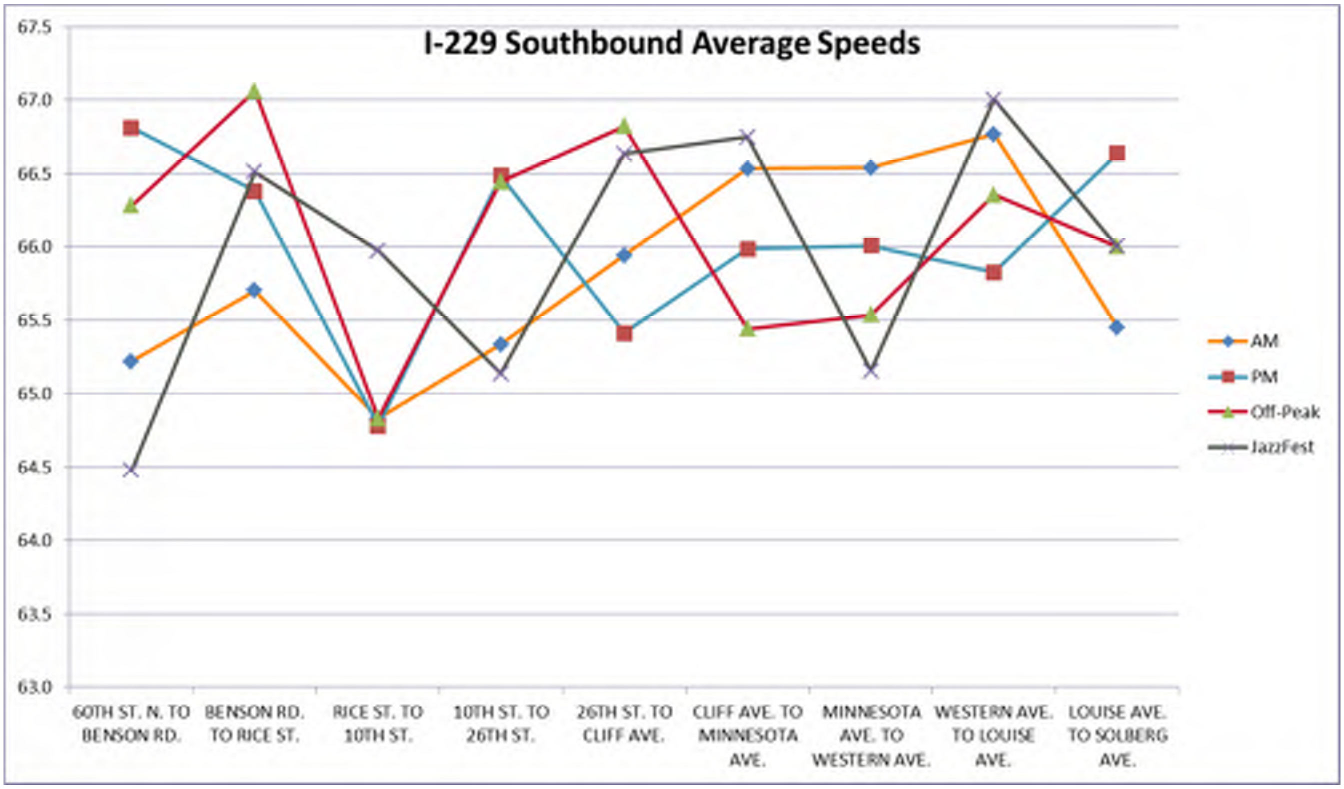
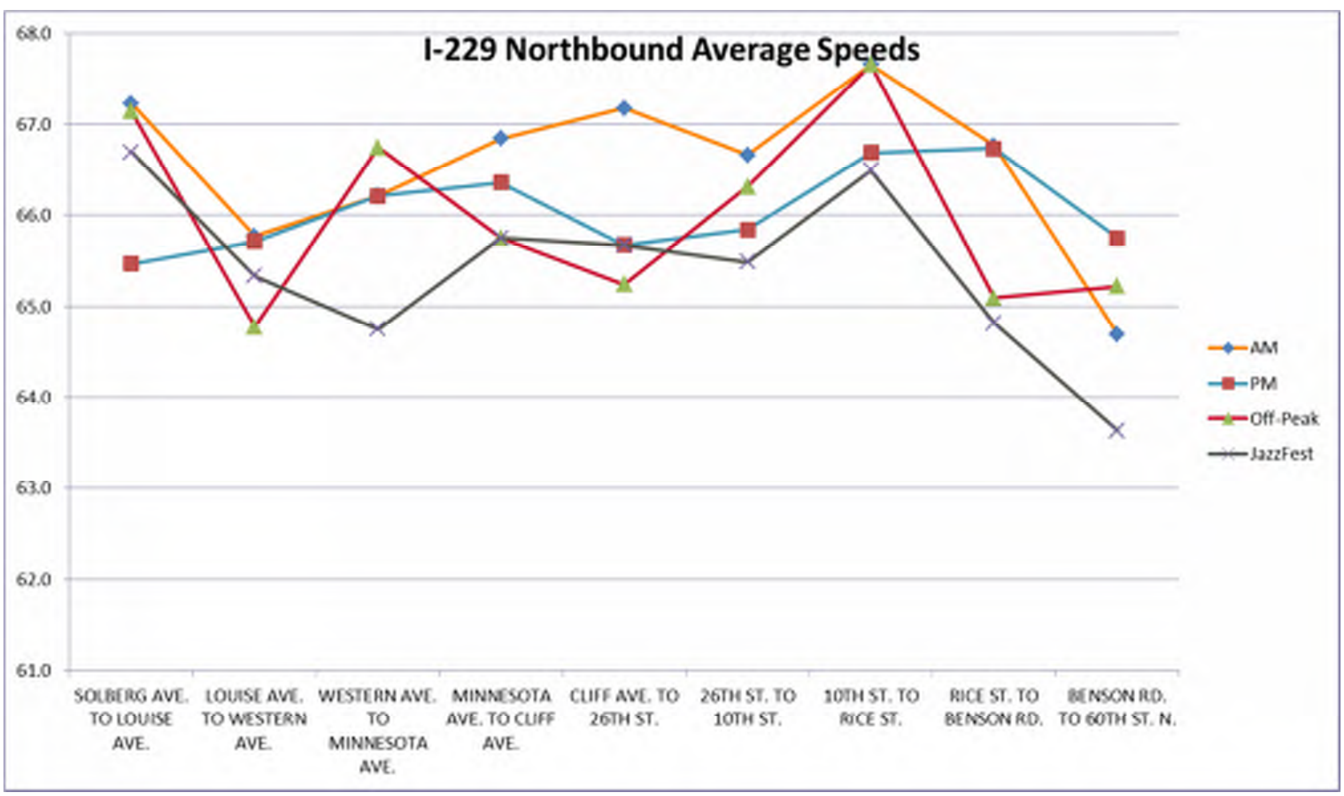


__FIGURE 2. I-229 NORTHBOUND AVERAGE SPEEDS__



Travel Time Data

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/20/13**
WEATHER: 10F, CLEAR
RUN NUMBER: AM PEAK 1

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	6:58	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'26"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'26"	+3'31"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'31"	+4'44"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'44"	+5'47"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'47"	+6'44"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'44"	+7'39"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'39"	+8'41"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'41"	+9'31"	0.014	0.924	66.00
	TOTAL		0.159	10.442	
	AVERAGE				65.67

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	6:47	+0'49"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'49"	+1'52"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'52"	+2'46"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'46"	+3'43"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'43"	+4'48"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'48"	+5'58"	0.019	1.316	69.26
10TH ST. TO RICE ST.	+5'58"	+7'02"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'02"	+8'31"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'31"	+9'27"	0.016	1.018	63.63
	TOTAL		0.159	10.475	
	AVERAGE				65.88

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/20/13**

WEATHER: 10F, CLEAR

RUN NUMBER: AM PEAK 2

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	7:23	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'27"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'27"	+3'32"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'32"	+4'50"	0.022	1.328	60.36
26TH ST. TO CLIFF AVE.	+4'50"	+5'54"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'54"	+6'52"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'52"	+7'49"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'49"	+8'52"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'52"	+9'42"	0.014	0.924	66.00
	TOTAL		0.163	10.442	
	AVERAGE				64.06

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	7:13	+0'50"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'50"	+1'54"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'54"	+2'50"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'50"	+3'47"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'47"	+4'53"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'53"	+6'04"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'04"	+7'06"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'06"	+8'35"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'35"	+9'32"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/20/13**

WEATHER: 10F, CLEAR

RUN NUMBER: AM PEAK 3

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	7:49	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'23"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'23"	+3'25"	0.017	1.166	68.59
10TH ST. TO 26TH ST.	+3'25"	+4'36"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'36"	+5'37"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'37"	+6'33"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'33"	+7'28"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'28"	+8'28"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'28"	+9'22"	0.015	0.924	61.60
	TOTAL		0.157	10.442	
	AVERAGE				66.51

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	7:38	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'55"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'49"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'49"	+3'43"	0.015	1.052	70.13
CLIFF AVE. TO 26TH ST.	+3'43"	+4'49"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'49"	+6'01"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'01"	+7'02"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'02"	+8'30"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'30"	+9'25"	0.015	1.018	67.87
	TOTAL		0.156	10.475	
	AVERAGE				67.15

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/20/13**

WEATHER: 10F, CLEAR

RUN NUMBER: AM PEAK 4

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	8:15	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'25"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'25"	+3'29"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'29"	+4'43"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'43"	+5'46"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'46"	+6'41"	0.015	1.047	69.80
MINNESOTA AVE. TO WESTERN AVE.	+6'41"	+7'37"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'37"	+8'38"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'38"	+9'27"	0.014	0.924	66.00
	TOTAL		0.160	10.442	
	AVERAGE				65.26

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	8:04	+0'47"	0.013	0.940	72.31
LOUISE AVE. TO WESTERN AVE.	+0'47"	+1'50"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'50"	+2'45"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'45"	+3'41"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'41"	+4'47"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'47"	+6'00"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'00"	+7'03"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'03"	+8'33"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'33"	+9'30"	0.016	1.018	63.63
	TOTAL		0.159	10.475	
	AVERAGE				65.88

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/21/13**

WEATHER: 10F, CLEAR

RUN NUMBER: AM PEAK 5

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	6:50	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'26"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'26"	+3'33"	0.019	1.166	61.37
10TH ST. TO 26TH ST.	+3'33"	+4'48"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'48"	+5'53"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'53"	+6'50"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'50"	+7'45"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'45"	+8'47"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'47"	+9'38"	0.014	0.924	66.00
	TOTAL		0.161	10.442	
	AVERAGE				64.86

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	6:39	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'54"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'54"	+2'49"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'49"	+3'44"	0.015	1.052	70.13
CLIFF AVE. TO 26TH ST.	+3'44"	+4'46"	0.017	1.182	69.53
26TH ST. TO 10TH ST.	+4'46"	+5'57"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+5'57"	+6'59"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+6'59"	+8'26"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'26"	+9'22"	0.016	1.018	63.63
	TOTAL		0.156	10.475	
	AVERAGE				67.15

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/21/13**

WEATHER: 10F, CLEAR

RUN NUMBER: AM PEAK 6

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	7:17	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'24"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'24"	+3'29"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'29"	+4'43"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'43"	+5'45"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'45"	+6'41"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'41"	+7'35"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'35"	+8'38"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'38"	+9'28"	0.014	0.924	66.00
	TOTAL		0.159	10.442	
	AVERAGE				65.67

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	7:05	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'53"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'53"	+2'47"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'47"	+3'45"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'45"	+4'48"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'48"	+5'59"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+5'59"	+7'01"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'01"	+8'30"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'30"	+9'26"	0.016	1.018	63.63
	TOTAL		0.158	10.475	
	AVERAGE				66.30

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/21/13**

WEATHER: 10F, CLEAR

RUN NUMBER: AM PEAK 7

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	7:42	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'24"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'24"	+3'29"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'29"	+4'39"	0.019	1.328	69.89
26TH ST. TO CLIFF AVE.	+4'39"	+5'38"	0.016	1.152	72.00
CLIFF AVE. TO MINNESOTA AVE.	+5'38"	+6'32"	0.015	1.047	69.80
MINNESOTA AVE. TO WESTERN AVE.	+6'32"	+7'28"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'28"	+8'30"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'30"	+9'19"	0.014	0.924	66.00
	TOTAL		0.155	10.442	
	AVERAGE				67.37

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	7:31	+0'50"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'50"	+1'52"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'52"	+2'46"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'46"	+3'42"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'42"	+4'45"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'45"	+5'55"	0.019	1.316	69.26
10TH ST. TO RICE ST.	+5'55"	+6'58"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+6'58"	+8'23"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'23"	+9'18"	0.015	1.018	67.87
	TOTAL		0.156	10.475	
	AVERAGE				67.15

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/21/13**

WEATHER: 10F, CLEAR

RUN NUMBER: AM PEAK 8

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	8:08	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'26"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'26"	+3'31"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'31"	+4'41"	0.019	1.328	69.89
26TH ST. TO CLIFF AVE.	+4'41"	+5'44"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'44"	+6'42"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'42"	+7'36"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'36"	+8'37"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'37"	+9'27"	0.014	0.924	66.00
	TOTAL		0.157	10.442	
	AVERAGE				66.51

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	7:57	+0'54"	0.015	0.940	62.67
LOUISE AVE. TO WESTERN AVE.	+0'54"	+1'53"	0.016	1.149	71.81
WESTERN AVE. TO MINNESOTA AVE.	+1'53"	+2'49"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'49"	+3'48"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'48"	+4'47"	0.016	1.182	73.88
26TH ST. TO 10TH ST.	+4'47"	+5'59"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+5'59"	+7'02"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'02"	+8'26"	0.023	1.626	70.70
BENSON RD. TO 60TH ST. N.	+8'26"	+9'22"	0.016	1.018	63.63
	TOTAL		0.156	10.475	
	AVERAGE				67.15

TRAVEL TIME/SPEED SUMMARY

SOUTHBOUND																		
	TRAVEL TIME (HR)									AVERAGE SPEED (MPH)								
SEGMENT	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE
60TH ST. N. TO BENSON RD.	0.016	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.016	63.63	63.63	63.63	63.63	63.63	67.87	67.87	67.87	65.22
BENSON RD. TO RICE ST.	0.025	0.025	0.024	0.025	0.025	0.025	0.025	0.025	0.025	65.36	65.36	68.08	65.36	65.36	65.36	65.36	65.36	65.70
RICE ST. TO 10TH ST.	0.018	0.018	0.017	0.018	0.019	0.018	0.018	0.018	0.018	64.78	64.78	68.59	64.78	61.37	64.78	64.78	64.78	64.83
10TH ST. TO 26TH ST.	0.020	0.022	0.020	0.021	0.021	0.021	0.019	0.019	0.020	66.40	60.36	66.40	63.24	63.24	63.24	69.89	69.89	65.33
26TH ST. TO CLIFF AVE.	0.018	0.018	0.017	0.018	0.018	0.017	0.016	0.018	0.018	64.00	64.00	67.76	64.00	64.00	67.76	72.00	64.00	65.94
CLIFF AVE. TO MINNESOTA AVE.	0.016	0.016	0.016	0.015	0.016	0.016	0.015	0.016	0.016	65.44	65.44	65.44	69.80	65.44	65.44	69.80	65.44	66.53
MINNESOTA AVE. TO WESTERN AVE.	0.015	0.016	0.015	0.016	0.015	0.015	0.016	0.015	0.015	68.13	63.88	68.13	63.88	68.13	68.13	63.88	68.13	66.54
WESTERN AVE. TO LOUISE AVE.	0.017	0.018	0.017	0.017	0.017	0.018	0.017	0.017	0.017	67.71	63.94	67.71	67.71	67.71	63.94	67.71	67.71	66.77
LOUISE AVE. TO SOLBERG AVE.	0.014	0.014	0.015	0.014	0.014	0.014	0.014	0.014	0.014	66.00	66.00	61.60	66.00	66.00	66.00	66.00	66.00	65.45
												AVERAGE SPEED SOUTHBOUND						65.81

NORTHBOUND																		
	TRAVEL TIME (HR)									AVERAGE SPEED (MPH)								
SEGMENT	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE
SOLBERG AVE. TO LOUISE AVE.	0.014	0.014	0.014	0.013	0.014	0.014	0.014	0.015	0.014	67.14	67.14	67.14	72.31	67.14	67.14	67.14	62.67	67.23
LOUISE AVE. TO WESTERN AVE.	0.018	0.018	0.018	0.018	0.018	0.017	0.017	0.016	0.018	63.83	63.83	63.83	63.83	63.83	67.59	67.59	71.81	65.77
WESTERN AVE. TO MINNESOTA AVE.	0.015	0.016	0.015	0.015	0.015	0.015	0.015	0.016	0.015	67.27	63.06	67.27	67.27	67.27	67.27	67.27	63.06	66.22
MINNESOTA AVE. TO CLIFF AVE.	0.016	0.016	0.015	0.016	0.015	0.016	0.016	0.016	0.016	65.75	65.75	70.13	65.75	70.13	65.75	65.75	65.75	66.85
CLIFF AVE. TO 26TH ST.	0.018	0.018	0.018	0.018	0.017	0.018	0.018	0.016	0.018	65.67	65.67	65.67	65.67	69.53	65.67	65.67	73.88	67.18
26TH ST. TO 10TH ST.	0.019	0.020	0.020	0.020	0.020	0.020	0.019	0.020	0.020	69.26	65.80	65.80	65.80	65.80	65.80	69.26	65.80	66.67
10TH ST. TO RICE ST.	0.018	0.017	0.017	0.018	0.017	0.017	0.018	0.018	0.018	65.72	69.59	69.59	65.72	69.59	69.59	65.72	65.72	67.66
RICE ST. TO BENSON RD.	0.025	0.025	0.024	0.025	0.024	0.025	0.024	0.023	0.024	65.04	65.04	67.75	65.04	67.75	65.04	67.75	70.70	66.76
BENSON RD. TO 60TH ST. N.	0.016	0.016	0.015	0.016	0.016	0.016	0.015	0.016	0.016	63.63	63.63	67.87	63.63	63.63	63.63	67.87	63.63	64.69
												AVERAGE SPEED NORTHBOUND						66.56

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/20/13**
WEATHER: 28F, CLEAR
RUN NUMBER: PM PEAK 1

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	4:28	+0'54"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'54"	+2'22"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'22"	+3'25"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'25"	+4'39"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'39"	+5'42"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'42"	+6'38"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'38"	+7'34"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'34"	+8'37"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'37"	+9'28"	0.014	0.924	66.00
	TOTAL		0.160	10.442	
	AVERAGE				65.26

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	4:17	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'55"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'48"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'48"	+3'45"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'45"	+4'50"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'50"	+6'03"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'03"	+7'07"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'07"	+8'35"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'35"	+9'29"	0.015	1.018	67.87
	TOTAL		0.158	10.475	
	AVERAGE				66.30

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/20/13**

WEATHER: 28F, CLEAR

RUN NUMBER: PM PEAK 2

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	4:53	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'24"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'24"	+3'29"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'29"	+4'40"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'40"	+5'42"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'42"	+6'41"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'41"	+7'36"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'36"	+8'39"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'39"	+9'29"	0.014	0.924	66.00
	TOTAL		0.158	10.442	
	AVERAGE				66.09

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	4:43	+0'50"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'50"	+1'51"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'51"	+2'46"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'46"	+3'44"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'44"	+4'48"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'48"	+6'01"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'01"	+7'07"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'07"	+8'35"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'35"	+9'31"	0.016	1.018	63.63
	TOTAL		0.158	10.475	
	AVERAGE				66.30

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/20/13**

WEATHER: 28F, CLEAR

RUN NUMBER: PM PEAK 3

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	5:19	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'25"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'25"	+3'28"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'28"	+4'41"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'41"	+5'44"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'44"	+6'41"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'41"	+7'35"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'35"	+8'37"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'37"	+9'26"	0.014	0.924	66.00
	TOTAL		0.158	10.442	
	AVERAGE				66.09

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	5:08	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'55"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'51"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'51"	+3'47"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'47"	+4'51"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'51"	+6'03"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'03"	+7'06"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'06"	+8'35"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'35"	+9'29"	0.015	1.018	67.87
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY
MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/20/13**
WEATHER: 28F, CLEAR
RUN NUMBER: PM PEAK 4

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	5:44	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'25"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'25"	+3'30"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'30"	+4'40"	0.019	1.328	69.89
26TH ST. TO CLIFF AVE.	+4'40"	+5'42"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'42"	+6'37"	0.015	1.047	69.80
MINNESOTA AVE. TO WESTERN AVE.	+6'37"	+7'30"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'30"	+8'31"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'31"	+9'20"	0.014	0.924	66.00
	TOTAL		0.155	10.442	
	AVERAGE				67.37

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	5:33	+0'53"	0.015	0.940	62.67
LOUISE AVE. TO WESTERN AVE.	+0'53"	+1'55"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'49"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'49"	+3'44"	0.015	1.052	70.13
CLIFF AVE. TO 26TH ST.	+3'44"	+4'48"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'48"	+5'58"	0.019	1.316	69.26
10TH ST. TO RICE ST.	+5'58"	+6'59"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+6'59"	+8'28"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'28"	+9'24"	0.016	1.018	63.63
	TOTAL		0.157	10.475	
	AVERAGE				66.72

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/21/13**

WEATHER: 30F, CLEAR

RUN NUMBER: PM PEAK 5

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	4:23	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'26"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'26"	+3'31"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'31"	+4'45"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'45"	+5'49"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'49"	+6'45"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'45"	+7'41"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'41"	+8'45"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'45"	+9'36"	0.014	0.924	66.00
	TOTAL		0.162	10.442	
	AVERAGE				64.46

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	4:12	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'53"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'53"	+2'49"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'49"	+3'49"	0.017	1.052	61.88
CLIFF AVE. TO 26TH ST.	+3'49"	+4'52"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'52"	+6'06"	0.021	1.316	62.67
10TH ST. TO RICE ST.	+6'06"	+7'10"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'10"	+8'38"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'38"	+9'35"	0.016	1.018	63.63
	TOTAL		0.161	10.475	
	AVERAGE				65.06

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/21/13**

WEATHER: 30F, CLEAR

RUN NUMBER: PM PEAK 6

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	4:49	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'25"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'25"	+3'29"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'29"	+4'40"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'40"	+5'43"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'43"	+6'41"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'41"	+7'37"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'37"	+8'38"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'38"	+9'26"	0.013	0.924	71.08
	TOTAL		0.159	10.442	
	AVERAGE				65.67

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	4:38	+0'53"	0.015	0.940	62.67
LOUISE AVE. TO WESTERN AVE.	+0'53"	+1'56"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'56"	+2'51"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'51"	+3'46"	0.015	1.052	70.13
CLIFF AVE. TO 26TH ST.	+3'46"	+4'49"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'49"	+6'01"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'01"	+7'05"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'05"	+8'35"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'35"	+9'31"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/21/13**

WEATHER: 30F, CLEAR

RUN NUMBER: PM PEAK 7

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	5:15	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'22"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'22"	+3'26"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'26"	+4'39"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'39"	+5'42"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'42"	+6'40"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'40"	+7'39"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'39"	+8'42"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'42"	+9'33"	0.014	0.924	66.00
	TOTAL		0.159	10.442	
	AVERAGE				65.67

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	5:04	+0'53"	0.015	0.940	62.67
LOUISE AVE. TO WESTERN AVE.	+0'53"	+1'57"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'57"	+2'52"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'52"	+3'48"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'48"	+4'51"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'51"	+6'02"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'02"	+7'04"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'04"	+8'29"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'29"	+9'23"	0.015	1.018	67.87
	TOTAL		0.158	10.475	
	AVERAGE				66.30

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/21/13**

WEATHER: 30F, CLEAR

RUN NUMBER: PM PEAK 8

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	5:41	+0'54"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'54"	+2'21"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'21"	+3'26"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'26"	+4'36"	0.019	1.328	69.89
26TH ST. TO CLIFF AVE.	+4'36"	+5'38"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'38"	+6'35"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'35"	+7'30"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'30"	+8'31"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'31"	+9'20"	0.014	0.924	66.00
	TOTAL		0.155	10.442	
	AVERAGE				67.37

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	5:30	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'53"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'53"	+2'47"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'47"	+3'44"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'44"	+4'48"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'48"	+5'59"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+5'59"	+7'02"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'02"	+8'29"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'29"	+9'22"	0.015	1.018	67.87
	TOTAL		0.157	10.475	
	AVERAGE				66.72

TRAVEL TIME/SPEED SUMMARY

SOUTHBOUND																		
	TRAVEL TIME (HR)									AVERAGE SPEED (MPH)								
SEGMENT	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE
60TH ST. N. TO BENSON RD.	0.015	0.015	0.015	0.015	0.016	0.016	0.015	0.015	0.015	67.87	67.87	67.87	67.87	63.63	63.63	67.87	67.87	66.81
BENSON RD. TO RICE ST.	0.024	0.025	0.025	0.025	0.025	0.025	0.024	0.024	0.025	68.08	65.36	65.36	65.36	65.36	65.36	68.08	68.08	66.38
RICE ST. TO 10TH ST.	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	64.78	64.78	64.78	64.78	64.78	64.78	64.78	64.78	64.78
10TH ST. TO 26TH ST.	0.021	0.020	0.020	0.019	0.021	0.020	0.020	0.019	0.020	63.24	66.40	66.40	69.89	63.24	66.40	66.40	69.89	66.48
26TH ST. TO CLIFF AVE.	0.018	0.017	0.018	0.017	0.018	0.018	0.018	0.017	0.018	64.00	67.76	64.00	67.76	64.00	64.00	64.00	67.76	65.41
CLIFF AVE. TO MINNESOTA AVE.	0.016	0.016	0.016	0.015	0.016	0.016	0.016	0.016	0.016	65.44	65.44	65.44	69.80	65.44	65.44	65.44	65.44	65.99
MINNESOTA AVE. TO WESTERN AVE.	0.016	0.015	0.015	0.015	0.016	0.016	0.016	0.015	0.016	63.88	68.13	68.13	68.13	63.88	63.88	63.88	68.13	66.01
WESTERN AVE. TO LOUISE AVE.	0.018	0.018	0.017	0.017	0.018	0.017	0.018	0.017	0.018	63.94	63.94	67.71	67.71	63.94	67.71	63.94	67.71	65.83
LOUISE AVE. TO SOLBERG AVE.	0.014	0.014	0.014	0.014	0.014	0.013	0.014	0.014	0.014	66.00	66.00	66.00	66.00	66.00	71.08	66.00	66.00	66.64
												AVERAGE SPEED SOUTHBOUND						66.03

NORTHBOUND																		
	TRAVEL TIME (HR)									AVERAGE SPEED (MPH)								
SEGMENT	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE
SOLBERG AVE. TO LOUISE AVE.	0.014	0.014	0.014	0.015	0.014	0.015	0.015	0.014	0.014	67.14	67.14	67.14	62.67	67.14	62.67	62.67	67.14	65.46
LOUISE AVE. TO WESTERN AVE.	0.018	0.017	0.018	0.017	0.017	0.018	0.018	0.017	0.018	63.83	67.59	63.83	67.59	67.59	63.83	63.83	67.59	65.71
WESTERN AVE. TO MINNESOTA AVE.	0.015	0.015	0.016	0.015	0.016	0.015	0.015	0.015	0.015	67.27	67.27	63.06	67.27	63.02	67.27	67.27	67.27	66.21
MINNESOTA AVE. TO CLIFF AVE.	0.016	0.016	0.016	0.015	0.017	0.015	0.016	0.016	0.016	65.75	65.75	65.75	70.13	61.88	70.13	65.75	65.75	66.36
CLIFF AVE. TO 26TH ST.	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67
26TH ST. TO 10TH ST.	0.020	0.020	0.020	0.019	0.021	0.020	0.020	0.020	0.020	65.80	65.80	65.80	69.26	62.67	65.80	65.80	65.80	65.84
10TH ST. TO RICE ST.	0.018	0.018	0.018	0.017	0.018	0.018	0.017	0.018	0.018	65.72	65.72	65.72	69.59	65.72	65.72	69.59	65.72	66.69
RICE ST. TO BENSON RD.	0.024	0.024	0.025	0.025	0.024	0.025	0.024	0.024	0.024	67.75	67.75	65.04	65.04	67.75	65.04	67.75	67.75	66.73
BENSON RD. TO 60TH ST. N.	0.015	0.016	0.015	0.016	0.016	0.016	0.015	0.015	0.016	67.87	63.63	67.87	63.63	63.63	63.63	67.87	67.87	65.75
												AVERAGE SPEED NORTHBOUND						66.05

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/6/13**
WEATHER: 20F, CLOUDY
RUN NUMBER: OFF PEAK 1

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	8:53	+0'54"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'54"	+2'22"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'22"	+3'26"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'26"	+4'39"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'39"	+5'39"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'39"	+6'35"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'35"	+7'29"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'29"	+8'32"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'32"	+9'21"	0.014	0.924	66.00
	TOTAL		0.157	10.442	
	AVERAGE				66.51

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	8:43	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'54"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'54"	+2'50"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'50"	+3'49"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'49"	+4'53"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'53"	+6'04"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'04"	+7'06"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'06"	+8'35"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'35"	+9'30"	0.015	1.018	67.87
	TOTAL		0.159	10.475	
	AVERAGE				65.88

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/6/13**

WEATHER: 20F, CLOUDY

RUN NUMBER: OFF PEAK 2

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	9:24	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'23"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'23"	+3'25"	0.017	1.166	68.59
10TH ST. TO 26TH ST.	+3'25"	+4'38"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'38"	+5'40"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'40"	+6'37"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'37"	+7'32"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'32"	+8'34"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'34"	+9'24"	0.014	0.924	66.00
	TOTAL		0.155	10.442	
	AVERAGE				67.37

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	9:13	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'53"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'53"	+2'47"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'47"	+3'45"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'45"	+4'52"	0.019	1.182	62.21
26TH ST. TO 10TH ST.	+4'52"	+6'03"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'03"	+7'06"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'06"	+8'34"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'34"	+9'29"	0.015	1.018	67.87
	TOTAL		0.158	10.475	
	AVERAGE				66.30

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/6/13**

WEATHER: 22F, CLOUDY

RUN NUMBER: OFF PEAK 3

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	9:52	+0'54"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'54"	+2'20"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'20"	+3'23"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'23"	+4'33"	0.019	1.328	69.89
26TH ST. TO CLIFF AVE.	+4'33"	+5'35"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'35"	+6'31"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'31"	+7'24"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'24"	+8'24"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'24"	+9'15"	0.014	0.924	66.00
	TOTAL		0.155	10.442	
	AVERAGE				67.37

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	9:42	+0'50"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'50"	+1'53"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'53"	+2'47"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'47"	+3'45"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'45"	+4'49"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'49"	+5'59"	0.019	1.316	69.26
10TH ST. TO RICE ST.	+5'59"	+7'00"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'00"	+8'28"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'28"	+9'23"	0.015	1.018	67.87
	TOTAL		0.156	10.475	
	AVERAGE				67.15

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/6/13**

WEATHER: 26F, CLOUDY

RUN NUMBER: OFF PEAK 4

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	13:33	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'23"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'23"	+3'28"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'28"	+4'40"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'40"	+5'42"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'42"	+6'39"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'39"	+7'36"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'36"	+8'38"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'38"	+9'28"	0.014	0.924	66.00
	TOTAL		0.158	10.442	
	AVERAGE				66.09

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	13:21	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'54"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'54"	+2'49"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'49"	+3'46"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'46"	+4'51"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'51"	+6'05"	0.021	1.316	62.67
10TH ST. TO RICE ST.	+6'05"	+7'07"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'07"	+8'38"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'38"	+9'34"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/6/13**

WEATHER: 26F, CLOUDY

RUN NUMBER: OFF PEAK 5

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	14:00	+0'54"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'54"	+2'21"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'21"	+3'24"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'24"	+4'36"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'36"	+5'38"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'38"	+6'36"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'36"	+7'31"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'31"	+8'34"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'34"	+9'23"	0.014	0.924	66.00
	TOTAL		0.157	10.442	
	AVERAGE				66.51

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	13:49	+0'49"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'49"	+1'51"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'51"	+2'45"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'45"	+3'42"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'42"	+4'46"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'46"	+5'56"	0.019	1.316	69.26
10TH ST. TO RICE ST.	+5'56"	+6'58"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+6'58"	+8'27"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'27"	+9'23"	0.016	1.018	63.63
	TOTAL		0.157	10.475	
	AVERAGE				66.72

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/7/13**

WEATHER: 34F, PARTLY CLOUDY

RUN NUMBER: OFF PEAK 6

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	11:43	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'25"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'25"	+3'30"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'30"	+4'43"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'43"	+5'45"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'45"	+6'41"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'41"	+7'40"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'40"	+8'43"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'43"	+9'33"	0.014	0.924	66.00
	TOTAL		0.159	10.442	
	AVERAGE				65.67

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	11:32	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'55"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'50"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'50"	+3'46"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'46"	+4'51"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'51"	+6'01"	0.019	1.316	69.26
10TH ST. TO RICE ST.	+6'01"	+7'04"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'04"	+8'33"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'33"	+9'30"	0.016	1.018	63.63
	TOTAL		0.159	10.475	
	AVERAGE				65.88

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/7/13**

WEATHER: 34F, PARTLY CLOUDY

RUN NUMBER: OFF PEAK 7

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	12:11	+0'57"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'57"	+2'26"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'26"	+3'31"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'31"	+4'45"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'45"	+5'48"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'48"	+6'45"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'45"	+7'41"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'41"	+8'45"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'45"	+9'35"	0.014	0.924	66.00
	TOTAL		0.162	10.442	
	AVERAGE				64.46

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	11:59	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'55"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'49"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'49"	+3'47"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'47"	+4'52"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'52"	+6'06"	0.021	1.316	62.67
10TH ST. TO RICE ST.	+6'06"	+7'09"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'09"	+8'41"	0.026	1.626	62.54
BENSON RD. TO 60TH ST. N.	+8'41"	+9'38"	0.016	1.018	63.63
	TOTAL		0.162	10.475	
	AVERAGE				64.66

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 3/7/13**

WEATHER: 34F, PARTLY CLOUDY

RUN NUMBER: OFF PEAK 8

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	12:38	+0'57"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'57"	+2'28"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'28"	+3'38"	0.019	1.166	61.37
10TH ST. TO 26TH ST.	+3'38"	+4'51"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'51"	+5'57"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'57"	+6'55"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'55"	+7'56"	0.017	1.022	60.12
WESTERN AVE. TO LOUISE AVE.	+7'56"	+8'55"	0.016	1.151	71.94
LOUISE AVE. TO SOLBERG AVE.	+8'55"	+9'45"	0.014	0.924	66.00
	TOTAL		0.161	10.442	
	AVERAGE				64.86

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	12:27	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'56"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'56"	+2'51"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'51"	+3'49"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'49"	+4'55"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'55"	+6'07"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'07"	+7'11"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'11"	+8'43"	0.026	1.626	62.54
BENSON RD. TO 60TH ST. N.	+8'43"	+9'40"	0.016	1.018	63.63
	TOTAL		0.161	10.475	
	AVERAGE				65.06

TRAVEL TIME/SPEED SUMMARY

SOUTHBOUND																		
	TRAVEL TIME (HR)									AVERAGE SPEED (MPH)								
SEGMENT	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE
60TH ST. N. TO BENSON RD.	0.015	0.015	0.015	0.016	0.015	0.015	0.016	0.016	0.015	67.87	67.87	67.87	63.63	67.87	67.87	63.63	63.63	66.28
BENSON RD. TO RICE ST.	0.024	0.024	0.024	0.024	0.024	0.025	0.025	0.025	0.024	68.08	68.08	68.08	68.08	68.08	65.36	65.36	65.36	67.06
RICE ST. TO 10TH ST.	0.018	0.017	0.018	0.018	0.018	0.018	0.018	0.019	0.018	64.78	68.59	64.78	64.78	64.78	64.78	64.78	61.37	64.83
10TH ST. TO 26TH ST.	0.020	0.020	0.019	0.020	0.020	0.020	0.021	0.020	0.020	66.40	66.40	69.89	66.40	66.40	66.40	63.24	66.40	66.44
26TH ST. TO CLIFF AVE.	0.017	0.017	0.017	0.017	0.017	0.017	0.018	0.018	0.017	67.76	67.76	67.76	67.76	67.76	67.76	64.00	64.00	66.82
CLIFF AVE. TO MINNESOTA AVE.	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	65.44	65.44	65.44	65.44	65.44	65.44	65.44	65.44	65.44
MINNESOTA AVE. TO WESTERN AVE.	0.015	0.015	0.015	0.016	0.015	0.016	0.016	0.017	0.016	68.13	68.13	68.13	63.88	68.13	63.88	63.88	60.12	65.54
WESTERN AVE. TO LOUISE AVE.	0.018	0.017	0.017	0.017	0.018	0.018	0.018	0.016	0.017	63.94	67.71	67.71	67.71	63.94	63.94	63.94	71.94	66.35
LOUISE AVE. TO SOLBERG AVE.	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00
												AVERAGE SPEED SOUTHBOUND						66.08

NORTHBOUND																		
	TRAVEL TIME (HR)									AVERAGE SPEED (MPH)								
SEGMENT	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	AVERAGE
SOLBERG AVE. TO LOUISE AVE.	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	67.14	67.14	67.14	67.14	67.14	67.14	67.14	67.14	67.14
LOUISE AVE. TO WESTERN AVE.	0.018	0.017	0.018	0.018	0.017	0.018	0.018	0.018	0.018	63.83	67.59	63.83	63.83	67.59	63.83	63.83	63.83	64.77
WESTERN AVE. TO MINNESOTA AVE.	0.016	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	63.06	67.27	67.27	67.27	67.27	67.27	67.27	67.27	66.74
MINNESOTA AVE. TO CLIFF AVE.	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	65.75	65.75	65.75	65.75	65.75	65.75	65.75	65.75	65.75
CLIFF AVE. TO 26TH ST.	0.018	0.019	0.018	0.018	0.018	0.018	0.018	0.018	0.018	65.67	62.21	65.67	65.67	65.67	65.67	65.67	65.67	65.24
26TH ST. TO 10TH ST.	0.020	0.020	0.019	0.021	0.019	0.019	0.021	0.020	0.020	65.8	65.8	69.26	62.67	69.26	69.26	62.67	65.8	66.32
10TH ST. TO RICE ST.	0.017	0.018	0.017	0.017	0.017	0.018	0.018	0.018	0.018	69.59	65.72	69.59	69.59	69.59	65.72	65.72	65.72	67.66
RICE ST. TO BENSON RD.	0.025	0.024	0.024	0.025	0.025	0.025	0.026	0.026	0.025	65.04	67.75	67.75	65.04	65.04	65.04	62.54	62.54	65.09
BENSON RD. TO 60TH ST. N.	0.015	0.015	0.015	0.016	0.016	0.016	0.016	0.016	0.016	67.87	67.87	67.87	63.63	63.63	63.63	63.63	63.63	65.22
												AVERAGE SPEED NORTHBOUND						65.99

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/19/13**
WEATHER: 85F, PARTLY CLOUDY
RUN NUMBER: JAZZFEST 1

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	18:09	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'24"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'24"	+3'29"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'29"	+4'44"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'44"	+5'46"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'46"	+6'42"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'42"	+7'39"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'39"	+8'41"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'41"	+9'30"	0.014	0.924	66.00
	TOTAL		0.159	10.442	
	AVERAGE				65.67

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	18:22	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'55"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'54"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'54"	+3'53"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'53"	+4'58"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'58"	+6'11"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'11"	+7'13"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'13"	+8'43"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'43"	+9'41"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/19/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 2

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	18:35	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'23"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'23"	+3'28"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'28"	+4'41"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'41"	+5'43"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'43"	+6'39"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'39"	+7'34"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'34"	+8'35"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'35"	+9'24"	0.014	0.924	66.00
	TOTAL		0.156	10.442	
	AVERAGE				66.94

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	18:49	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'54"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'54"	+2'50"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'50"	+3'47"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'47"	+4'52"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'52"	+6'05"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'05"	+7'09"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'09"	+8'40"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'40"	+9'37"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/19/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 3

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	19:03	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'23"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'23"	+3'26"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'26"	+4'37"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'37"	+5'38"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'38"	+6'33"	0.015	1.047	69.80
MINNESOTA AVE. TO WESTERN AVE.	+6'33"	+7'28"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'28"	+8'29"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'29"	+9'19"	0.014	0.924	66.00
	TOTAL		0.156	10.442	
	AVERAGE				66.94

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	19:17	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'54"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'54"	+2'52"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'52"	+3'50"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'50"	+4'56"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'56"	+6'08"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'08"	+7'11"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'11"	+8'43"	0.026	1.626	62.54
BENSON RD. TO 60TH ST. N.	+8'43"	+9'40"	0.016	1.018	63.63
	TOTAL		0.162	10.475	
	AVERAGE				64.66

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/19/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 4

SOUTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
60TH ST. N. TO BENSON RD.	19:30	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'24"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'24"	+3'26"	0.017	1.166	68.59
10TH ST. TO 26TH ST.	+3'26"	+4'38"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'38"	+5'39"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'39"	+6'36"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'36"	+7'34"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'34"	+8'33"	0.016	1.151	71.94
LOUISE AVE. TO SOLBERG AVE.	+8'33"	+9'24"	0.014	0.924	66.00
	TOTAL		0.156	10.442	
	AVERAGE				66.94

NORTHBOUND					
SEGMENT	START TIME	FINISH TIME	TRAVEL TIME (HR)	SEGMENT DISTANCE	AVERAGE SPEED
SOLBERG AVE. TO LOUISE AVE.	19:44	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'56"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'56"	+2'52"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'52"	+3'49"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'49"	+4'53"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'53"	+6'04"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'04"	+7'10"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'10"	+8'38"	0.024	1.626	67.75
BENSON RD. TO 60TH ST. N.	+8'38"	+9'36"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/20/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 5

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	15:07	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'24"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'24"	+3'27"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'27"	+4'39"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'39"	+5'42"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'42"	+6'37"	0.015	1.047	69.80
MINNESOTA AVE. TO WESTERN AVE.	+6'37"	+7'31"	0.015	1.022	68.13
WESTERN AVE. TO LOUISE AVE.	+7'31"	+8'31"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'31"	+9'21"	0.014	0.924	66.00
	TOTAL		0.157	10.442	
	AVERAGE				66.51

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	15:21	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'52"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'52"	+2'48"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'48"	+3'45"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'45"	+4'50"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'50"	+6'01"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'01"	+7'04"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'04"	+8'36"	0.026	1.626	62.54
BENSON RD. TO 60TH ST. N.	+8'36"	+9'35"	0.016	1.018	63.63
	TOTAL		0.161	10.475	
	AVERAGE				65.06

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/20/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 6

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	15:33	+0'57"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'57"	+2'35"	0.027	1.634	60.52
RICE ST. TO 10TH ST.	+2'35"	+3'33"	0.016	1.166	72.88
10TH ST. TO 26TH ST.	+3'33"	+4'45"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'45"	+5'46"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'46"	+6'44"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'44"	+7'40"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'40"	+8'43"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'43"	+9'34"	0.014	0.924	66.00
	TOTAL		0.160	10.442	
	AVERAGE				65.26

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	15:48	+0'53"	0.015	0.940	62.67
LOUISE AVE. TO WESTERN AVE.	+0'53"	+1'56"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'56"	+2'51"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'51"	+3'48"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'48"	+4'54"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'54"	+6'07"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'07"	+7'09"	0.017	1.183	69.59
RICE ST. TO BENSON RD.	+7'09"	+8'38"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'38"	+9'35"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/20/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 7

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	15:59	+0'55"	0.015	1.018	67.87
BENSON RD. TO RICE ST.	+0'55"	+2'23"	0.024	1.634	68.08
RICE ST. TO 10TH ST.	+2'23"	+3'28"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'28"	+4'42"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'42"	+5'44"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'44"	+6'42"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'42"	+7'39"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'39"	+8'41"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'41"	+9'32"	0.014	0.924	66.00
	TOTAL		0.158	10.442	
	AVERAGE				66.09

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	16:14	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'55"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'50"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'50"	+3'46"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'46"	+4'50"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'50"	+6'04"	0.021	1.316	62.67
10TH ST. TO RICE ST.	+6'04"	+7'07"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'07"	+8'37"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'37"	+9'36"	0.016	1.018	63.63
	TOTAL		0.161	10.475	
	AVERAGE				65.06

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/20/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 8

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	16:25	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'25"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'25"	+3'30"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'30"	+4'44"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'44"	+5'46"	0.017	1.152	67.76
CLIFF AVE. TO MINNESOTA AVE.	+5'46"	+6'45"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'45"	+7'41"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'41"	+8'44"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'44"	+9'34"	0.014	0.924	66.00
	TOTAL		0.161	10.442	
	AVERAGE				64.86

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	16:40	+0'50"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'50"	+1'51"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'51"	+2'46"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'46"	+3'43"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'43"	+4'48"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'48"	+6'01"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'01"	+7'04"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'04"	+8'34"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'34"	+9'31"	0.016	1.018	63.63
	TOTAL		0.159	10.475	
	AVERAGE				65.88

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/20/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 9

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	18:56	+0'56"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'56"	+2'25"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'25"	+3'28"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'28"	+4'42"	0.021	1.328	63.24
26TH ST. TO CLIFF AVE.	+4'42"	+5'45"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'45"	+6'42"	0.016	1.047	65.44
MINNESOTA AVE. TO WESTERN AVE.	+6'42"	+7'39"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'39"	+8'42"	0.018	1.151	63.94
LOUISE AVE. TO SOLBERG AVE.	+8'42"	+9'33"	0.014	0.924	66.00
	TOTAL		0.162	10.442	
	AVERAGE				64.46

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	18:45	+0'52"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'52"	+1'55"	0.018	1.149	63.83
WESTERN AVE. TO MINNESOTA AVE.	+1'55"	+2'50"	0.015	1.009	67.27
MINNESOTA AVE. TO CLIFF AVE.	+2'50"	+3'47"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'47"	+4'52"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'52"	+6'03"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'03"	+7'06"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'06"	+8'37"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'37"	+9'35"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME AND DELAY STUDY

MOVING VEHICLE METHOD FIELD SHEET

ROUTE: I-229 **DATE: 7/20/13**

WEATHER: 85F, PARTLY CLOUDY

RUN NUMBER: JAZZFEST 10

SOUTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
60TH ST. N. TO BENSON RD.	19:22	+0'57"	0.016	1.018	63.63
BENSON RD. TO RICE ST.	+0'57"	+2'26"	0.025	1.634	65.36
RICE ST. TO 10TH ST.	+2'26"	+3'30"	0.018	1.166	64.78
10TH ST. TO 26TH ST.	+3'30"	+4'41"	0.020	1.328	66.40
26TH ST. TO CLIFF AVE.	+4'41"	+5'44"	0.018	1.152	64.00
CLIFF AVE. TO MINNESOTA AVE.	+5'44"	+6'39"	0.015	1.047	69.80
MINNESOTA AVE. TO WESTERN AVE.	+6'39"	+7'35"	0.016	1.022	63.88
WESTERN AVE. TO LOUISE AVE.	+7'35"	+8'36"	0.017	1.151	67.71
LOUISE AVE. TO SOLBERG AVE.	+8'36"	+9'25"	0.014	0.924	66.00
	TOTAL		0.159	10.442	
	AVERAGE				65.67

NORTHBOUND					
SEGMENT	**START TIME**	**FINISH TIME**	**TRAVEL TIME (HR)**	**SEGMENT DISTANCE**	**AVERAGE SPEED**
SOLBERG AVE. TO LOUISE AVE.	19:12	+0'51"	0.014	0.940	67.14
LOUISE AVE. TO WESTERN AVE.	+0'51"	+1'53"	0.017	1.149	67.59
WESTERN AVE. TO MINNESOTA AVE.	+1'53"	+2'49"	0.016	1.009	63.06
MINNESOTA AVE. TO CLIFF AVE.	+2'49"	+3'47"	0.016	1.052	65.75
CLIFF AVE. TO 26TH ST.	+3'47"	+4'53"	0.018	1.182	65.67
26TH ST. TO 10TH ST.	+4'53"	+6'04"	0.020	1.316	65.80
10TH ST. TO RICE ST.	+6'04"	+7'09"	0.018	1.183	65.72
RICE ST. TO BENSON RD.	+7'09"	+8'38"	0.025	1.626	65.04
BENSON RD. TO 60TH ST. N.	+8'38"	+9'35"	0.016	1.018	63.63
	TOTAL		0.160	10.475	
	AVERAGE				65.47

TRAVEL TIME/SPEED SUMMARY

SOUTHBOUND																						
	TRAVEL TIME (HR)											AVERAGE SPEED (MPH)										
SEGMENT	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	RUN 9	RUN 10	AVERAGE	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8	RUN 9	RUN 10	AVERAGE
60TH ST. N. TO BENSON RD.	0.016	0.015	0.016	0.016	0.016	0.016	0.015	0.016	0.016	0.016	0.016	63.63	67.87	63.63	63.63	63.63	63.63	67.87	63.63	63.63	63.63	64.48
BENSON RD. TO RICE ST.	0.024	0.024	0.024	0.024	0.024	0.027	0.024	0.025	0.025	0.025	0.025	68.08	68.08	68.08	68.08	68.08	60.52	68.08	65.36	65.36	65.36	66.51
RICE ST. TO 10TH ST.	0.018	0.018	0.018	0.017	0.018	0.016	0.018	0.018	0.018	0.018	0.018	64.78	64.78	64.78	68.59	64.78	72.88	64.78	64.78	64.78	64.78	65.97
10TH ST. TO 26TH ST.	0.021	0.020	0.020	0.020	0.020	0.020	0.021	0.021	0.021	0.020	0.020	63.24	66.40	66.40	66.40	66.40	66.40	63.24	63.24	63.24	66.40	65.14
26TH ST. TO CLIFF AVE.	0.017	0.017	0.017	0.017	0.018	0.017	0.017	0.017	0.018	0.018	0.017	67.76	67.76	67.76	67.76	64.00	67.76	67.76	67.76	64.00	64.00	66.63
CLIFF AVE. TO MINNESOTA AVE.	0.016	0.016	0.015	0.016	0.015	0.016	0.016	0.016	0.016	0.015	0.016	65.44	65.44	69.80	65.44	69.80	65.44	65.44	65.44	65.44	69.80	66.75
MINNESOTA AVE. TO WESTERN AVE.	0.016	0.015	0.015	0.016	0.015	0.016	0.016	0.016	0.016	0.016	0.016	63.88	68.13	68.13	63.88	68.13	63.88	63.88	63.88	63.88	63.88	65.16
WESTERN AVE. TO LOUISE AVE.	0.017	0.017	0.017	0.016	0.017	0.018	0.017	0.018	0.018	0.017	0.017	67.71	67.71	67.71	71.94	67.71	63.94	67.71	63.94	63.94	67.71	67.00
LOUISE AVE. TO SOLBERG AVE.	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00
												AVERAGE SPEED SOUTHBOUND										65.96

NORTHBOUND																						
	TRAVEL TIME (HR)											AVERAGE SPEED (MPH)										
SEGMENT	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8			AVERAGE	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8			AVERAGE
SOLBERG AVE. TO LOUISE AVE.	0.014	0.014	0.014	0.014	0.014	0.015	0.014	0.014	0.014	0.014	0.014	67.14	67.14	67.14	67.14	67.14	62.67	67.14	67.14	67.14	67.14	66.69
LOUISE AVE. TO WESTERN AVE.	0.018	0.017	0.018	0.018	0.017	0.018	0.018	0.017	0.018	0.017	0.018	63.83	67.59	63.83	63.83	67.59	63.83	63.83	67.59	63.83	67.59	65.33
WESTERN AVE. TO MINNESOTA AVE.	0.016	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.016	0.016	63.06	63.09	63.06	63.06	63.06	67.27	67.27	67.27	67.27	63.06	64.75
MINNESOTA AVE. TO CLIFF AVE.	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	65.75	65.75	65.75	65.75	65.75	65.75	65.75	65.75	65.75	65.75	65.75
CLIFF AVE. TO 26TH ST.	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67
26TH ST. TO 10TH ST.	0.020	0.020	0.020	0.020	0.020	0.020	0.021	0.020	0.020	0.020	0.020	65.80	65.80	65.80	65.80	65.80	65.80	62.67	65.80	65.80	65.80	65.49
10TH ST. TO RICE ST.	0.017	0.018	0.018	0.018	0.018	0.017	0.018	0.018	0.018	0.018	0.018	69.59	65.72	65.72	65.72	65.72	69.59	65.72	65.72	65.72	65.72	66.49
RICE ST. TO BENSON RD.	0.025	0.025	0.026	0.024	0.026	0.025	0.025	0.025	0.025	0.025	0.025	65.04	65.04	62.54	67.75	62.54	65.04	65.04	65.04	65.04	65.04	64.81
BENSON RD. TO 60TH ST. N.	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	63.63	63.63	63.63	63.63	63.63	63.63	63.63	63.63	63.63	63.63	63.63
												AVERAGE SPEED NORTHBOUND										65.40

SPOT SPEED DATA

SPOT SPEED STUDY

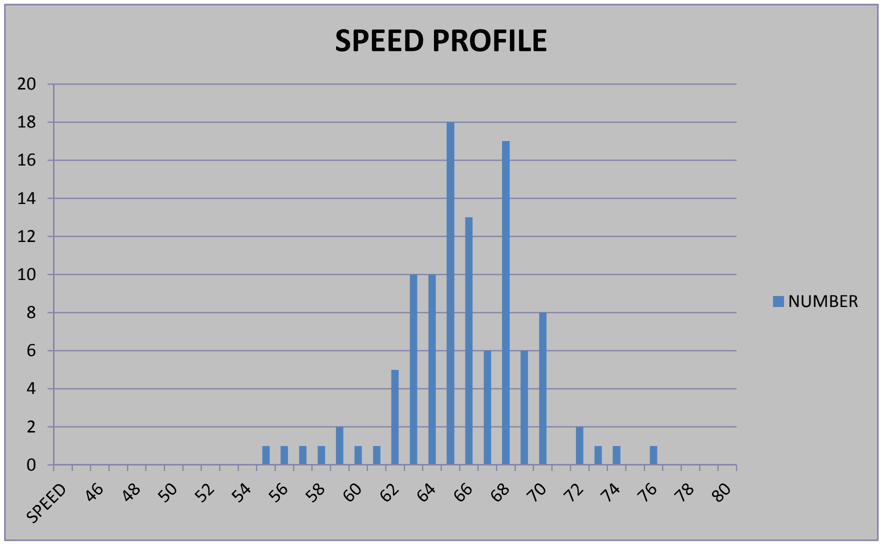
I-229 MIS

LOCATION: NORTHBOUND, BETWEEN SOLBERG AND LOUISE

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	0	0
54	0	0
55	1	1
56	1	2
57	1	3
58	1	4
59	2	6
60	1	7
61	1	8
62	5	13
63	10	23
64	10	33
65	18	51
66	13	64
67	6	70
68	17	87
69	6	93
70	8	101
71	0	101
72	2	103
73	1	104
74	1	105
75	0	105
76	1	106
77	0	106
78	0	106
79	0	106
80	0	106

TOTAL OBSERVATIONS: 106

MEAN SPEED: 65.77
85TH % SPEED: 69



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

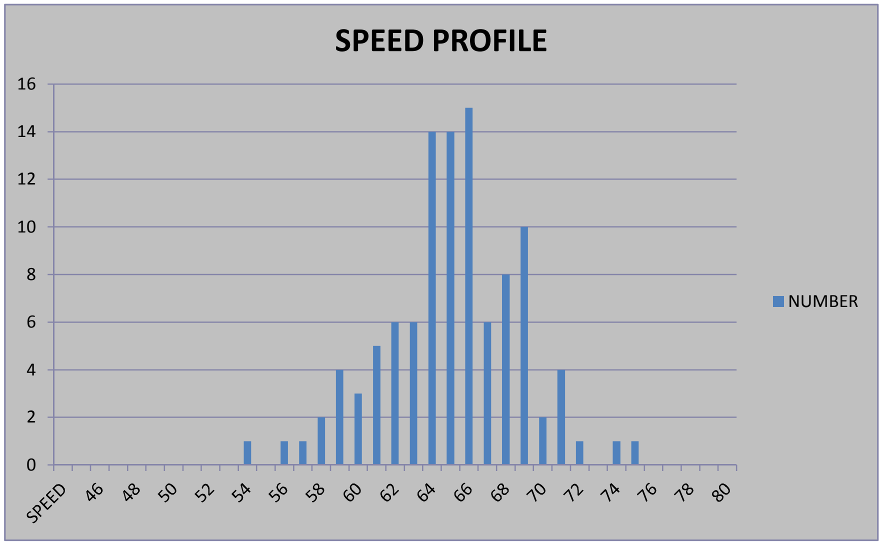
I-229 MIS

LOCATION: NORTHBOUND, BETWEEN LOUISE AND WESTERN

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	0	0
54	1	1
55	0	1
56	1	2
57	1	3
58	2	5
59	4	9
60	3	12
61	5	17
62	6	23
63	6	29
64	14	43
65	14	57
66	15	72
67	6	78
68	8	86
69	10	96
70	2	98
71	4	102
72	1	103
73	0	103
74	1	104
75	1	105
76	0	105
77	0	105
78	0	105
79	0	105
80	0	105

TOTAL OBSERVATIONS: 105

MEAN SPEED: 65.06
85TH % SPEED: 69



SPOT SPEED STUDY

I-229 MIS

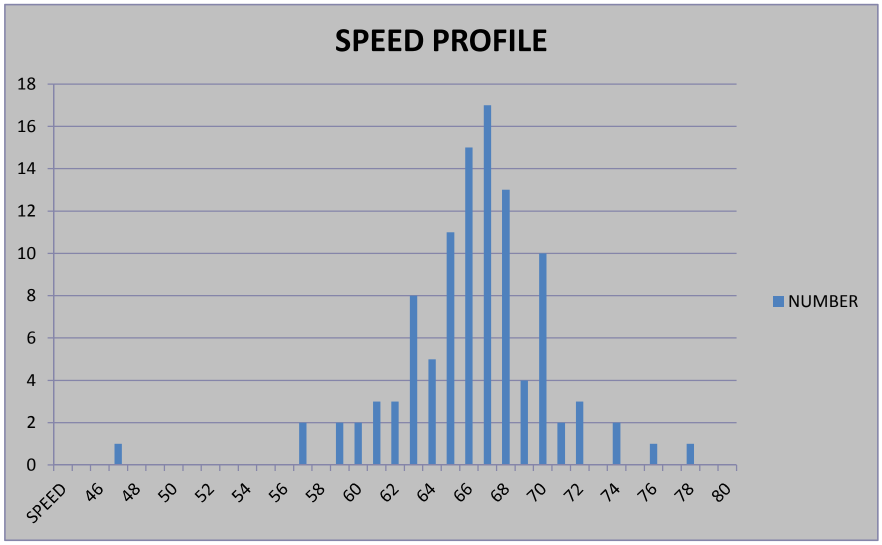
LOCATION: NORTHBOUND, BETWEEN WESTERN AND MINNESOTA

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
45	0	0
46	0	0
47	1	1
48	0	1
49	0	1
50	0	1
51	0	1
52	0	1
53	0	1
54	0	1
55	0	1
56	0	1
57	2	3
58	0	3
59	2	5
60	2	7
61	3	10
62	3	13
63	8	21
64	5	26
65	11	37
66	15	52
67	17	69
68	13	82
69	4	86
70	10	96
71	2	98
72	3	101
73	0	101
74	2	103
75	0	103
76	1	104
77	0	104
78	1	105
79	0	105
80	0	105

TOTAL OBSERVATIONS: 105

MEAN SPEED: 66.25

85TH % SPEED: 70



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

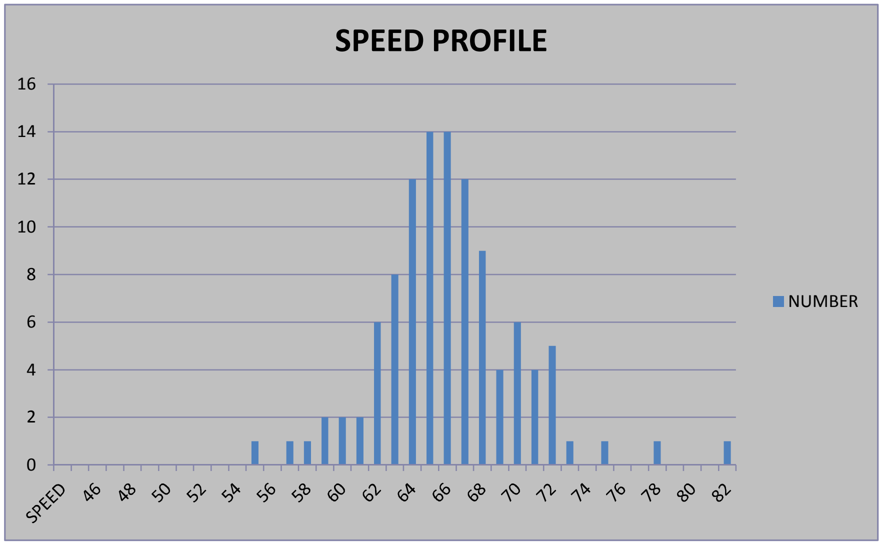
LOCATION: NORTHBOUND, BETWEEN MINNESOTA AND CLIFF

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	0	0
54	0	0
55	1	1
56	0	1
57	1	2
58	1	3
59	2	5
60	2	7
61	2	9
62	6	15
63	8	23
64	12	35
65	14	49
66	14	63
67	12	75
68	9	84
69	4	88
70	6	94
71	4	98
72	5	103
73	1	104
74	0	104
75	1	105
76	0	105
77	0	105
78	1	106
79	0	106
80	0	106
81	0	106
82	1	107

TOTAL OBSERVATIONS: 107

MEAN SPEED: 66.09

85TH % SPEED: 70



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

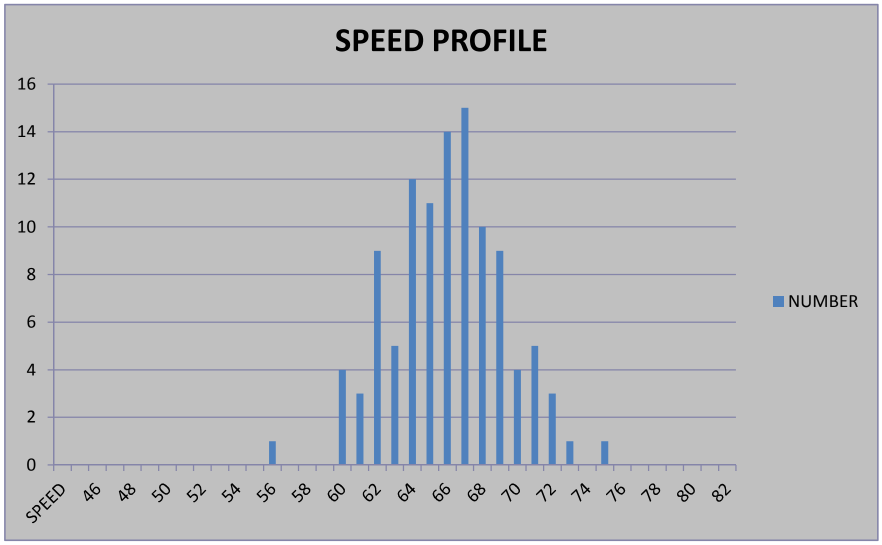
LOCATION: NORTHBOUND, BETWEEN CLIFF AND 26TH

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	0	0
54	0	0
55	0	0
56	1	1
57	0	1
58	0	1
59	0	1
60	4	5
61	3	8
62	9	17
63	5	22
64	12	34
65	11	45
66	14	59
67	15	74
68	10	84
69	9	93
70	4	97
71	5	102
72	3	105
73	1	106
74	0	106
75	1	107
76	0	107
77	0	107
78	0	107
79	0	107
80	0	107
81	0	107
82	0	107

TOTAL OBSERVATIONS: 107

MEAN SPEED: 66.02

85TH % SPEED: 69



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

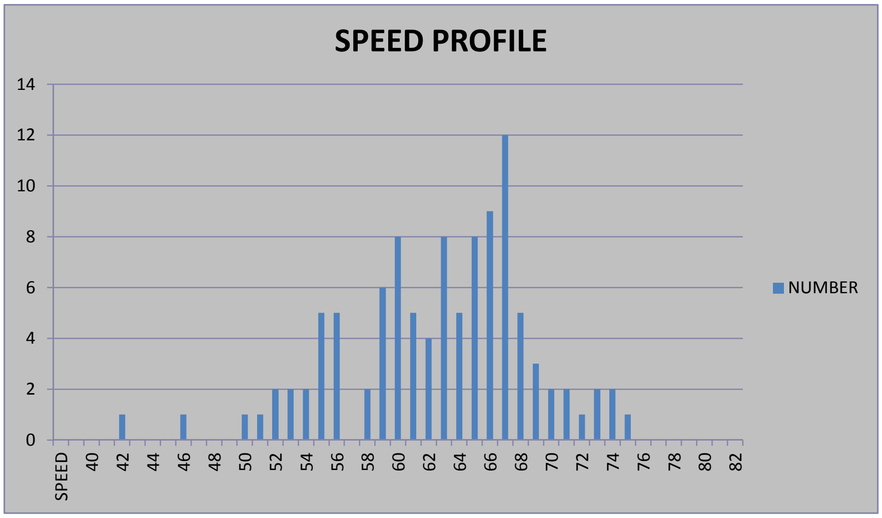
LOCATION: NORTHBOUND, BETWEEN 26TH AND 10TH

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	1	1
43	0	1
44	0	1
45	0	1
46	1	2
47	0	2
48	0	2
49	0	2
50	1	3
51	1	4
52	2	6
53	2	8
54	2	10
55	5	15
56	5	20
57	0	20
58	2	22
59	6	28
60	8	36
61	5	41
62	4	45
63	8	53
64	5	58
65	8	66
66	9	75
67	12	87
68	5	92
69	3	95
70	2	97
71	2	99
72	1	100
73	2	102
74	2	104
75	1	105
76	0	105
77	0	105
78	0	105
79	0	105
80	0	105
81	0	105
82	0	105

TOTAL OBSERVATIONS: 105

MEAN SPEED: 62.25

85TH % SPEED: 68



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

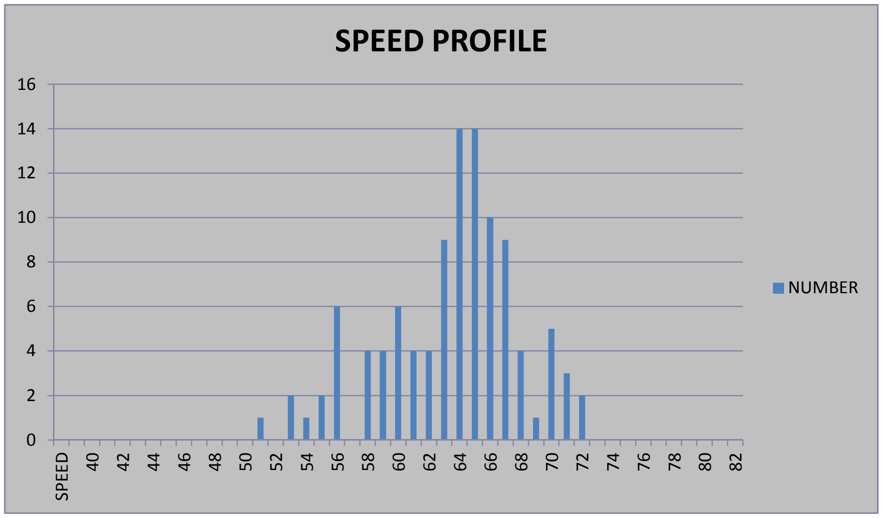
LOCATION: NORTHBOUND, BETWEEN 10TH AND RICE

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	1	1
52	0	1
53	2	3
54	1	4
55	2	6
56	6	12
57	0	12
58	4	16
59	4	20
60	6	26
61	4	30
62	4	34
63	9	43
64	14	57
65	14	71
66	10	81
67	9	90
68	4	94
69	1	95
70	5	100
71	3	103
72	2	105
73	0	105
74	0	105
75	0	105
76	0	105
77	0	105
78	0	105
79	0	105
80	0	105
81	0	105
82	0	105

TOTAL OBSERVATIONS: 105

MEAN SPEED: 63.44

85TH % SPEED: 67



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

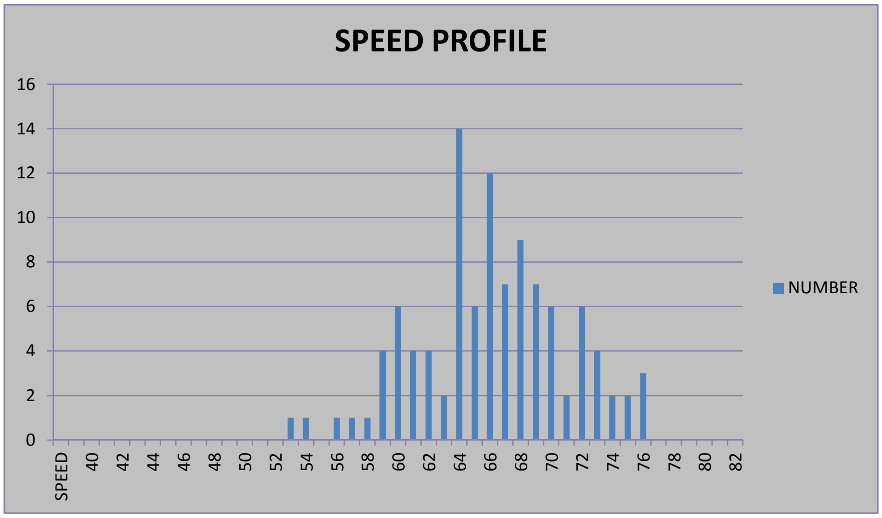
LOCATION: NORTHBOUND, BETWEEN RICE AND BENSON

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	1	1
54	1	2
55	0	2
56	1	3
57	1	4
58	1	5
59	4	9
60	6	15
61	4	19
62	4	23
63	2	25
64	14	39
65	6	45
66	12	57
67	7	64
68	9	73
69	7	80
70	6	86
71	2	88
72	6	94
73	4	98
74	2	100
75	2	102
76	3	105
77	0	105
78	0	105
79	0	105
80	0	105
81	0	105
82	0	105

TOTAL OBSERVATIONS: 105

MEAN SPEED: 66.15

85TH % SPEED: 72



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

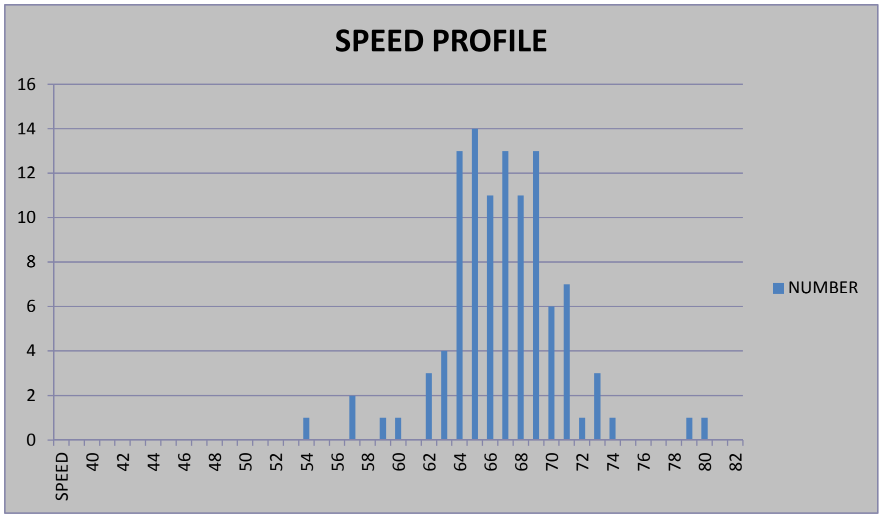
I-229 MIS

LOCATION: NORTHBOUND, BETWEEN BENSON AND 60TH N

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	0	0
54	1	1
55	0	1
56	0	1
57	2	3
58	0	3
59	1	4
60	1	5
61	0	5
62	3	8
63	4	12
64	13	25
65	14	39
66	11	50
67	13	63
68	11	74
69	13	87
70	6	93
71	7	100
72	1	101
73	3	104
74	1	105
75	0	105
76	0	105
77	0	105
78	0	105
79	1	106
80	1	107
81	0	107
82	0	107

TOTAL OBSERVATIONS: 107

MEAN SPEED: 66.82
85TH % SPEED: 70



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

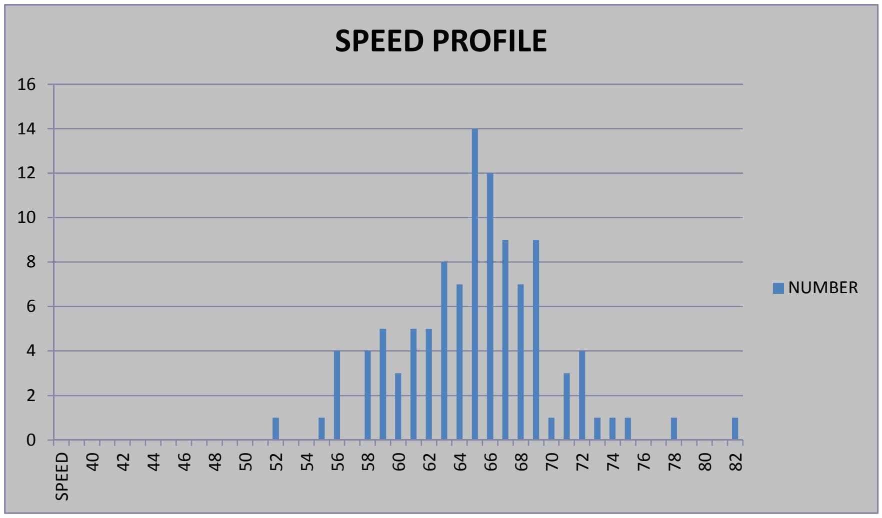
LOCATION: SOUTHTHBOUND, BETWEEN 60TH N AND BENSON

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	1	1
53	0	1
54	0	1
55	1	2
56	4	6
57	0	6
58	4	10
59	5	15
60	3	18
61	5	23
62	5	28
63	8	36
64	7	43
65	14	57
66	12	69
67	9	78
68	7	85
69	9	94
70	1	95
71	3	98
72	4	102
73	1	103
74	1	104
75	1	105
76	0	105
77	0	105
78	1	106
79	0	106
80	0	106
81	0	106
82	1	107

TOTAL OBSERVATIONS: 107

MEAN SPEED: 65.05

85TH % SPEED: 69



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

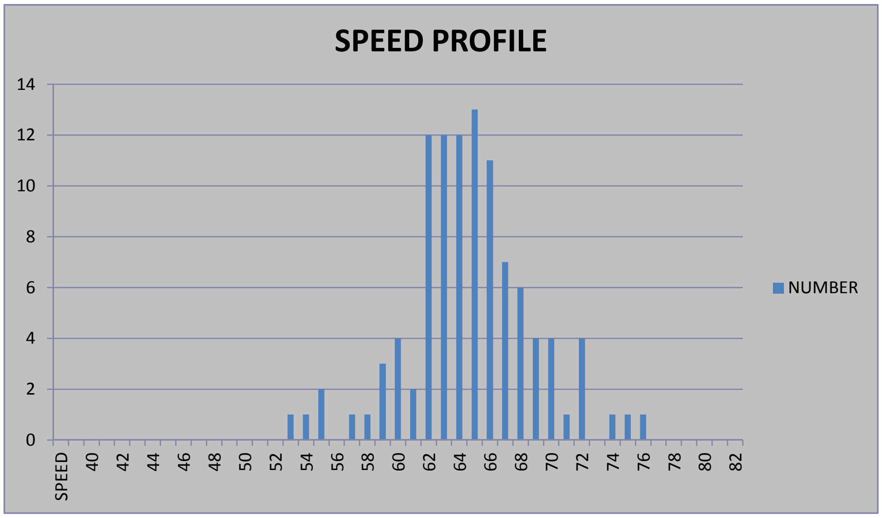
LOCATION: SOUTHBOUND, BETWEEN BENSON AND RICE

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	1	1
54	1	2
55	2	4
56	0	4
57	1	5
58	1	6
59	3	9
60	4	13
61	2	15
62	12	27
63	12	39
64	12	51
65	13	64
66	11	75
67	7	82
68	6	88
69	4	92
70	4	96
71	1	97
72	4	101
73	0	101
74	1	102
75	1	103
76	1	104
77	0	104
78	0	104
79	0	104
80	0	104
81	0	104
82	0	104

TOTAL OBSERVATIONS: 104

MEAN SPEED: 64.68

85TH % SPEED: 68



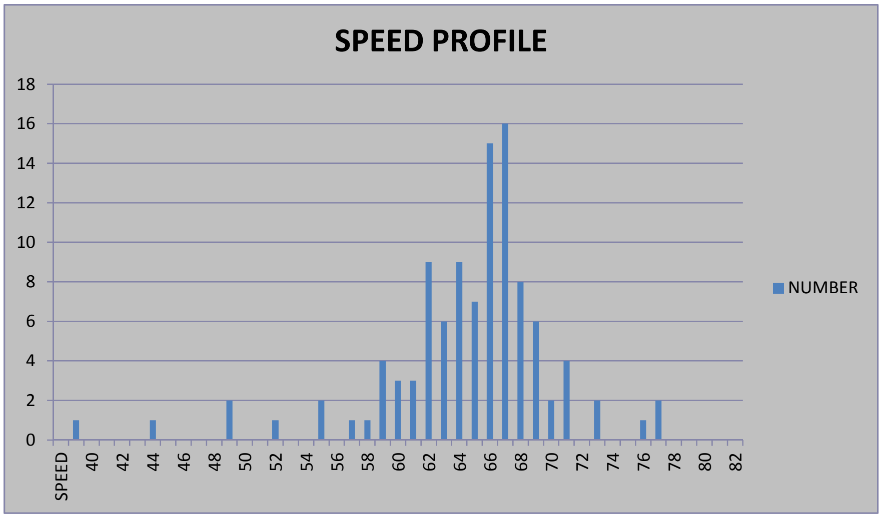
Data Collected Thursday March 14, 2013

SPOT SPEED STUDY
I-229 MIS
LOCATION: SOUTHBOUND, BETWEEN RICE AND 10TH

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	1	1
40	0	1
41	0	1
42	0	1
43	0	1
44	1	2
45	0	2
46	0	2
47	0	2
48	0	2
49	2	4
50	0	4
51	0	4
52	1	5
53	0	5
54	0	5
55	2	7
56	0	7
57	1	8
58	1	9
59	4	13
60	3	16
61	3	19
62	9	28
63	6	34
64	9	43
65	7	50
66	15	65
67	16	81
68	8	89
69	6	95
70	2	97
71	4	101
72	0	101
73	2	103
74	0	103
75	0	103
76	1	104
77	2	106
78	0	106
79	0	106
80	0	106
81	0	106
82	0	106

TOTAL OBSERVATIONS: 106

MEAN SPEED: 63.81
85TH % SPEED: 69



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

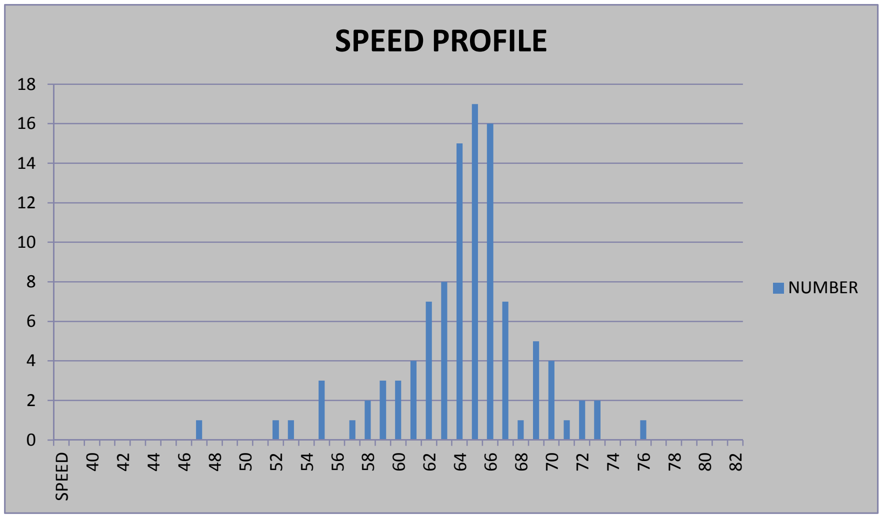
LOCATION: SOUTHBOUND, BETWEEN 10TH AND 26TH

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	1	1
48	0	1
49	0	1
50	0	1
51	0	1
52	1	2
53	1	3
54	0	3
55	3	6
56	0	6
57	1	7
58	2	9
59	3	12
60	3	15
61	4	19
62	7	26
63	8	34
64	15	49
65	17	66
66	16	82
67	7	89
68	1	90
69	5	95
70	4	99
71	1	100
72	2	102
73	2	104
74	0	104
75	0	104
76	1	105
77	0	105
78	0	105
79	0	105
80	0	105
81	0	105
82	0	105

TOTAL OBSERVATIONS: 105

MEAN SPEED: 64.28

85TH % SPEED: 67



SPOT SPEED STUDY

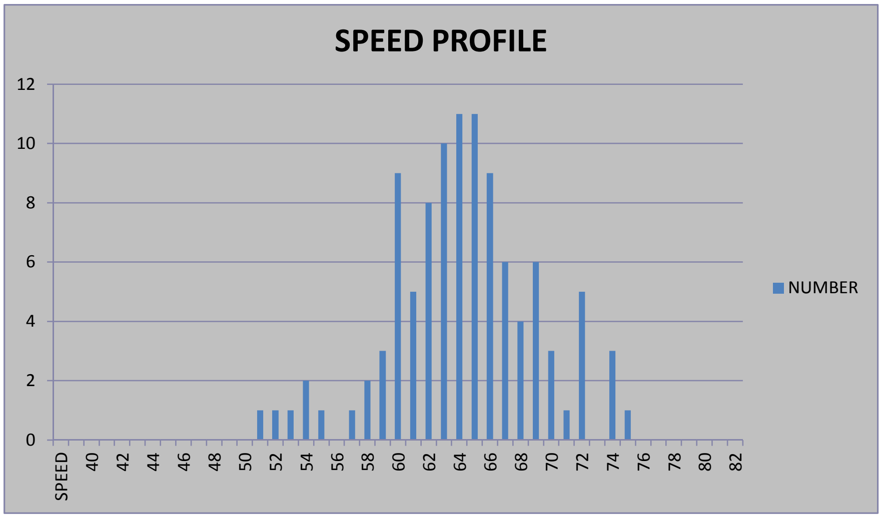
I-229 MIS

LOCATION: SOUTHBOUND, BETWEEN 26TH AND CLIFF

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	1	1
52	1	2
53	1	3
54	2	5
55	1	6
56	0	6
57	1	7
58	2	9
59	3	12
60	9	21
61	5	26
62	8	34
63	10	44
64	11	55
65	11	66
66	9	75
67	6	81
68	4	85
69	6	91
70	3	94
71	1	95
72	5	100
73	0	100
74	3	103
75	1	104
76	0	104
77	0	104
78	0	104
79	0	104
80	0	104
81	0	104
82	0	104

TOTAL OBSERVATIONS: 104

MEAN SPEED: 64.22
85TH % SPEED: 69



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

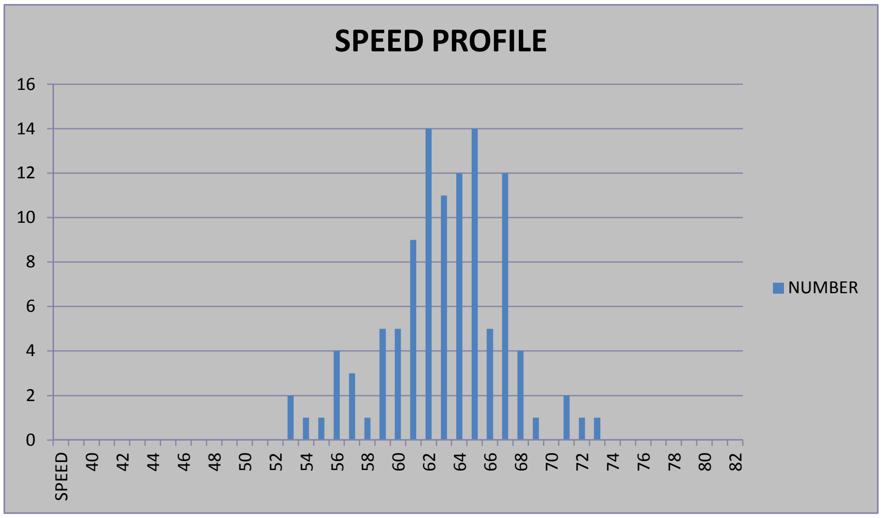
I-229 MIS

LOCATION: SOUTHBOUND, BETWEEN CLIFF AND MINNESOTA

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	0	0
53	2	2
54	1	3
55	1	4
56	4	8
57	3	11
58	1	12
59	5	17
60	5	22
61	9	31
62	14	45
63	11	56
64	12	68
65	14	82
66	5	87
67	12	99
68	4	103
69	1	104
70	0	104
71	2	106
72	1	107
73	1	108
74	0	108
75	0	108
76	0	108
77	0	108
78	0	108
79	0	108
80	0	108
81	0	108
82	0	108

TOTAL OBSERVATIONS: 108

MEAN SPEED: 63.08
85TH % SPEED: 67



SPOT SPEED STUDY

I-229 MIS

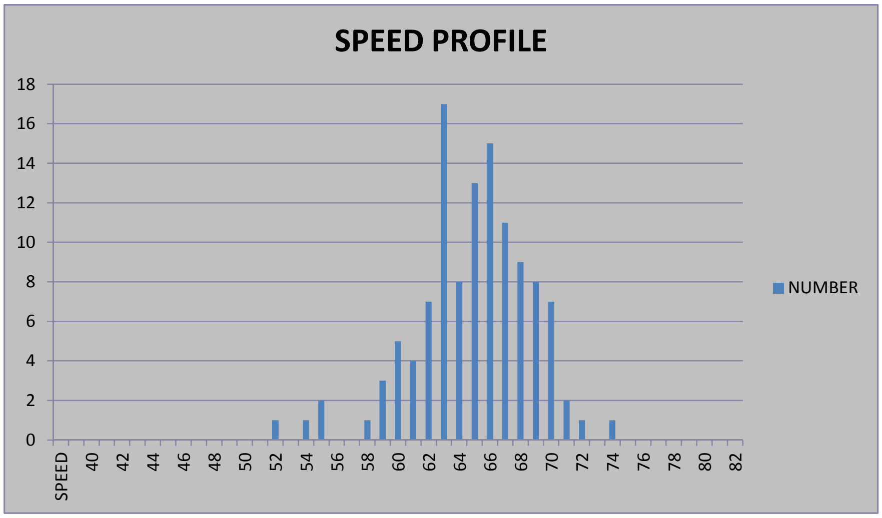
LOCATION: SOUTHBOUND, BETWEEN MINNESOTA AND WESTERN

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	0	0
52	1	1
53	0	1
54	1	2
55	2	4
56	0	4
57	0	4
58	1	5
59	3	8
60	5	13
61	4	17
62	7	24
63	17	41
64	8	49
65	13	62
66	15	77
67	11	88
68	9	97
69	8	105
70	7	112
71	2	114
72	1	115
73	0	115
74	1	116
75	0	116
76	0	116
77	0	116
78	0	116
79	0	116
80	0	116
81	0	116
82	0	116

TOTAL OBSERVATIONS: 116

MEAN SPEED: 64.88

85TH % SPEED: 69



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

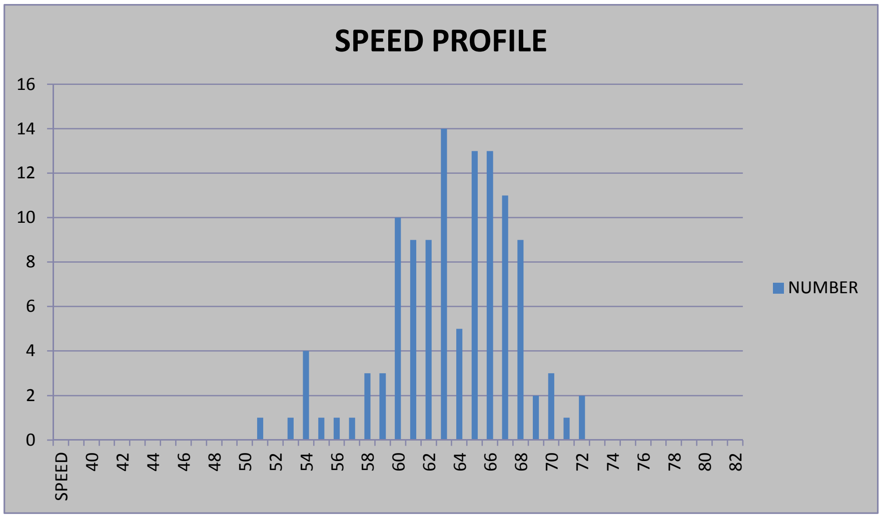
LOCATION: SOUTHBOUND, BETWEEN WESTERN AND LOUISE

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	1	1
52	0	1
53	1	2
54	4	6
55	1	7
56	1	8
57	1	9
58	3	12
59	3	15
60	10	25
61	9	34
62	9	43
63	14	57
64	5	62
65	13	75
66	13	88
67	11	99
68	9	108
69	2	110
70	3	113
71	1	114
72	2	116
73	0	116
74	0	116
75	0	116
76	0	116
77	0	116
78	0	116
79	0	116
80	0	116
81	0	116
82	0	116

TOTAL OBSERVATIONS: 116

MEAN SPEED: 63.47

85TH % SPEED: 67



Data Collected Thursday March 14, 2013

SPOT SPEED STUDY

I-229 MIS

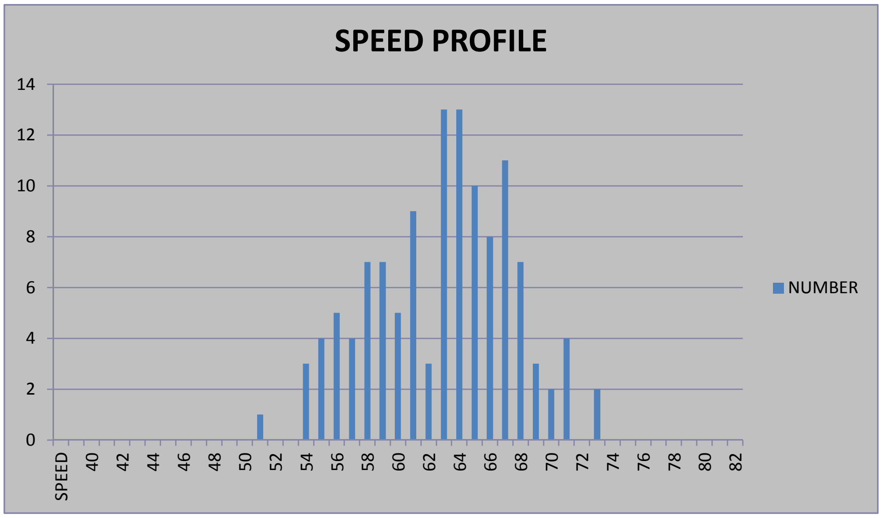
LOCATION: SOUTHBOUND, BETWEEN LOUISE AND SOLBERG

SPEED	NUMBER OBSERVED	ACCUMULATED NUMBER
39	0	0
40	0	0
41	0	0
42	0	0
43	0	0
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	1	1
52	0	1
53	0	1
54	3	4
55	4	8
56	5	13
57	4	17
58	7	24
59	7	31
60	5	36
61	9	45
62	3	48
63	13	61
64	13	74
65	10	84
66	8	92
67	11	103
68	7	110
69	3	113
70	2	115
71	4	119
72	0	119
73	2	121
74	0	121
75	0	121
76	0	121
77	0	121
78	0	121
79	0	121
80	0	121
81	0	121
82	0	121

TOTAL OBSERVATIONS: 121

MEAN SPEED: 62.93

85TH % SPEED: 67



Data Collected Thursday March 14, 2013

APPENDIX C. ORIGIN-DESTINATION DATA

Origin-Destination Data

The O-D data from AirSage was gathered for a 30-day period from February 12, 2013 to March 13, 2013. During this time, a total of 1.5 million unique devices were recognized. AirSage reported a sampling rate of 32.4% of the population in Sioux Falls.

Over the data collection period, the O-D data was organized in four unique data sets, including:

- Average Weekday Trips (22 day average)
- Average Weekend Trips (8 day average)
- 2/13/2013 Trips (AM construction activity, I-229 SB near 18th Street, lane closure due to guardrail work)
- 2/22/2013 Trips (Winter weather, 3-6” of snow, school was not cancelled)

The O-D data was provided by 5 time periods: Morning (6-10 AM), Mid-day (10 AM-3 PM), Afternoon (3-7 PM), Evening (7 PM-12 AM), Night (12 AM-6 AM), and by 9 trip purposes: HH, HO, OH, HW, WH, WW, WO, OW, and OO. H indicates the “Home” trip end, “W indicates “Work” trip end and O indicates “Other” trip end, such that HW relates to a trip from home to work.

The study area used in the O-D data collection included the 686 travel analysis zones (TAZ’s) used in the Sioux Falls MPO travel demand model, in addition to 30 external TAZs, which were roughly defined by a 60-mile radius from the center of Sioux Falls. A map of the AirSage Data coverage is shown in ***FIGURE 1***. Within the study coverage area, 145,735 devices with home assignments were identified. This can be compared to a census population of 448,603, yielding a 32.4% sampling rate of the Sioux Falls area.

Review of the O-D data showed trends in the number of trips made in the Sioux Falls region by day of the week. As shown below in ***FIGURE 2***, trip making generally increased on a weekly basis from Monday to Friday, with decreases on Saturday and Sunday.

Figure 1. AirSage Origin-Destination Data Coverage

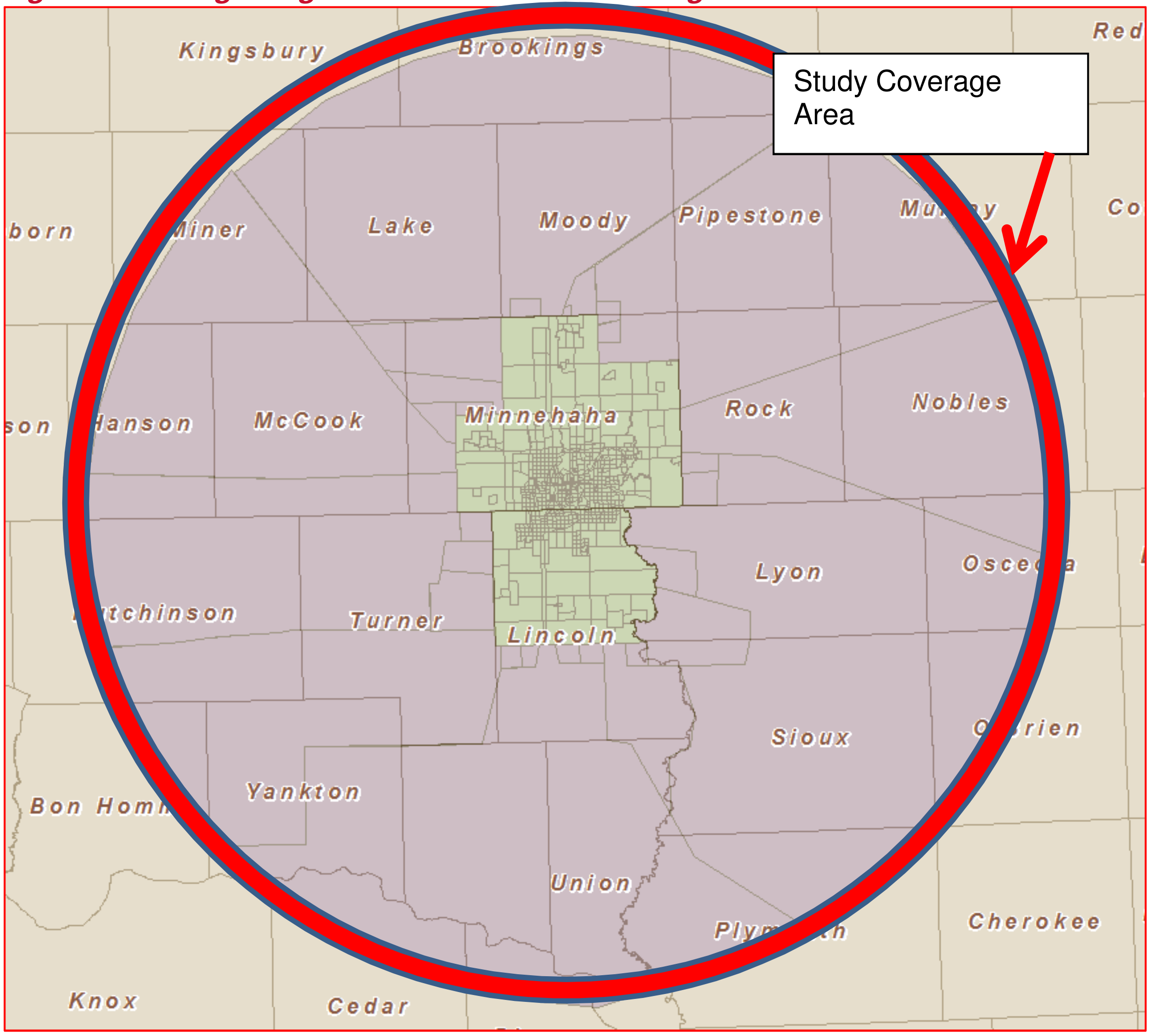
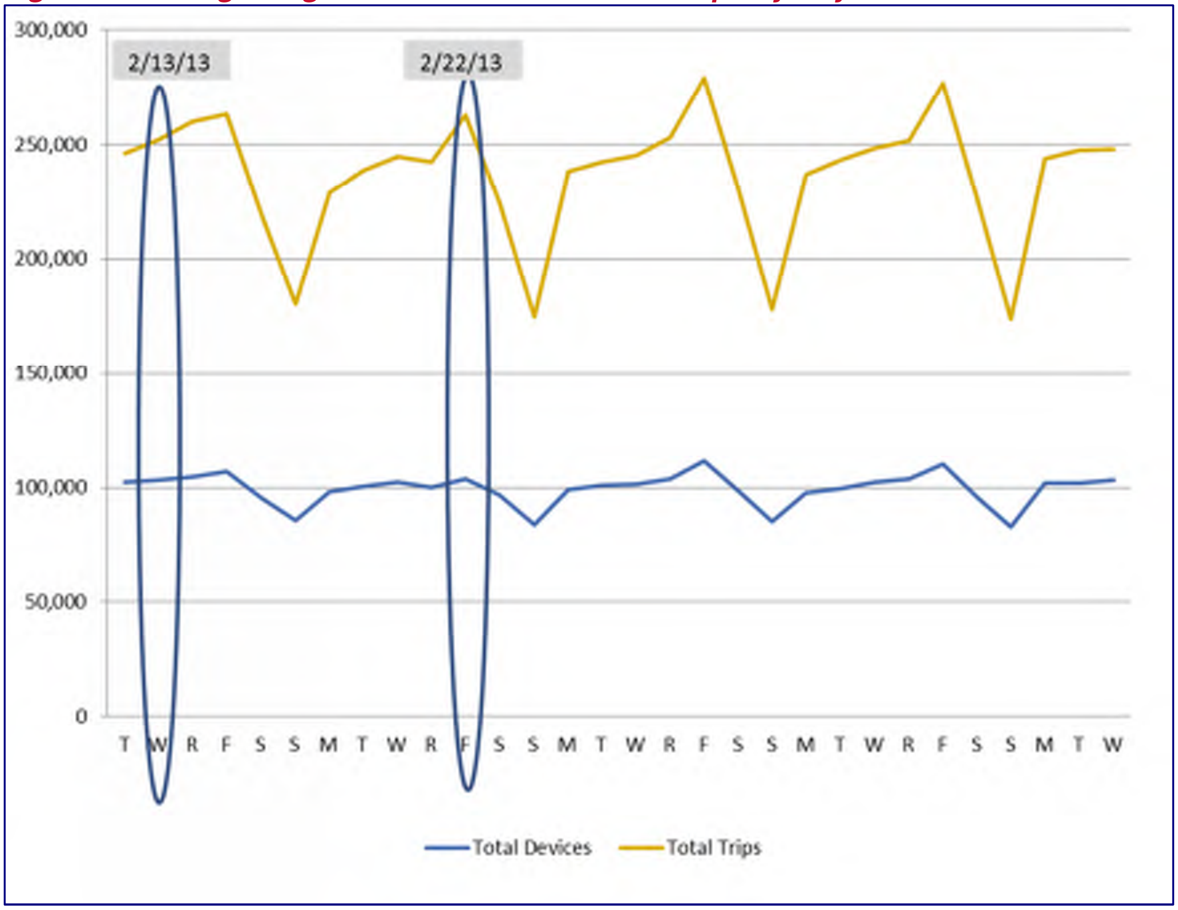


Figure 2. AirSage Origin-Destination Data Total Trips by Day of the Week

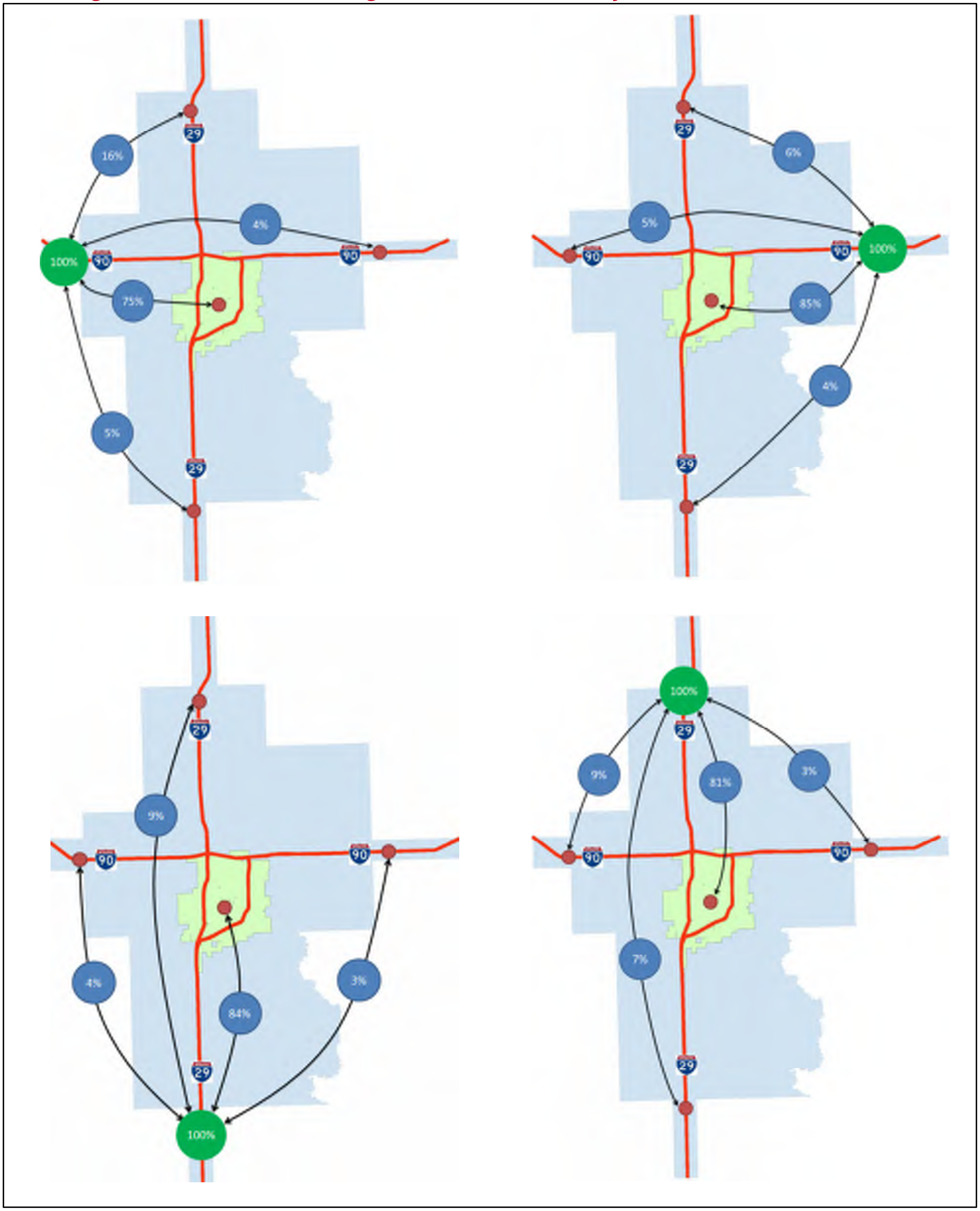


LOCAL VS. REGIONAL TRIPS

The AirSage O-D data allowed for an understanding of regional travel patterns. An illustration of the percentage of vehicles entering and exiting the Sioux Falls metro area along the Interstate is shown in ***FIGURE 3***. The percentages shown represent all trips starting and ending at the four major interstate points outside of the metro area (I-29 North, I-29 South, I-90 East and I-90 West).

This assessment shows, for example, that of all of the trips (100%) that began or ended south of Sioux Falls on I-29, 84% of those trips either ended or began within the urban core of Sioux Falls, and 9% of those trips either ended or began north of Sioux Falls on I-29. These figures generally show the strong connection between the interstate system and local traffic in the urban core of Sioux Falls.

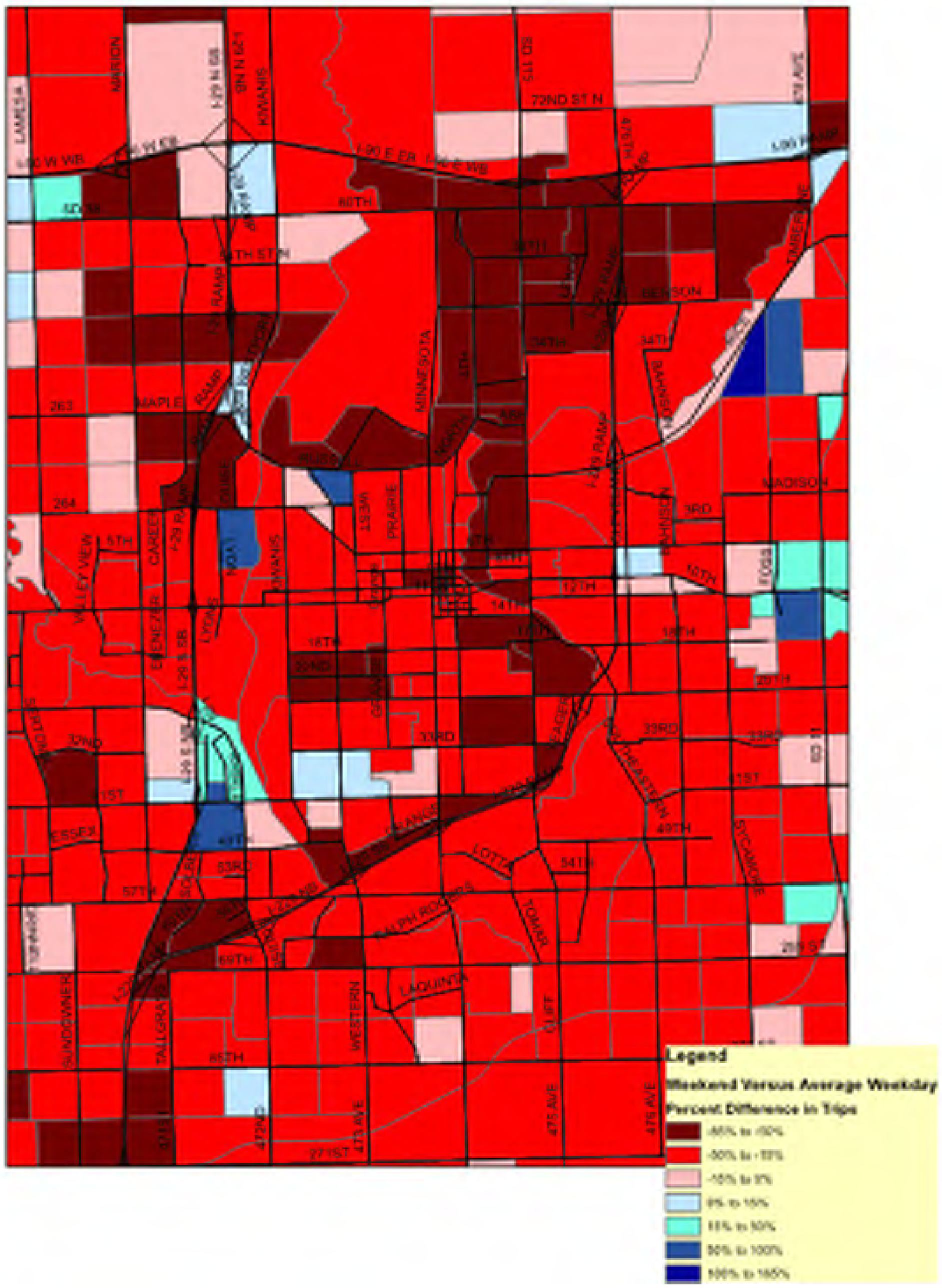
Figure 3. External Travel Origins and Destinations By Interstate Location



WEEKEND VS. WEEKDAY TRIPS

The AirSage O-D data also allowed for a comparison of average weekday trip patterns compared to an average weekend day. For the overall Sioux Falls region, the total number of average weekend trips was 75% of average weekday trips. ***FIGURE 4*** shows the percent difference in trips comparing weekend to weekday trips. Along the I-229 corridor, many zones show a weekend decrease in trips. An increase of weekend trips is found in zones containing special event/recreational characteristics, such as Great Bear Park, Empire Mall, and the Arena.

Figure 4. Origin-Destination Data Weekend vs. Weekday Trips



Weather Related Incident

An O-D matrix showing zonal pairs of origins and destinations matrix from February 22, 2013 provided a look at how travel patterns changed due to inclimate weather, compared to an average weekday. On this date, schools remained open, and the reported snowfall was 6 inches. This weather related incident day also fell on a Friday. Inspection of trip-making totals by day of week (as was shown in ***Figure 2***), shows that Friday is consistently the day of the week with the most total trips. Thus, as shown in ***Figure 5***, the net effect of the weather incident on trip making patterns was greatly varied, with some zones showing more trips, some zones showing less trips, generated during the weather incident day.

Construction Incident

An O-D matrix showing zonal pairs of origins and destinations matrix from February 13, 2013 provided a look at how travel patterns changed in the AM period due to a lane closure on I-229, compared to the AM period on an average weekday. On this date, a lane on I-229 southbound was closed in the morning due to guardrail work at Exits 4 (Cliff Avenue) and 6 (10^{th} Street). ***Figure 6*** shows the percent difference in AM trips for the construction incident day versus an average weekday. The lane closure appeared to have slightly increased trip activity adjacent to Bahnson Avenue, and slightly decreased trip activity south and west of Southeastern Avenue.

Figure 5. Origin-Destination Data Weather Incident vs. Average Weekday

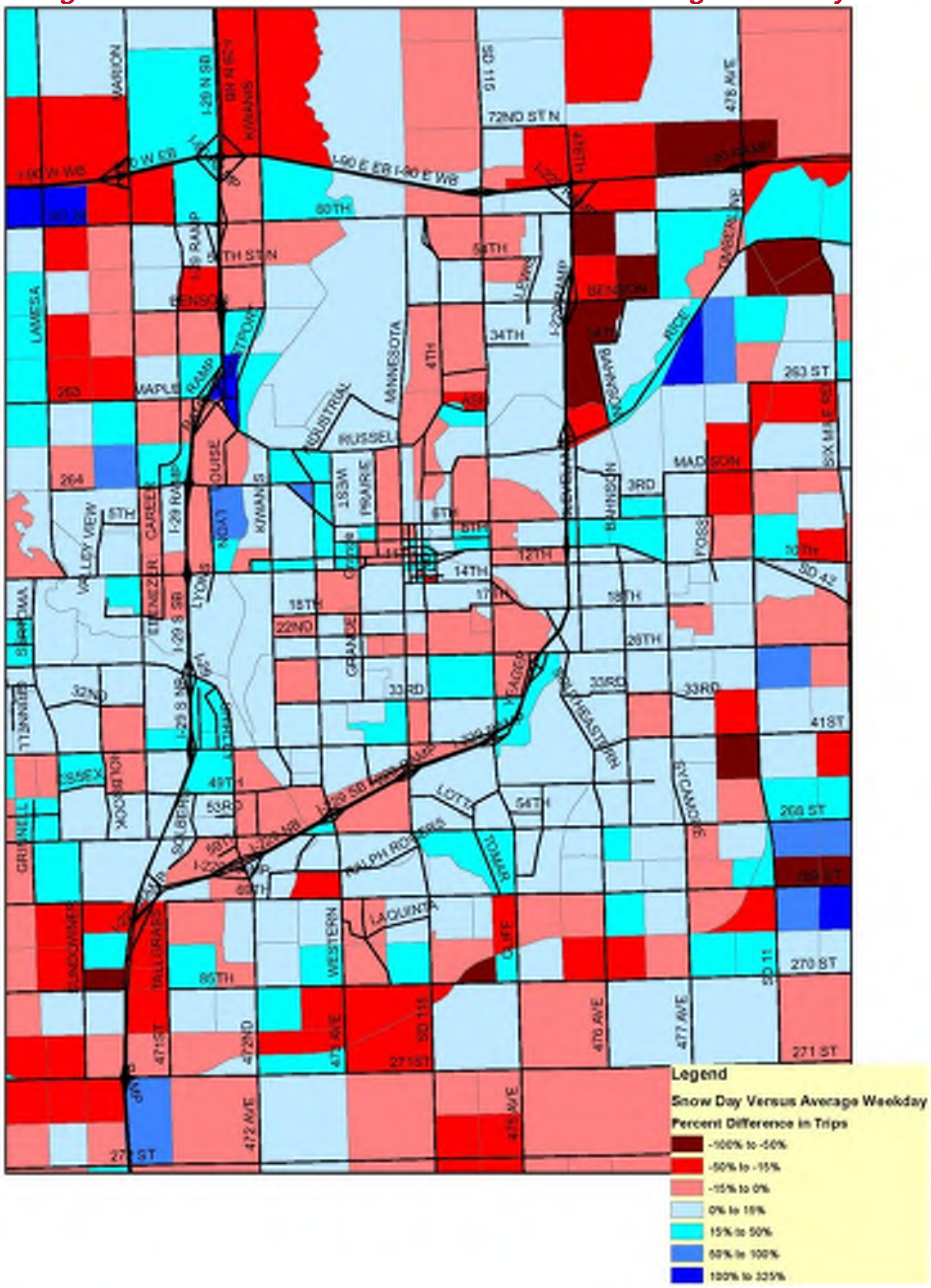
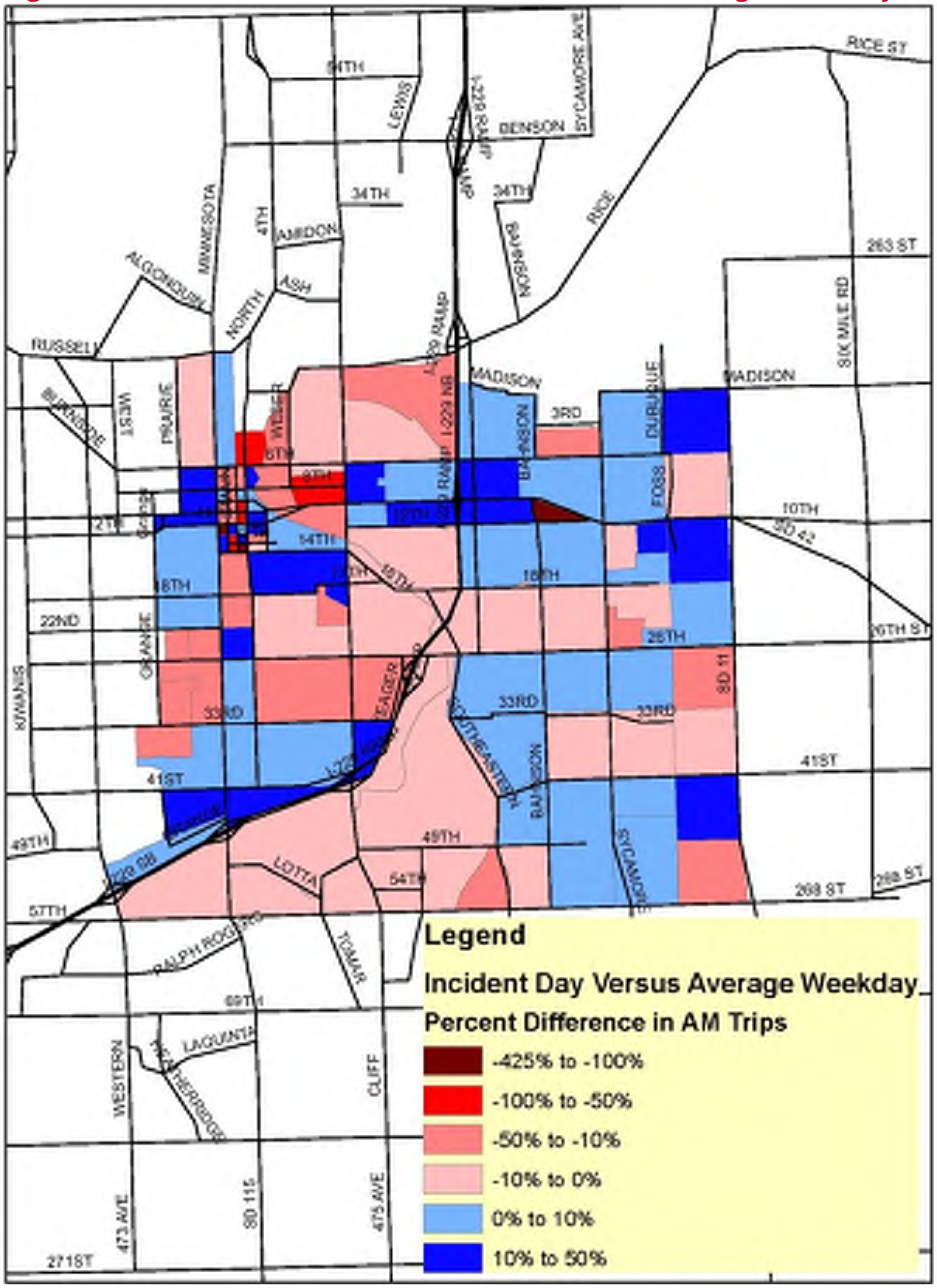


Figure 6. Origin-Destination Data Construction Incident vs. Average Weekday



APPENDIX D -

DTA MODEL VALIDATION REPORT

I-229 MIS Model Validation and Application Approach Report

HDR, July 2014

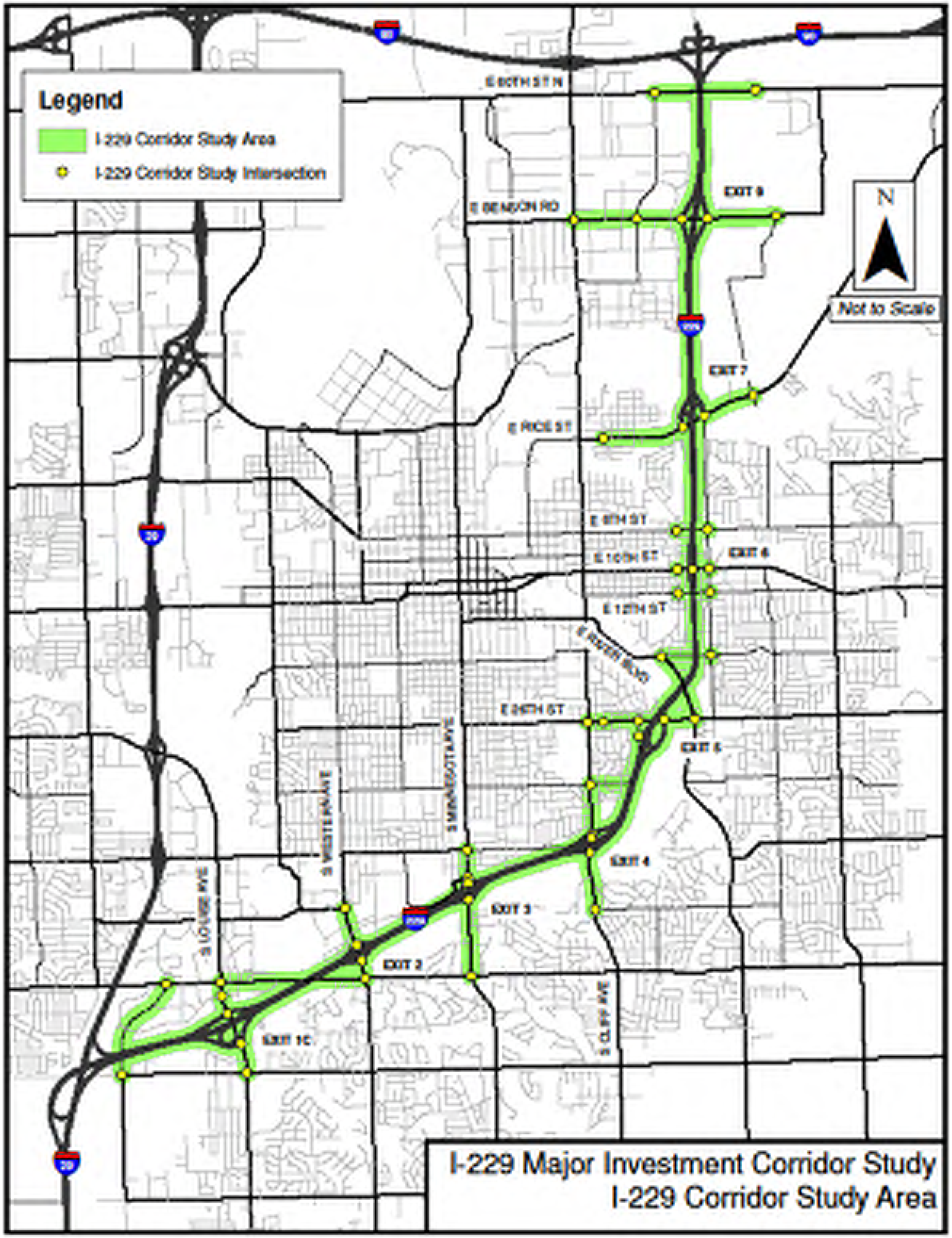
INTRODUCTION

The I-229 Major Investment Corridor Study (MIS) was commissioned by the South Dakota Department of Transportation (SDDOT) to identify the existing and future operational performance of Interstate 229, its associated ramps, and cross streets in Sioux Falls, South Dakota. FIGURE 1 displays the limits of the study area. For study area roadways and intersections that do not meet particular level of service expectations, conceptual improvements will be developed and analyzed, both individually and as a group, to identify a grouping of improvements that optimize system performance.

Multi-resolution modeling - including mesoscopic simulation with dynamic traffic assignment (DTA) using Cube Avenue - was chosen to estimate realistic travel patterns in the congested study area network. Multi-resolution modeling is an analytic approach that attempts to make use of information at multiple scales, both spatially (area-based) and temporally (time-based). The multi-resolution model (I-229 MIS model) will be used to perform a high-level analysis of conceptual improvements, and to assist in the development of traffic volume projections.

The I-229 MIS model was developed by the project team based on the Sioux Falls Metropolitan Planning Organization (MPO) regional travel demand model with an added sub-area evaluation using mesoscopic simulation and DTA. The first section of this report will cover the validation of the I-229 MIS model. The second section of this report will cover the intended applications of the I-229 MIS model.

Figure 1. I-229 Major Investment Corridor Study Area



I-229 MIS MODEL DEVELOPMENT AND VALIDATION

Role and Development of the I-229 MIS Model

The I-229 MIS model was developed to best utilize data at multiple spatial and temporal scales to provide the most accurate representation of traffic flow and traffic operations in regard to the I-229 corridor. The I-229 MIS model processes sequentially through three resolutions: the macro-scale, regional meso-scale, and sub-area meso-scale. Each resolution provides an opportunity to analyze a different aspect of changes to the Sioux Falls network. The I-229 MIS model starts by analyzing 2-hour AM and PM peak periods for the entire region at the macro-scale, and then refines the traffic demand on the network to hourly demand for use in the regional meso-scale simulation. Moving from the regional meso-scale simulation to the sub-area meso-scale simulation, the model network is reduced in size to just the I-229 area of influence (as shown in FIGURE 2). Also at this stage, the hourly demand volumes are refined to fifteen minute intervals. This refinement uses an origin-destination matrix estimation (ODME) procedure to leverage counts when developing the fifteen minute levels of demand. The ODME also utilizes AirSage cell phone origin-destination trip tables as seed matrices. Input from the macro-model is not part of the process in developing base year traffic demand.

The macro-model's primary link to the rest of the I-229 model is in developing growth factors for future year analysis.

Macro-Scale

The macro-scale (or regional travel demand) model is the first component of the I-229 MIS model. The primary purpose of the macro-scale model within this multi-resolution model is to identify trips that interact with the study area. All trips interacting with the study area will be included in the mesoscopic DTA portion of the model. Additionally, the travel demand model may also be used independently of the mesoscopic DTA model to offer screening comparisons of future year alternatives utilizing measures such as V/C ratio. These ratios will provide a high-level examination at the level of congestion on individual links over an aggregate peak period.

Meso-Scale

The second element of the I-229 MIS model is the meso-scale model. In the I-229 MIS model two levels of meso-scale modeling are performed: regional simulation and sub-area simulation.

- *Regional Simulation*. In the regional simulation modeling, a combined regional scale static and dynamic traffic assignment is performed, with simulation of only those trips that interact with the study corridor. The regional simulation acts as a transitional phase of the model, providing an intermediate level of temporal refinement while still looking at traffic patterns over the entire region.
- *Sub-area Simulation*. At the sub-area simulation scale, a detailed fully dynamic traffic assignment and simulation is performed in the study sub-area network. The sub-area simulation provides the finest level of temporal detail and improved realism in the simulation of intersections compared to the macro model and regional simulation.

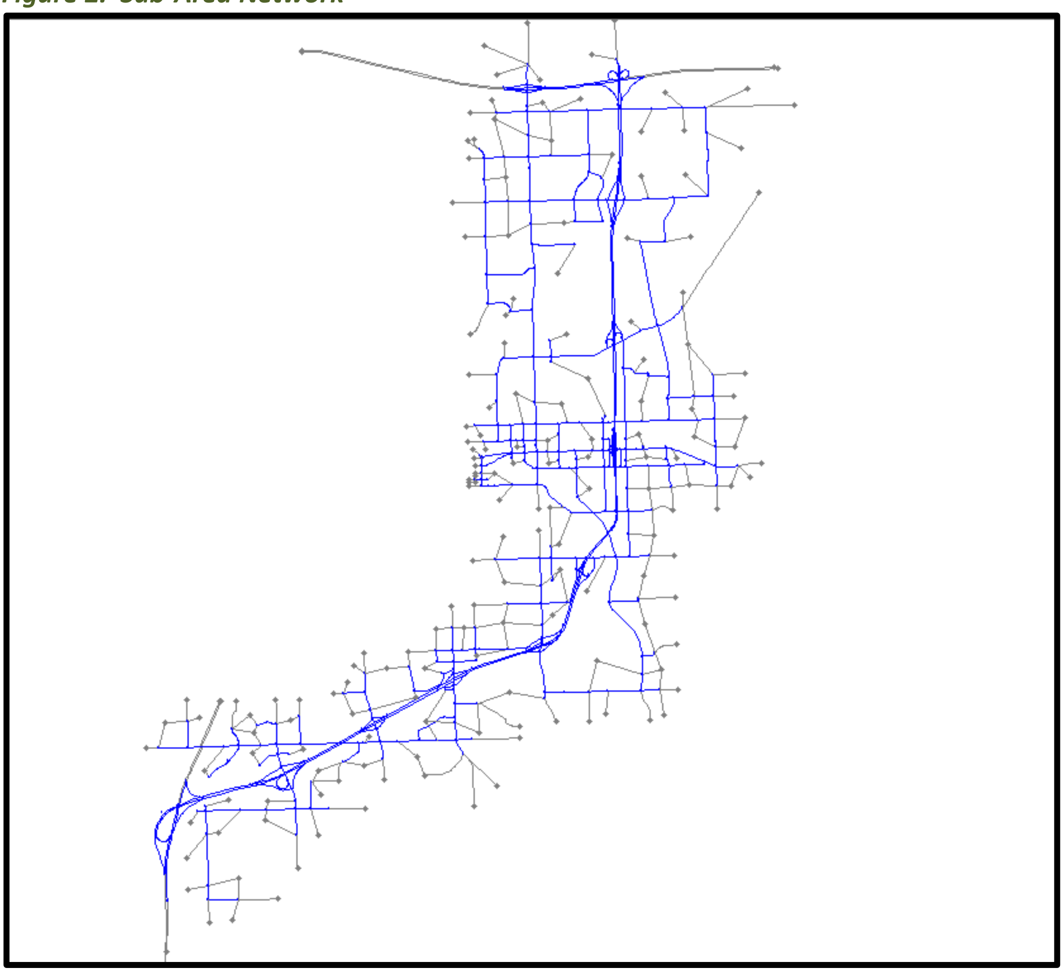
The multi-resolution model as a whole allows analysis of traffic flows ranging from peak periods to fifteen minute intervals. It also allows for the examination of network impacts ranging from a high level (V/C ratio) to a detailed level (peak fifteen minute queues).

Validation of the Macro-Scale Model for I-229 MIS

The macro-scale component of the I-229 MIS model is the Cube Voyager format travel demand model from the Sioux Falls MPO. The Sioux Falls MPO model was calibrated to the 2008 base year prior to the start of the I-229 MIS, and thus no additional regional calibration or regional validation was performed on the model for this project. The calibrated model files received from the MPO included model output assignment volumes for peak periods and daily traffic, as well as attribute data for 2008 average daily traffic (ADT) counts.

However, since the macro-scale model was repurposed to feed sub-area travel demand, a sub-area validation was performed on the portion of the model network that included the study area for the I-229 Corridor Study. Travel demand model link attributes such as speed limits, number of lanes, area type, facility type, and control device were reviewed for consistency. This sub-area network is shown in FIGURE 2.

Figure 2. Sub-Area Network



The 2008 Cube Voyager travel demand model was further reviewed in the study area for a comparison of the daily counts (2008 ADT) and the raw model daily assignments. Sub-area validation was based on the calculation of percent root mean square error (RMSE) between 2008 ADT counts and the model generated link flows. Root Mean Square Error is a measure of the relative error between the count and model assignment, where the smaller the value, the closer the modeled assignment is to the target count. Ideally, values of zero for each of these statistics would mean that the model assignment is exactly the same as the actual traffic count.

The percent RMSE, or Relative RMSE (RRMSE) was calculated for the entire sub-area and also for several sub-groups of link flows as shown in TABLE 1. The use of volume-based grouping to check percent RMSE provides more detailed model results for facilities with the greatest regional significance, while the area-wide check documents that the model is maintaining a certain standard of accuracy for all links in the sub-area. The calculated percent RMSE values were compared to acceptable and desirable thresholds that have been established by the Florida DOT and are consistent with standard practice in travel demand modeling. All calculated percent RMSE values surpassed desirable ranges.

Table 1. Macro Model Sub-Area Validation Based on RRMSE by Daily Volume Group

Daily Volume Group	Error Squared[1]	Number of Counts[1]	Sum of Counts[1]	Calculated RRMSE (Sub-Area)[1]	Acceptable RRMSE Goal[2]	Desirable RRMSE Goal[2]
< 5,000 VPD	1.2E+08	125	335,040	37%	100%	45%
5,000 - 9,999 VPD	3.3E+08	126	913,100	22%	45%	35%
10,000 - 14,999 VPD	1.78E+08	71	859,700	13%	35%	27%
15,000 - 19,999 VPD	74445879	14	236,100	14%	30%	25%
20,000 - 29,999 VPD	31289392	8	171,000	10%	27%	15%
Area-wide	7.33E+08	344	2,514,940	20%	45%	35%

[1]*Source: Sioux Falls MPO Travel Demand Model*
[2]*Source: RMSE Ranges- Source: Florida DOT, Systems Planning Office, FSUTMS-Cube Framework Phase II Model Calibration and Validation Standards, Table 2.11*

Additionally, a review of the raw model volume assignments compared to the counts, by facility type, was conducted. Desirable ranges for the ratio of raw model volume (base year 2008 assignment) to 2008 ADT count were calculated as a ratio, where 1.0 reflects a link with the model assignment exactly the same as the ground count. Sub-area links were grouped by facility type, with an aggregated Volume to Count Ratio as shown in TABLE 2. The average ratios are shown as a basic average of the links, and also as a weighted average by count volume.

Table 2. Macro Model Sub-Area Validation Based on Daily Volume to Count Ratio by Facility Type

Facility Type	Volume to Count Ratio			
	Target Range Minimum	Target Range Maximum	Sub-Area Link Average	Sub-Area Link Average, Weighted by Volume
Freeway	0.93	1.07	0.97	0.96
Arterial & Ramp	0.85	1.15	1.02	0.98
Collector	0.75	1.25	1.10	0.89

From TABLE 2, it is evident that the corridor sub-area within the macro model provides daily volumes that are similar to traffic counts based on the target ranges. This finding, coupled with the volume to traffic count comparison based on RRMSE, led the project team to consider the sub-area of the macro model validated.

Validation of the Meso-Scale Model for I-229 MIS

The meso-scale portion of the I-229 model includes both the regional simulation and sub-area simulation. In the model the regional simulation acts as an intermediary between the macro-model and the sub-area simulation. Due to that role, the regional simulation was not independently validated, but considered acceptable based on the validation of the macro-scale and sub-area simulation components.

The sub-area meso-scale simulation underwent a validation effort to establish that the model accurately reflects base year conditions. Unlike the macro-scale component, the sub-area meso-scale model used the newest traffic demand data available to set as a base year target. Thus the sub-area meso-scale model was validated to the base year of 2012, which matched the primary year of traffic count collection for the I-229 MIS and is reasonably close to the same time frame for the demand data collected in early 2013 by AirSage.

Prior to validating meso-scale model results, the model was checked to determine if the dynamic traffic assignment had reached an acceptable level of convergence. The model was structured to iteratively run through dynamic origin-destination matrix estimation and dynamic traffic assignment until a convergence criterion was met. The dynamic origin-destination matrix estimation would use assignment techniques and count data to iteratively improve the trip matrix and then dynamic traffic assignment would be run to load the improved trip matrix to the network. The output of the dynamic traffic assignment would include traffic volumes, which could then be compared to the traffic counts input in the dynamic origin-destination matrix estimation. If the model volumes were similar to the traffic counts within a certain error tolerance, then the iterative trip matrix estimation process was concluded and the dynamic traffic assignment was considered to have reached convergence. The error tolerance or convergence criterion used for this procedure was model volumes within 10% relative root mean square error of turning movement count data.

The validation was primarily driven by criteria listed in the scope of work for the I-229 Major Investment Corridor Study, with a target for validation at a minimum R-Squared value of 0.90. This value is an aggregated measure of the goodness of fit between count volumes and volume outputs from the model, for the Sub-area network. As shown in FIGURE 3 and FIGURE 4, linear regression was performed for both AM and PM peak periods yielding R-Squared values of 0.91 and 0.90 for the AM and PM peak periods, respectively.

Figure 3. AM Peak Period Meso-Model Link Volumes versus Link Traffic Counts

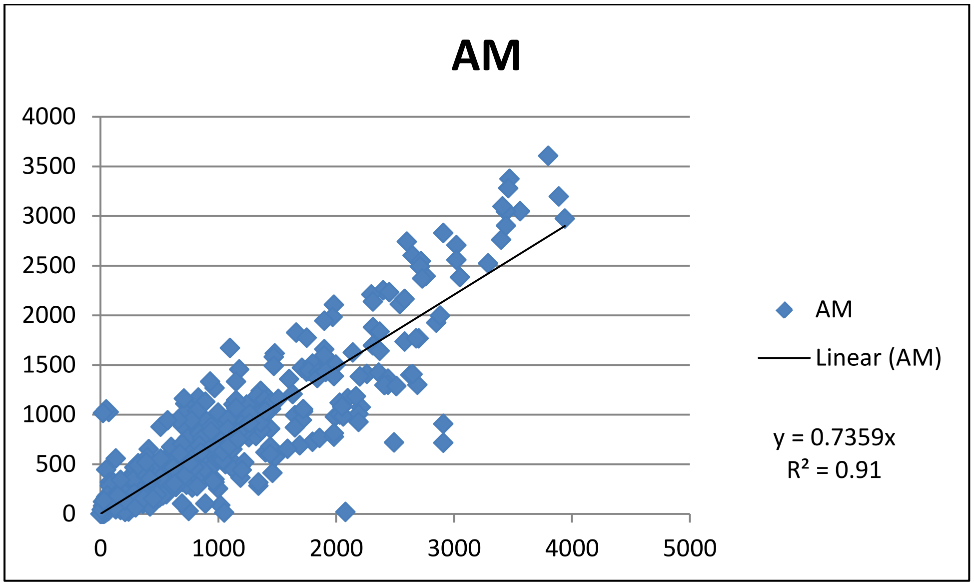
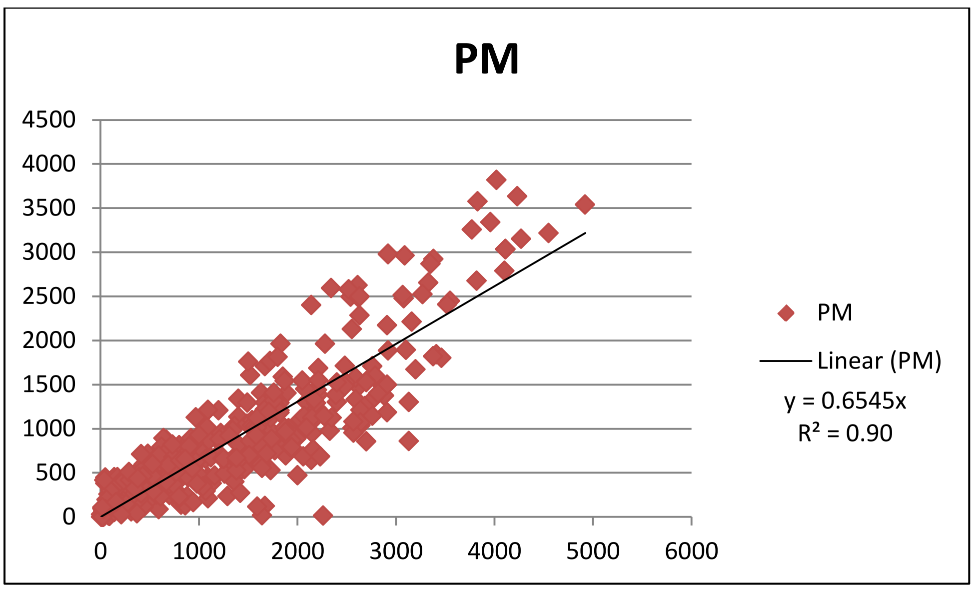


Figure 4. PM Peak Period Meso-Model Link Volumes versus Link Traffic Counts



In addition to the criteria of R-Squared, the project team evaluated the model output using several additional methods. These additional methods are offered by the project team as a supplement to R-

Squared criteria called for in the I-229 MIS scope of work, and to more thoroughly assess the I-229 MIS model such that it can be utilized as intended for the study.

The following supplemental standards were examined, with explanations following in the next section of this memo.

- Primary Analysis Area
    - Queue Visualization
- Full Sub-Area
    - RRMSE by volume group

Primary versus Secondary Analysis Areas

Mesoscopic models can vary widely in their capabilities as they are still an emerging technology. As such, the calibration of a mesoscopic model should be considered relative to the model's intended use. The I-229 MIS model will be used primarily for high-level screening alternative interchange configurations and secondarily as a tool for forecasting future traffic volumes. Thus, the I-229 MIS study area (as was shown in **FIGURE 2**) is further characterized as primary and secondary analysis areas.

The primary analysis area includes the interchange areas as well as the mainline freeway, which are linked to the interchanges. This primary analysis area must be scrutinized more closely than the full model sub-area because this primary area will be used in this study to provide measures of effectiveness, such as congested speeds, delays, and queue lengths. While the validation check from the project scope verifies similarity between model volumes and traffic counts, additional checks were conducted within the primary analysis area to check that the model is properly handling the dynamics of traffic flow.

The remaining area outside the primary analysis area is the secondary analysis area. This region of the model is important for allowing the proper regional routing of vehicles, but will not be examined for detailed measures of effectiveness. Therefore, the calibration of the secondary analysis area can be treated with less strict calibration standards because output from this area will be used only for volume development, which will be conducted in conjunction with a post-processing procedure. The secondary analysis area is therefore included as a part of the calibration for the full model sub-area, and not calibrated on its own.

Calibration Targets

Queue Visualization (Primary Analysis Area)

In addition to checking the primary analysis area for model volume to traffic count similarity, it is imperative that the model is checked for realism of flow dynamics. More precisely, it has been hypothesized by Greenshields[1] and others that the same traffic volume can occur in either the stable

[1] Greenshields, B., "A Study of Highway Capacity," *Proceedings of the Highway Research Board*, Vol. 14, Transportation Research Board, National Research Council, Washington DC, 1934.

flow or forced flow traffic regimes, so some other measure, such as speed or density, must be checked to verify that the model matches the traffic regime as well as just being similar to the traffic volume. For this particular project, the data for comparison of the modeled versus actual traffic flow regime was limited. However, the knowledge of the corridor amongst the project team was extensive. The best way to rectify the lack of hard data and the need to verify traffic dynamics of the model to field conditions was to use a qualitative comparison, such as continuously animated queues from the model versus anecdotal evidence of the field conditions. The review of model queuing showed that in most locations the queues from the model were reflective of field conditions for each the AM and PM peak periods. The Appendix includes a number of static figures of model queuing at each interchange along I-229. Screen captures were collected to serve as representative queuing animation for each third of the two hour peak period.

RRMSE (Primary and Secondary Analysis Areas)

The relative root mean square error is a commonly used function in the comparison of model volumes to traffic counts in an aggregate manner. The equation looks at links in an aggregate manner according to the equation below. In the equation ***m*** is the model predicted volume for an individual link, ***c*** is the traffic count for the corresponding link, ***N*** is the total number of counts, and the summation is over all model links with counts.

$$\mathrm{RRMSE} = \frac{\sqrt{\sum (\mathrm{m}-\mathrm{c})^2 / (\mathrm{N}-1)}}{\sum \mathrm{c} / \mathrm{N}}$$

Table 3. RRMSE for Primary and Secondary Analysis Areas by Volume Group

Peak Period Volume Group (Vehicles)	Calculated RRMSE (Sub-Area)		Acceptable RRMSE Goal	Desirable RRMSE Goal
	AM	PM		
< 800	66%	57%	100%	45%
800 - 1,600	42%	47%	45%	35%
1,600 - 2,400	40%	48%	35%	27%
2,400 - 3,200	36%	42%	30%	25%
> 3,200	15%	28%	27%	15%
Area-wide	47%	52%	45%	35%

TABLE 3 shows the RRMSE for Sub-Area links by volume group. A low RRMSE reflects good similarity between model volumes and traffic counts, but the use of volume groups allows the analyst to see if the model is better reflecting high priority roadways as opposed to low priority roadways. As some error is to be expected, especially for low priority roadways, a point of reference can be helpful in reviewing the RRMSE. The *FSUTMS-Cube Framework Phase II Model Calibration and Validation Standards* were translated to peak hour volumes using a conversion factor of peak period traffic equaling 16% of daily traffic and are displayed in the table with acceptable and desirable goals to illustrate how tolerances for RRMSE change by volume group. These travel demand modeling (macro-scale) goals are shown as there are currently no set RRMSE criteria for mesoscopic modeling.

The RRMSE for the I-229 model only meets some of the acceptable targets and almost none of the desirable targets by FSUTMS standards. The analysis by volume groups does show that even beyond the primary analysis area the model does a better job of modeling the highest volume, highest priority corridors.

Summary Discussion of Mesoscopic Model Calibration

Upon finalizing the mesoscopic component of the I-229 MIS model, it was compared against the R-Squared calibration target of 0.90 when relating model volumes to traffic counts set in the project scope of work. The I-229 model met the R-Squared target, with an R-Squared of 0.91 in the AM and 0.90 in the PM. In addition to the R-Squared target, the project team sought to include supplemental model evaluation methods to determine if the model is a reliable tool for its intended use in the study. The I-229 model was compared to traffic counts using RRMSE for multiple volume groups. An assessment was also conducted to review model flow dynamics to field conditions using a review of model queue outputs.

Based on the project team's experience and the level of similarity between model volume and queue outputs to field conditions, the project team concludes that the model should be considered calibrated for its intended use in this study. The project team also concludes that the model has shortcomings, and that those shortcomings should be recognized in the future use of this model as a high-level screening tool for the I-229 MIS. Key takeaways from this exercise lead the project team to the following conclusions for the meso-scale model's use in the I-229 MIS:

- Volume outputs generated from the I-229 mesoscopic model using DTA should be treated with an adjusting post-processing procedure, in order to account for deviations between the base year counts versus base year model output. A full set of post-processed volumes for AM and PM peak hours will be provided for the 2035 No-Build analysis.
- Speeds, delay, and queuing results directly out of the mesoscopic model should be treated with a lower level of scrutiny compared to HCM 2010 analysis. HCM 2010 methodology is built into the speeds and delays utilized in the Cube Avenue based meso-scale model- however, the volumes generated by the meso-scale model are simply raw volume output that have not yet been post-processed and adjusted for reasonableness. Typically, volume sets that are used in HCM analysis have gone through a post-processing and adjustment method and been reviewed with engineering judgment. As such, extra scrutiny is expected for using these metrics directly out of the I-229 mesoscopic model.

- All metrics should be treated comparatively between scenarios rather than in an absolute manner.
- Model results should be utilized at an aggregate level for interchange evaluation. Namely, alternatives should be compared based on the delay at all ramps and cross street approaches as a group as opposed to treating each ramp and cross street approach separately. Intersection queues may be reviewed by individual approach, but model results should be reported relative to the queue length output in the base model.
- The model was calibrated for the I-229 MIS and should not be used for other projects without recalibration of the model for that particular project.

TABLE 4, TABLE 5, and TABLE 6 provide I-229 MIS model output from the base model for the primary analysis area.

TABLE 7, TABLE 8, and TABLE 9 illustrate volume to count ratios from the macro scale and meso scale models. The macro scale model values are based on 2008 daily volumes, and the meso scale model values are based on 2012 AM and PM periods.

Table 4. Meso Model Interchange area AM and PM Peak Period count volumes, model volumes, and model speeds - Northbound I-229

Name	Direction	A Node	B Node	AM Count	AM Model Volume	AM Speed	PM Count	PM Model Volume	PM Speed
Mainline	NB	2227	2290	2600	2739	61.5	2340	2591	61.5
Louise Off	NB	2290	4006	620	636	27.8	670	873	27.7
Mainline	NB	2290	2336	1980	2105	63.6	1670	1709	63.7
Louise Loop On	NB	2343	2336	670	499	27.8	870	791	27.7
Mainline	NB	2336	2358	2650	2602	61.6	2540	2496	61.7
Louise Straight On	NB	4000	2358	820	771	22.2	550	469	22.6
Mainline	NB	2358	2390	3470	3373	63.5	3090	2961	63.6
Western Off	NB	2390	2399	560	545	22.9	470	468	17.1
Mainline	NB	2390	2408	2910	2825	61.4	2620	2485	61.5
Western On	NB	2399	2408	890	782	22.8	1400	1336	22.6
Mainline	NB	2408	2429	3800	3605	61.5	4020	3818	61.5
Minnesota Off	NB	2429	2452	780	900	14.3	640	891	19.8
Mainline	NB	2429	2469	3020	2705	61.5	3380	2923	61.5
Minnesota On	NB	2452	2469	540	343	27.9	850	713	27.8
Mainline	NB	2469	2527	3560	3047	63.6	4230	3634	63.5
Cliff Off	NB	2527	2549	800	655	17.1	880	759	23.1
Mainline	NB	2527	2560	2760	2393	63.5	3350	2868	63.4
Cliff On	NB	2549	2560	700	883	27.7	480	715	27.8
Mainline	NB	2560	2577	3460	3277	63.6	3830	3576	63.5
26th Off	NB	2577	2586	740	736	27.7	1220	950	27.7
Mainline	NB	2577	2580	2720	2543	63.5	2610	2625	63.5
26th On	NB	2586	2580	720	502	27.3	310	356	27.5
Mainline	NB	2580	2582	3440	3044	61.4	2920	2981	61.4
Mainline	NB	2582	2595	3440	3046	61.4	2920	2980	61.4

Table 4. Meso Model Interchange area AM and PM Peak Period count volumes, model volumes, and model speeds - Northbound I-229

Name	Direction	A Node	B Node	AM Count	AM Model Volume	AM Speed	PM Count	PM Model Volume	PM Speed
Mainline	NB	2595	2625	3440	3044	61.4	2920	2976	61.4
Mainline	NB	2625	2619	3440	3046	61.4	2920	2977	61.4
10th Off	NB	2619	2622	900	930	27.7	1200	1207	27.6
Mainline	NB	2619	2613	2540	2112	61.6	1720	1766	61.7
10th On	NB	2621	2613	900	787	27.7	800	811	27.7
Mainline	NB	2613	2614	3440	2901	63.6	2520	2577	63.7
Rice Off	NB	2614	2639	420	341	27.9	690	612	27.8
Mainline	NB	2614	2610	3020	2556	63.5	1830	1961	63.6
Rice On	NB	2639	2610	390	538	27.8	300	438	27.8
Mainline	NB	2610	2602	3410	3095	66.6	2140	2401	66.7
Benson Off	NB	2602	2643	2400	2251	27.1	620	794	27.4
Mainline	NB	2602	2638	1010	845	66.8	1520	1607	66.7
Benson On	NB	2643	2638	120	107	27.9	280	203	27.8
Mainline	NB	2638	2636	1130	953	63.8	1800	1813	63.6

Table 5. Meso Model Interchange area AM and PM Peak Period count volumes, model volumes, and model speeds - Southbound I-229

Name	Direction	A Node	B Node	AM Count	AM Model Volume	AM Speed	PM Count	PM Model Volume	PM Speed
Mainline	SB	2630	2635	1660	1823	63.6	1630	1406	63.7
Benson Off	SB	2635	2592	180	209	25.6	130	112	27.1
Mainline	SB	2635	2598	1480	1614	66.7	1490	1293	66.7
Benson On	SB	2592	2598	490	371	27.9	2280	1961	27.4
Mainline	SB	2598	2601	1970	1983	66.7	3770	3255	66.6
Rice Off	SB	2601	2594	220	210	23.9	440	594	21.4
Mainline	SB	2601	2603	1750	1774	63.6	3330	2656	63.5
Rice On	SB	2594	2603	700	454	27.8	630	681	27.8
Mainline	SB	2603	2605	2450	2230	63.7	3960	3338	63.6
10th Off	SB	2605	2599	740	762	27.7	1050	1163	27.6
Mainline	SB	2605	2609	1710	1469	61.7	2910	2170	61.6
10th On	SB	2600	2609	1000	1019	26.7	1200	858	27.0
Mainline	SB	2609	2623	2710	2487	61.5	4110	3031	61.4
Mainline	SB	2623	2593	2710	2492	61.5	4110	3034	61.4
Mainline	SB	2593	2581	2710	2492	61.5	4110	3035	61.4
26th Off	SB	2581	2550	410	286	21.5	840	511	20.5
Mainline	SB	2581	2578	2300	2207	61.6	3270	2525	61.5
26th On	SB	2550	2578	1100	554	27.7	1000	627	27.8
Mainline	SB	2578	2564	3400	2761	63.6	4270	3152	63.6
Cliff Off	SB	2564	2554	350	378	24.7	720	704	22.9
Mainline	SB	2564	2528	3050	2382	63.5	3550	2449	63.5
Cliff On	SB	2553	2528	840	810	27.7	1000	769	27.7
Mainline	SB	2528	2481	3890	3194	63.6	4550	3217	63.6
Minnesota Off	SB	2481	2448	600	673	21.2	730	538	18.2
Mainline	SB	2481	2430	3290	2522	63.5	3820	2677	63.5

Table 5. Meso Model Interchange area AM and PM Peak Period count volumes, model volumes, and model speeds - Southbound I-229

Name	Direction	A Node	B Node	AM Count	AM Model Volume	AM Speed	PM Count	PM Model Volume	PM Speed
Minnesota On	SB	2448	2430	650	449	27.8	1100	867	27.7
Mainline	SB	2430	2409	3940	2970	61.6	4920	3541	61.6
Western Off	SB	2409	2395	1360	1238	21.9	1400	1134	13.0
Mainline	SB	2409	2392	2580	1732	61.7	3520	2408	61.5
Western On	SB	2395	2392	270	193	27.9	580	383	27.9
Mainline	SB	2392	2360	2850	1925	63.7	4100	2788	63.6
Louise Off	SB	2360	2338	1200	935	21.7	1890	1404	24.3
Mainline	SB	2360	2285	1650	992	61.8	2210	1385	61.7
Louise On	SB	4011	2285	610	413	27.4	950	837	26.9
Mainline	SB	2285	2221	2260	1408	61.7	3160	2213	61.6

Table 6. Meso Model Interchange area AM and PM Peak Period count volumes, model volumes, and model speeds -Cross Streets

Name	Direction	A Node	B Node	AM Count	AM Model Volume	AM Speed	PM Count	PM Model Volume	PM Speed
Louise Overpass	NB	2343	2338	1770	1437	37.0	1850	979	34.7
	SB	2338	2343	1800	1511	39.7	3080	2478	39.6
Western Overpass	NB	2399	2395	1630	1204	34.1	1550	823	30.9
	SB	2395	2399	1350	1121	31.4	2760	1707	32.1
Minnesota Overpass	NB	2452	2448	2700	1765	35.2	1910	1004	35.2
	SB	2448	2452	1170	997	33.9	2880	1375	32.7
Cliff Overpass	NB	2549	2553	2690	1297	34.4	1510	1057	34.2
	SB	2553	2549	860	761	29.1	2400	1301	32.2
26th Overpass	EB	2574	2590	1000	255	10.7	2140	644	17.4
	WB	2590	2574	2490	720	2.1	1860	787	34.8
10th SPUI East Overpass	EB	2971	2612	960	558	29.7	2560	1007	28.3
	WB	2612	2971	1800	723	14.0	1880	694	10.7
Rice Overpass	EB	2594	2640	440	338	36.0	1480	804	37.2
	WB	2640	2594	1690	690	39.7	1090	451	33.5
Benson Overpass	EB	2592	2643	160	95	17.5	340	195	13.6
	WB	2643	2592	2580	2161	36.8	670	735	45.4

Table 7. Macro and Meso Volume to Count Ratios- Northbound

Name	Direction	Anode	Bnode	Macro-Scale	Meso-Scale	
				2008 Daily Volume / Count	2012 AM Model Volume / Count	2012 PM Model Volume / Count
Mainline	NB	2227	2290	0.86	1.05	1.11
Louise Off	NB	2290	4006	0.81	1.03	1.30
Mainline	NB	2290	2336		1.06	1.02
Louise Loop On	NB	2343	2336	1.13	0.74	0.91
Mainline	NB	2336	2358		0.98	0.98
Louise Straight On	NB	4000	2358	0.76	0.94	0.85
Mainline	NB	2358	2390	0.80	0.97	0.96
Western Off	NB	2390	2399	0.56	0.97	0.99
Mainline	NB	2390	2408		0.97	0.95
Western On	NB	2399	2408	1.13	0.88	0.95
Mainline	NB	2408	2429	0.94	0.95	0.95
Minnesota Off	NB	2429	2452	1.08	1.15	1.39
Mainline	NB	2429	2469		0.90	0.86
Minnesota On	NB	2452	2469	1.31	0.64	0.84
Mainline	NB	2469	2527	0.99	0.86	0.86
Cliff Off	NB	2527	2549	1.07	0.82	0.86
Mainline	NB	2527	2560		0.87	0.86
Cliff On	NB	2549	2560	1.45	1.26	1.49
Mainline	NB	2560	2577	1.04	0.95	0.93
26th Off	NB	2577	2586	0.95	0.99	0.78
Mainline	NB	2577	2580		0.94	1.01
26th On	NB	2586	2580	0.71	0.70	1.15
Mainline	NB	2580	2582		0.88	1.02
Mainline	NB	2582	2595		0.89	1.02

Table 7. Macro and Meso Volume to Count Ratios- Northbound

Name	Direction	Anode	Bnode	Macro-Scale	Meso-Scale	
				2008 Daily Volume / Count	2012 AM Model Volume / Count	2012 PM Model Volume / Count
Mainline	NB	2595	2625		0.89	1.02
Mainline	NB	2625	2619	1.02	0.89	1.02
10th Off	NB	2619	2622	0.91	1.03	1.01
Mainline	NB	2619	2613		0.83	1.03
10th On	NB	2621	2613	1.06	0.87	1.01
Mainline	NB	2613	2614	1.08	0.84	1.02
Rice Off	NB	2614	2639	1.74	0.81	0.89
Mainline	NB	2614	2610		0.85	1.07
Rice On	NB	2639	2610	1.31	1.38	1.46
Mainline	NB	2610	2602	1.00	0.91	1.12
Benson Off	NB	2602	2643	0.97	0.94	1.28
Mainline	NB	2602	2638		0.84	1.06
Benson On	NB	2643	2638	0.68	0.89	0.73
Mainline	NB	2638	2636	0.99	0.84	1.01

Table 8. Macro and Meso Volume to Count Ratios- Southbound

Name	Direction	Anode	Bnode	Macro-Scale	Meso-Scale	
				2008 Daily Volume / Count	2012 AM Model Volume / Count	2012 PM Model Volume / Count
Mainline	SB	2630	2635	0.97	1.10	0.86
Benson Off	SB	2635	2592	0.56	1.16	0.86
Mainline	SB	2635	2598		1.09	0.87
Benson On	SB	2592	2598	1.01	0.76	0.86
Mainline	SB	2598	2601	1.02	1.01	0.86
Rice Off	SB	2601	2594		0.96	1.35
Mainline	SB	2601	2603		1.01	0.80
Rice On	SB	2594	2603		0.65	1.08
Mainline	SB	2603	2605	1.12	0.91	0.84
10th Off	SB	2605	2599	1.14	1.03	1.11
Mainline	SB	2605	2609		0.86	0.75
10th On	SB	2600	2609	0.72	1.02	0.71
Mainline	SB	2609	2623	0.96	0.92	0.74
Mainline	SB	2623	2593		0.92	0.74
Mainline	SB	2593	2581		0.92	0.74
26th Off	SB	2581	2550	0.80	0.70	0.61
Mainline	SB	2581	2578		0.96	0.77
26th On	SB	2550	2578		0.50	0.63
Mainline	SB	2578	2564	1.03	0.81	0.74
Cliff Off	SB	2564	2554	1.20	1.08	0.98
Mainline	SB	2564	2528		0.78	0.69
Cliff On	SB	2553	2528	1.22	0.96	0.77
Mainline	SB	2528	2481	1.04	0.82	0.71
Minnesota Off	SB	2481	2448	1.66	1.12	0.74
Mainline	SB	2481	2430		0.77	0.70

Table 8. Macro and Meso Volume to Count Ratios- Southbound

Name	Direction	Anode	Bnode	Macro-Scale	Meso-Scale	
				2008 Daily Volume / Count	2012 AM Model Volume / Count	2012 PM Model Volume / Count
Minnesota On	SB	2448	2430	0.87	0.69	0.79
Mainline	SB	2430	2409	0.91	0.75	0.72
Western Off	SB	2409	2395	0.68	0.91	0.81
Mainline	SB	2409	2392		0.67	0.68
Western On	SB	2395	2392	0.68	0.71	0.66
Mainline	SB	2392	2360	0.97	0.68	0.68
Louise Off	SB	2360	2338	1.92	0.78	0.74
Mainline	SB	2360	2285		0.60	0.63
Louise On	SB	4011	2285	0.55	0.68	0.88
Mainline	SB	2285	2221	0.86	0.62	0.70

Table 9. Macro and Meso Volume to Count Ratios- Cross Streets

Name	Direction	Anode	Bnode	Macro-Scale	Meso-Scale	
				2008 Daily Volume / Count	2012 AM Model Volume / Count	2012 PM Model Volume / Count
Louise Overpass	NB	2343	2338	1.08	0.81	0.53
	SB	2338	2343	1.30	0.84	0.80
Western	NB	2399	2395	0.74	0.74	0.53
	SB	2395	2399	0.92	0.83	0.62
Minnesota	NB	2452	2448		0.65	0.53
	SB	2448	2452		0.85	0.48
Cliff Overpass	NB	2549	2553	0.94	0.48	0.70
	SB	2553	2549	0.93	0.88	0.54
26th Overpass	EB	2574	2590	0.66	0.26	0.30
	WB	2590	2574	1.00	0.29	0.42
10th SPUI East	EB	2971	2612		0.58	0.39
	WB	2612	2971		0.40	0.37
Rice Overpass	EB	2594	2640		0.77	0.54
	WB	2640	2594		0.41	0.41
Benson Overpass	EB	2592	2643		0.60	0.57
	WB	2643	2592		0.84	1.10

Application of the I-229 MIS Model

The purpose of the I-229 MIS multi-resolution model to be used for the I-229 Corridor Study is two-fold:

1. Aid in the volume development process for future year forecasts by establishing segment (link-level) assignments.

2. Provide a high level screening comparison for future year build scenarios and report measures of effectiveness at an aggregate level.

In order to prepare the existing conditions I-229 MIS multi-resolution model for use in the next (future year) phases of the study, the base year model will first be adjusted to reflect year 2035 No-Build conditions. Future year 2035 scenarios will be modeled in Cube Avenue by adjusting the base year matrix to future year based on growth factors from the planning model.

2035 No-Build Volume Development

Future year volume sets, including turning movement intersection volumes, will be finalized outside of the Meso-scale model. Segment (link-level) volumes output from the sub-area meso-scale model will be combined with existing intersection turning movement percentages, and adjusted for intersection balancing, in order to establish a full volume set in the study area. This post-processing exercise will only be utilized for the future year (2035) No-Build volume scenario for the full I-229 Corridor Study area.

Screening Comparison and MOE's for the I-229 Corridor Study

Following the establishment of a 2035 No-Build model, alternatives for the I-229 MIS study area will be tested with the I-229 MIS multi-resolution model. A full set of AM and PM peak hour volumes will not be provided for each screening alternative– rather, these alternatives will be compared to each other using Measures of Effectiveness (MOE's) that summarize the modeling results and allow for comparison in a relative manner. These MOE's may include:

- Interchange area AM and PM Peak Period total queue length
    - Interchange area to include ramps and roadway segments adjacent to ramp terminal intersections
- Off-ramp queue to length ratio (15-min traffic queue)
    - Reported relative to the base year model
- AM and PM Peak Period Travel Time between key origin-destination pairs
    - Select up to 5 pairs for comparison
- Interchange area AM and PM Peak Period delay
- Sub-Area level AM and PM Peak Period Overall System Delay

The consultant team has conducted preliminary sensitivity testing with the existing base year model in order to gauge the credibility of the I-229 MIS multi-resolution model results, particularly for the sub-area meso-scale simulation. Examples of the scenario test alternatives include a northbound to westbound flyover ramp at the Benson interchange, a northbound to westbound loop ramp at the Benson interchange, and widening of ramp terminal intersections and turn lanes at the Minnesota interchange. These sensitivity model runs resulted in a combination of intuitive and unintuitive MOE trends when comparing existing configurations to alternative improvement scenarios. The screening of alternatives in future phases of the I-229 MIS will need to be flexible in its evaluation of scenarios using the multi-resolution model.

Meso-Model Measures of Effectiveness for Further Consideration

FHWA requested incorporation of two additional components to this study as they pertain to the forecasting and Mesoscopic modeling process: travel time reliability and time-space diagrams. At this time, neither is a straightforward output from macro-scale travel demand modeling or meso-scale dynamic traffic assignment processes. The project team proposes not to proceed with these MOE's for the I-229 Major Investment Corridor Study.

- *Travel Time Reliability*
  The reliability of a transportation system is a measure that changes on a daily basis. Additional data would likely be required in order to assess this measure fully and integrate into the modeling process. This topic is currently being researched through the SHRP2 program as part of the Transportation Research Board (TRB), including a project entitled Incorporating Reliability of Performance Measures in Operations and Planning Modeling Tools (LO4). The final report on this product is not yet available.

- *Time-space diagrams*
  Time-space diagrams are typically suited for software that responds to traffic signal timing variables (such as Synchro).

Operational Analysis: Highway Capacity Software 2010 (HCS 2010)

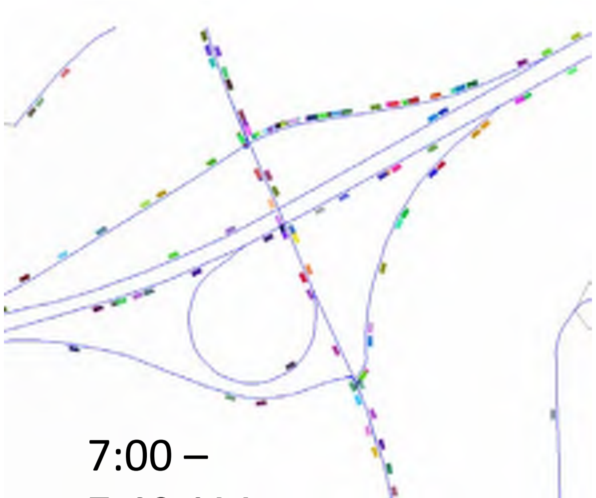
HCS 2010 analysis will be conducted for Existing and Future No-Build scenarios as part of the I-229 Major Investment Corridor Study. Existing conditions and 2035 post-processed No-Build volume sets will serve as input to this analysis. The operational analysis results will include:

- Level of Service (LOS)
  - Signalized Ramp Terminal Intersections
    - Overall intersection LOS will be reported for Existing and Future No-Build conditions.
  - Arterial Intersections
    - Overall intersection LOS will be reported for Existing and Future No-Build conditions. Unsignalized intersection LOS will be based on critical approach.
  - Basic Freeway, Ramp Junctions and Weave Areas
    - LOS will be reported for Existing and Future No-Build conditions.

Additional HCS 2010 analysis will be conducted for future year 2035 in the related Minnesota Avenue, 10th Street, and Benson Avenue Corridor Studies.

Appendix

Louise AM



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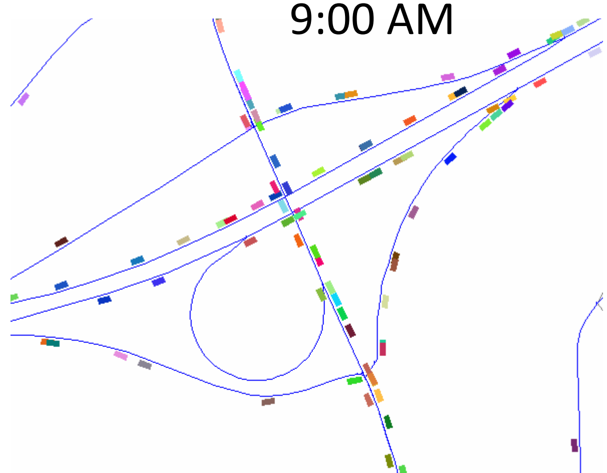

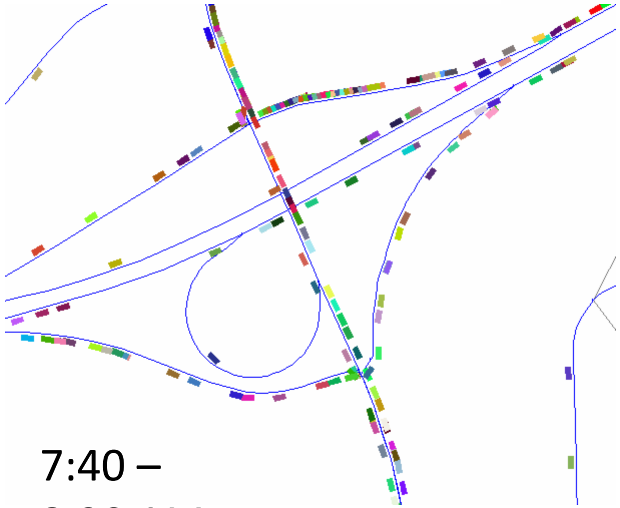

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Louise PM

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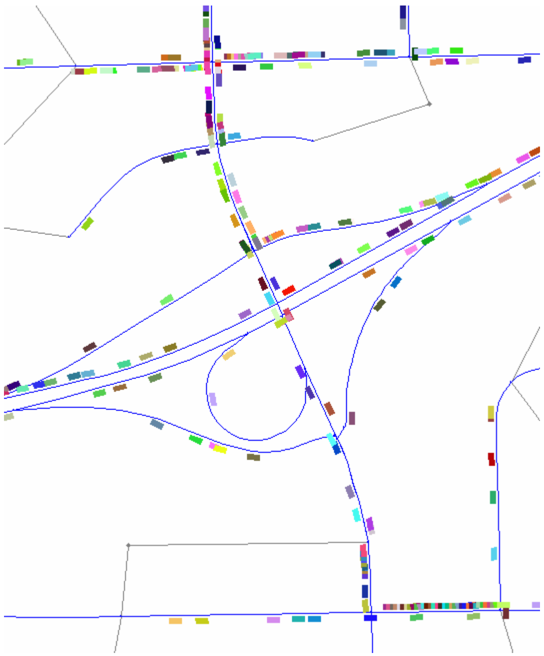

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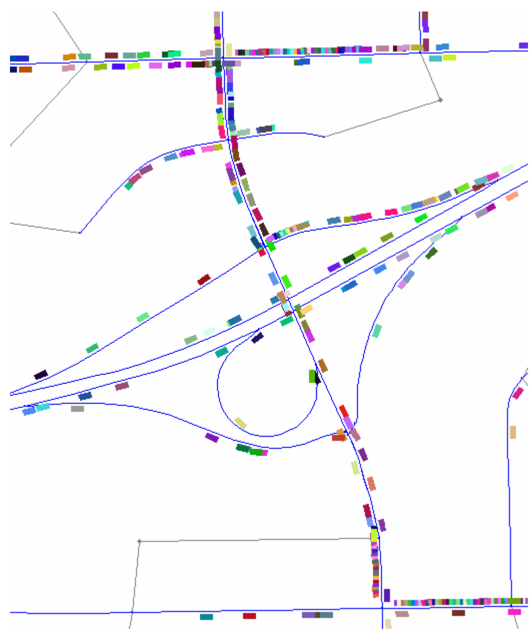

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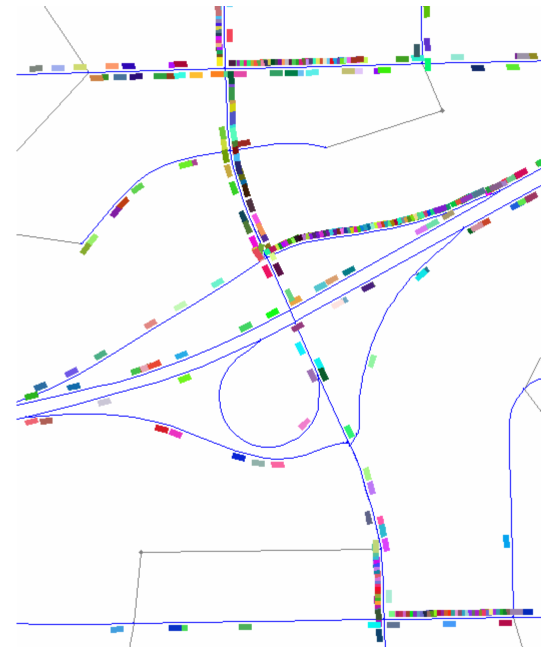

Western AM

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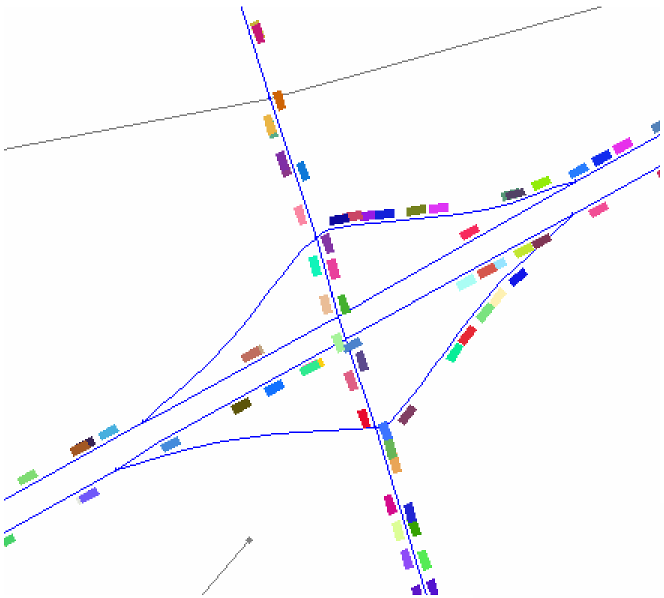

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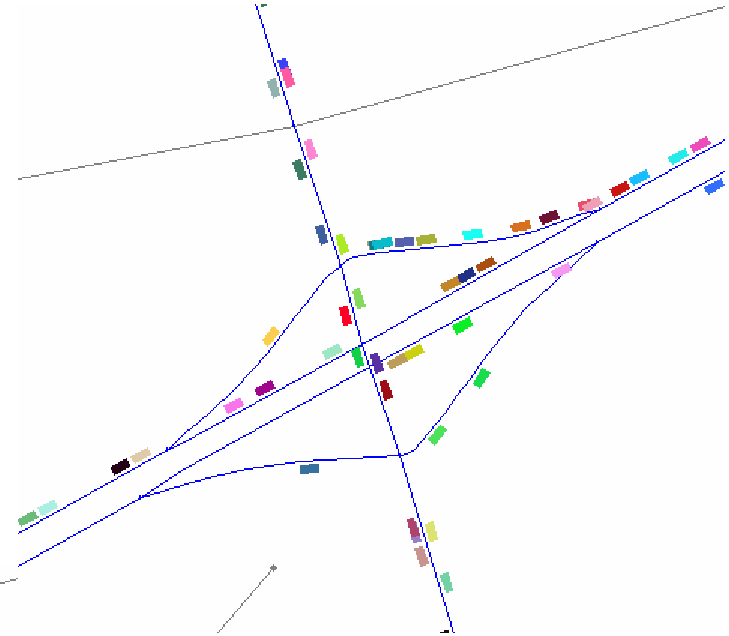

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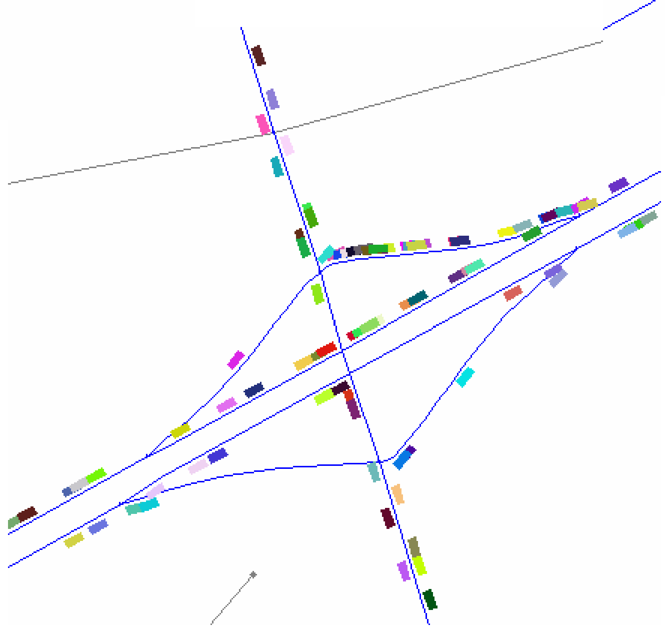

Western PM

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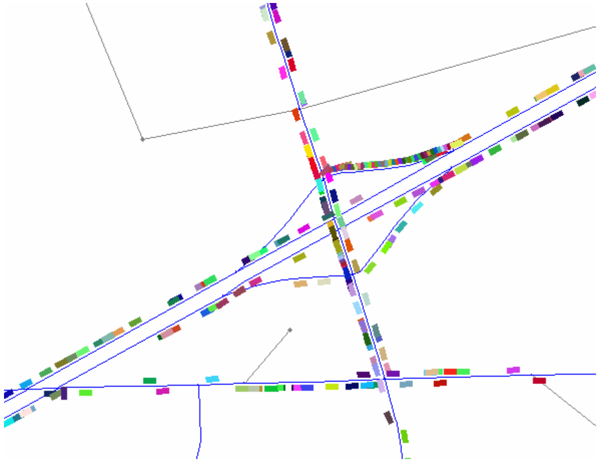

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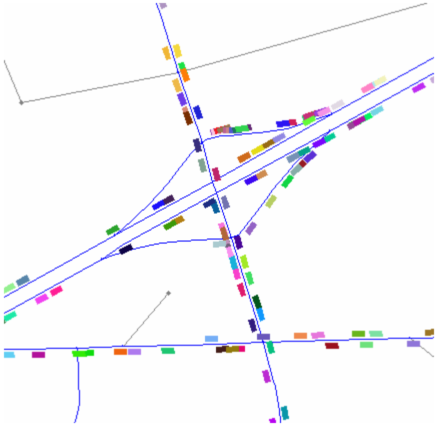

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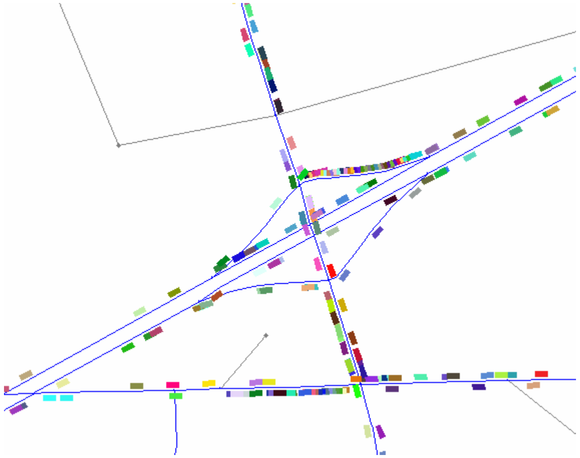

Minnesota AM

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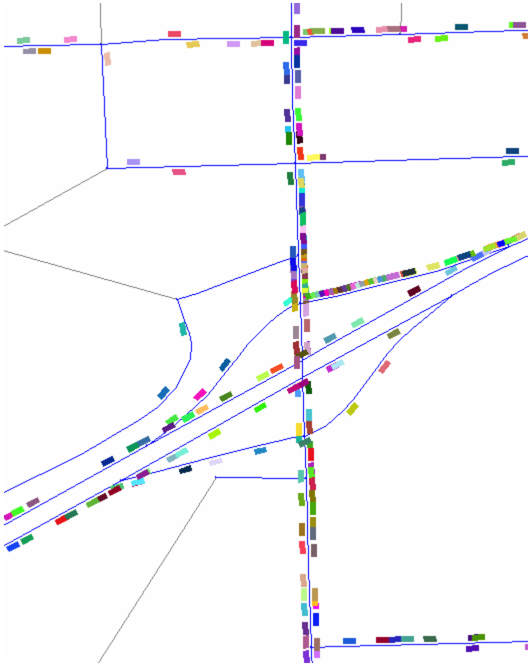

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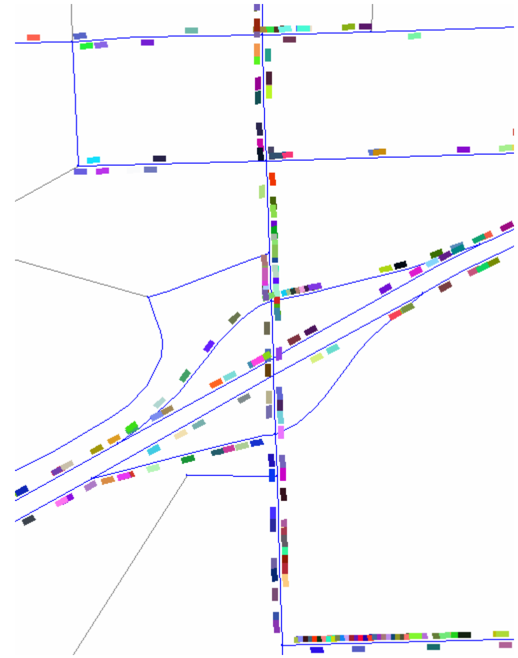

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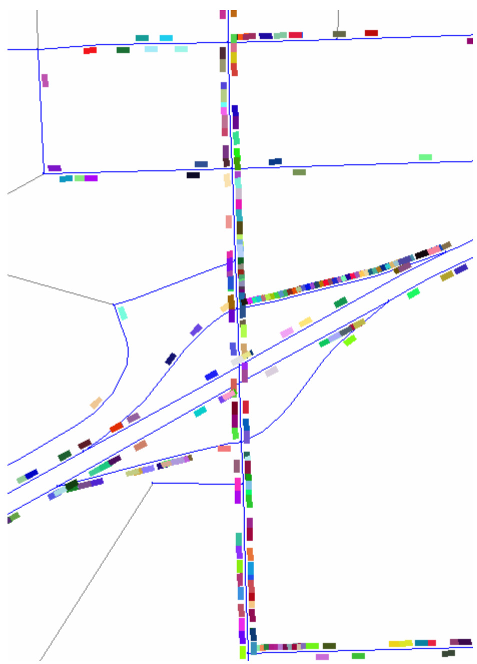

Minnesota PM

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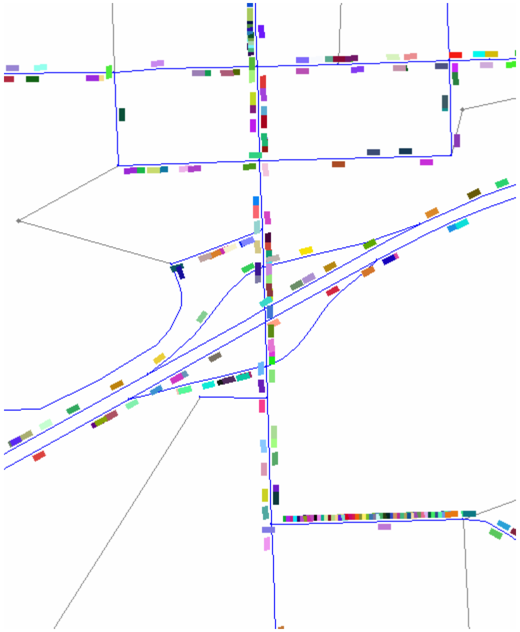

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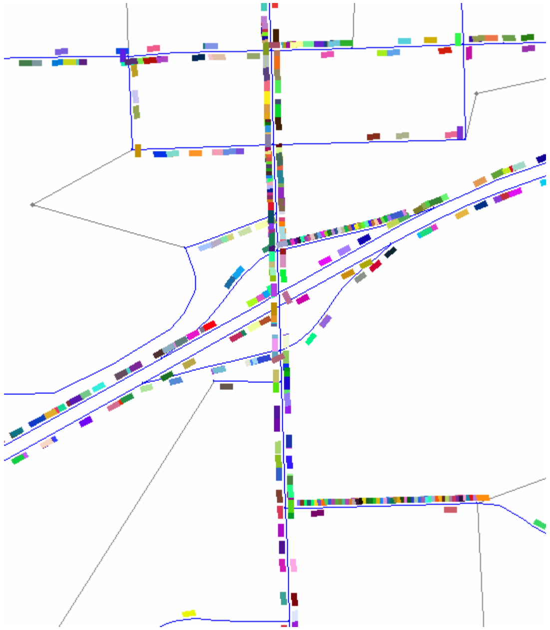

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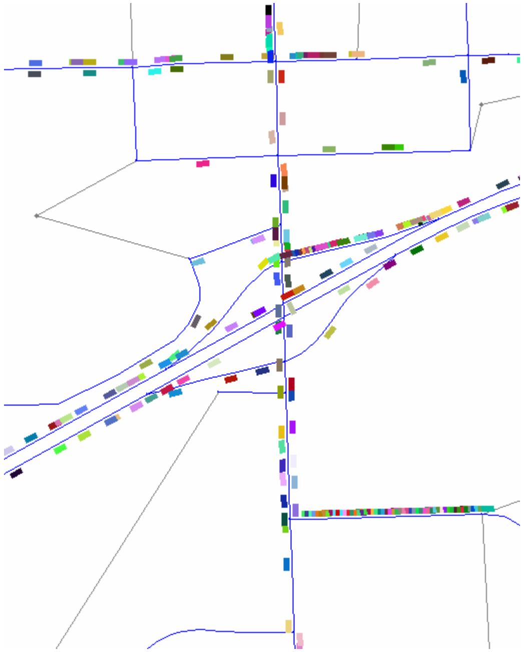

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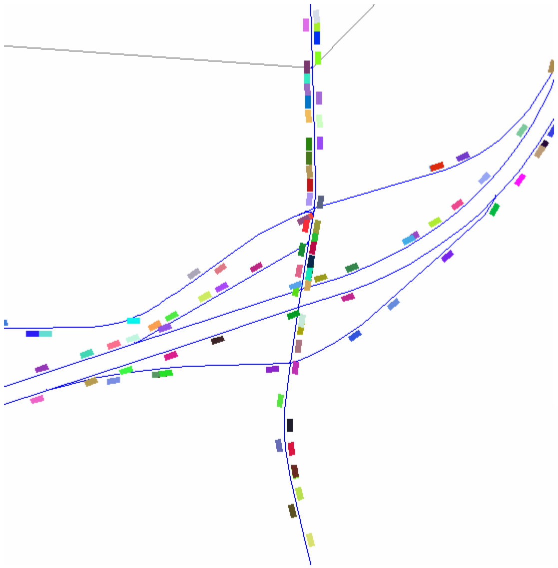

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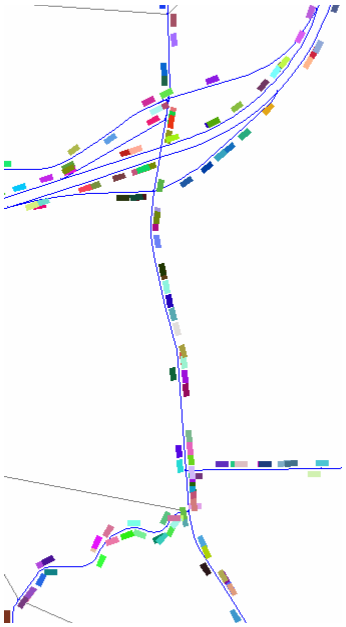

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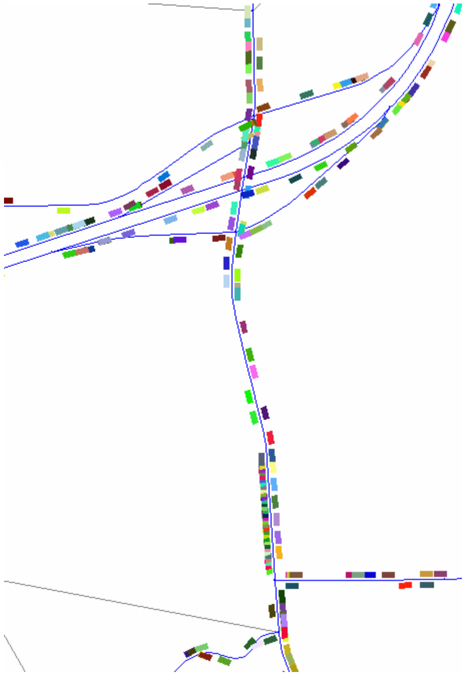

Cliff PM

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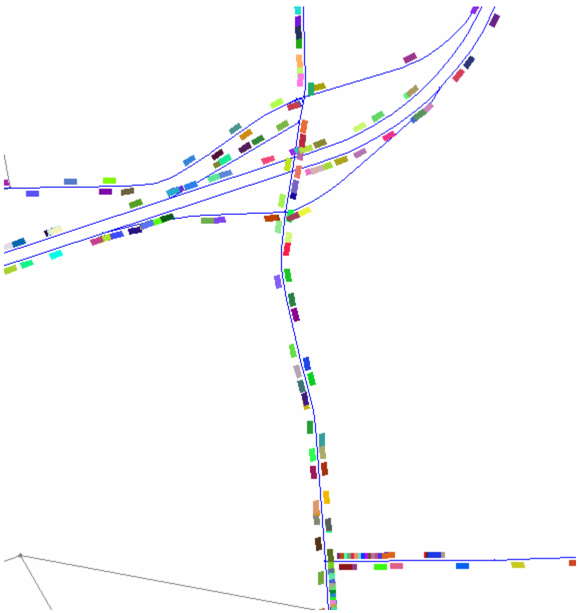

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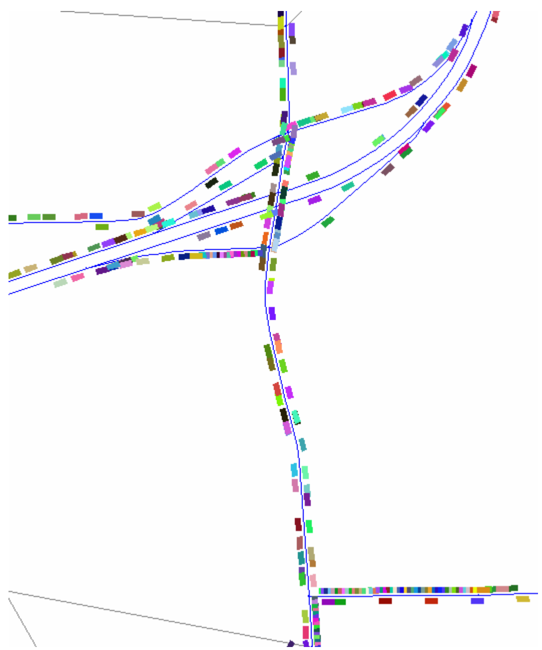

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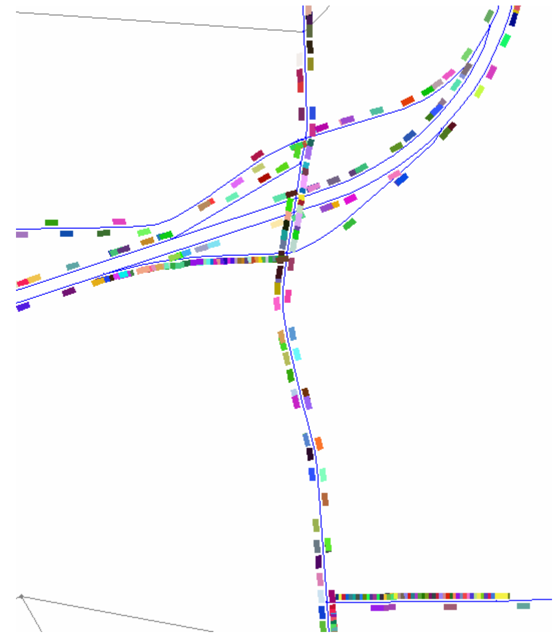

26th AM

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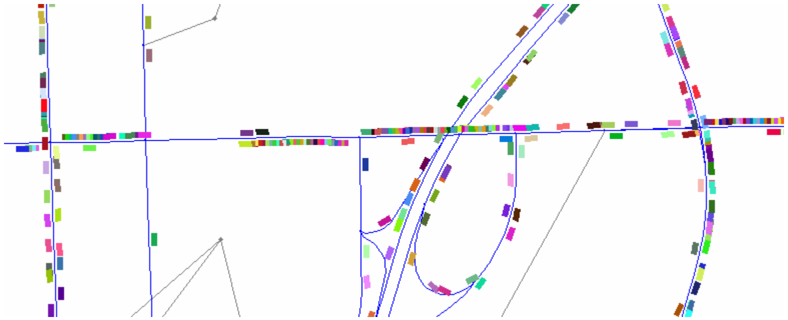

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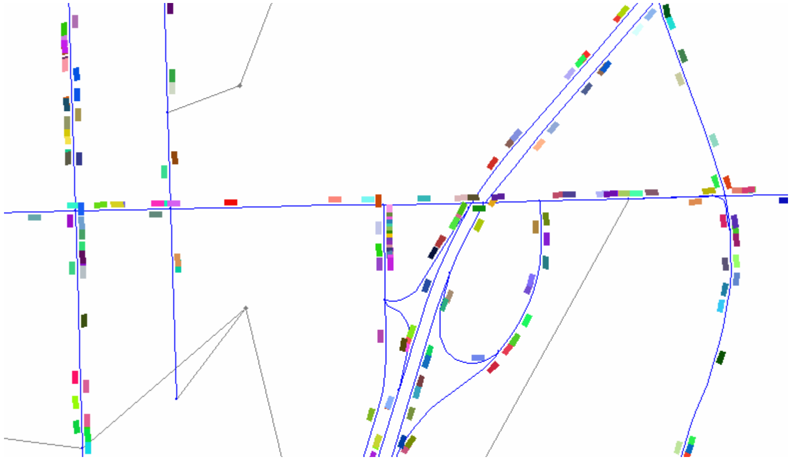

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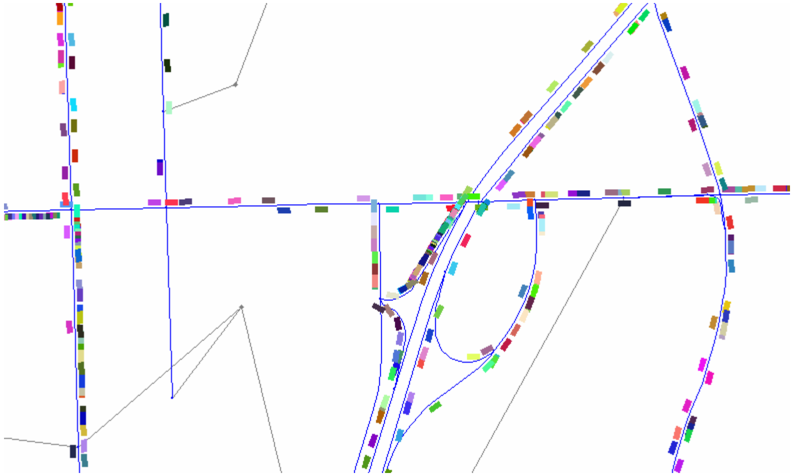

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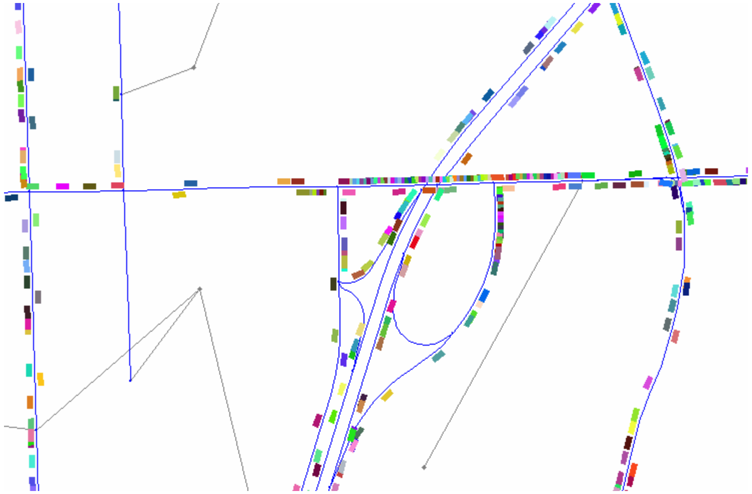

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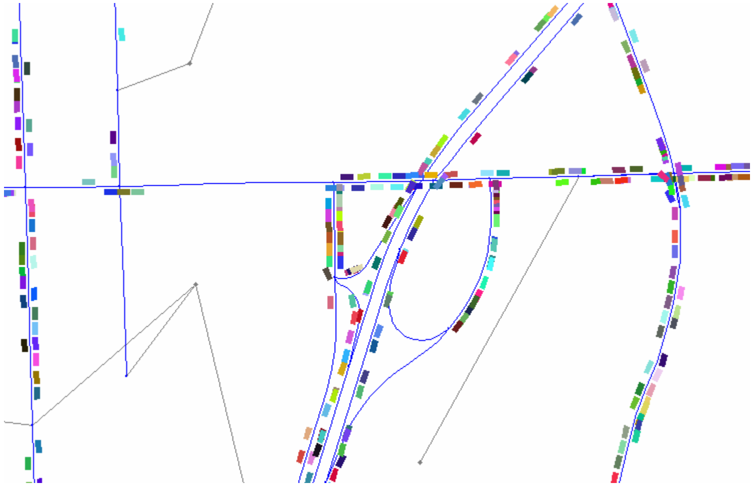

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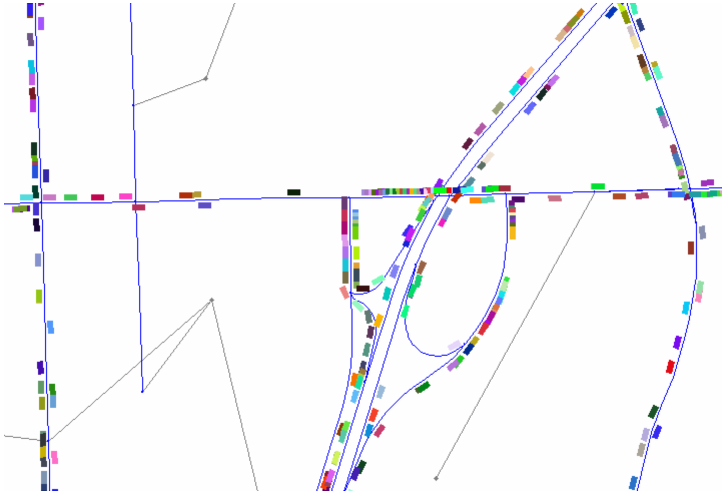

10th AM

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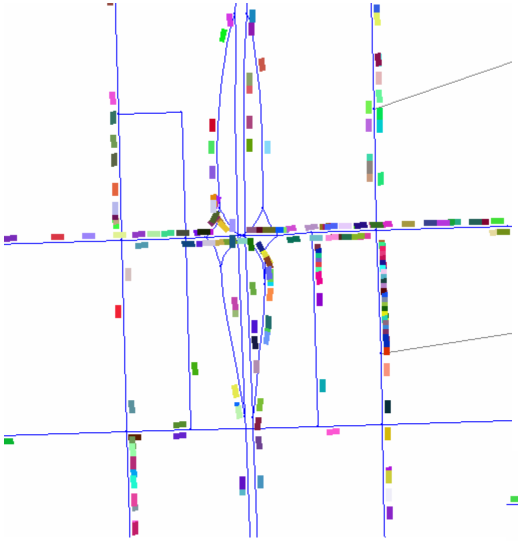
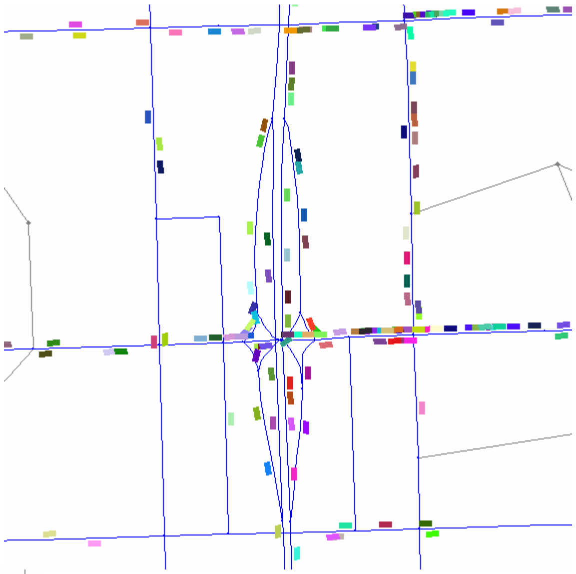
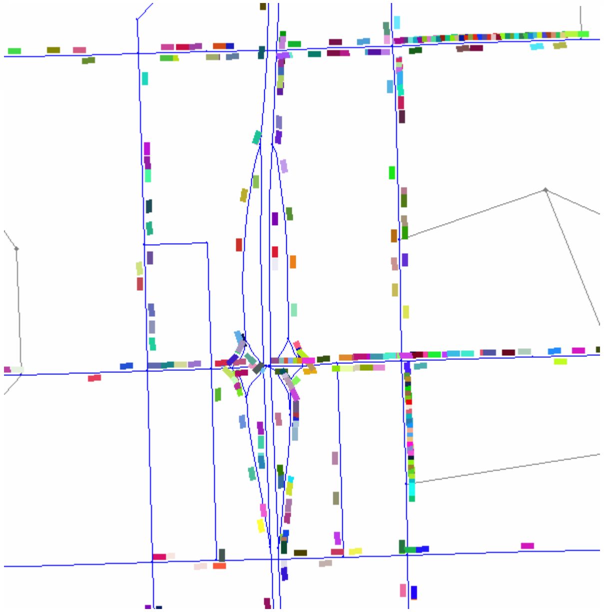
7:40 AM



8:20 –
9:00 AM

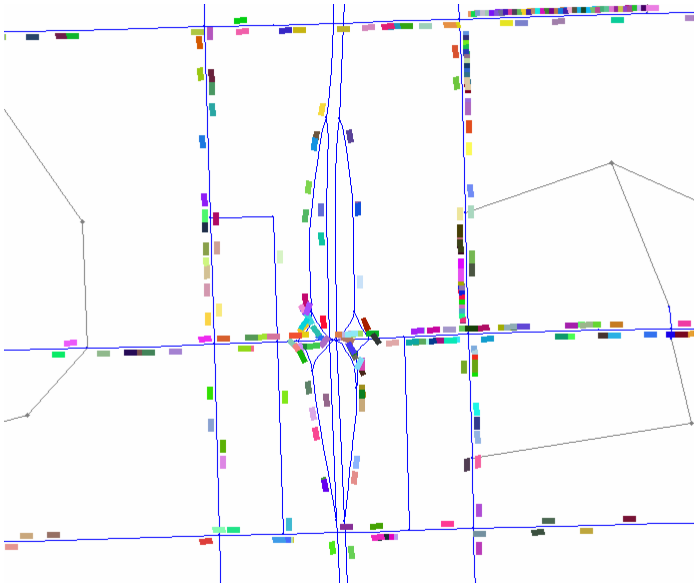


7:40 –
8:20 AM



10th PM

4:00 –
4:40 PM



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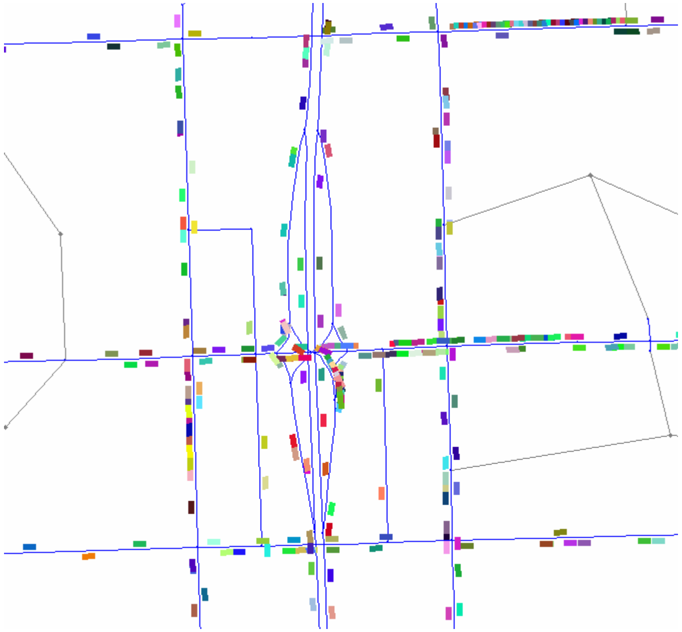
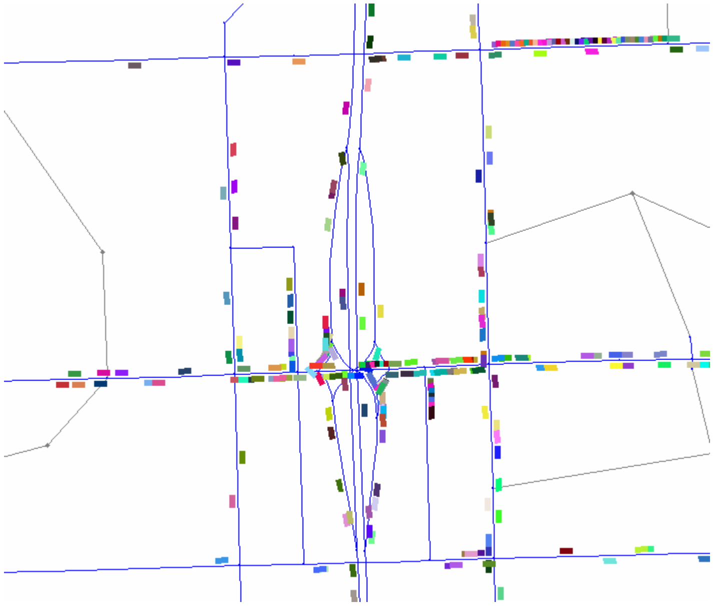
6:00 PM

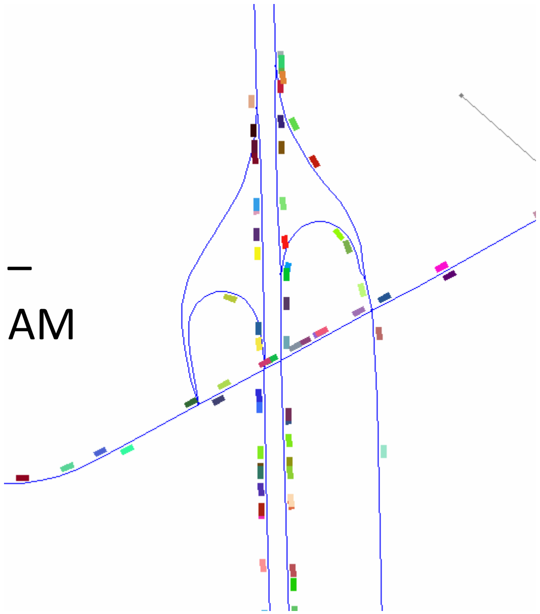


4:40 –
5:20 PM



Rice AM

7:00 – 8:00 AM



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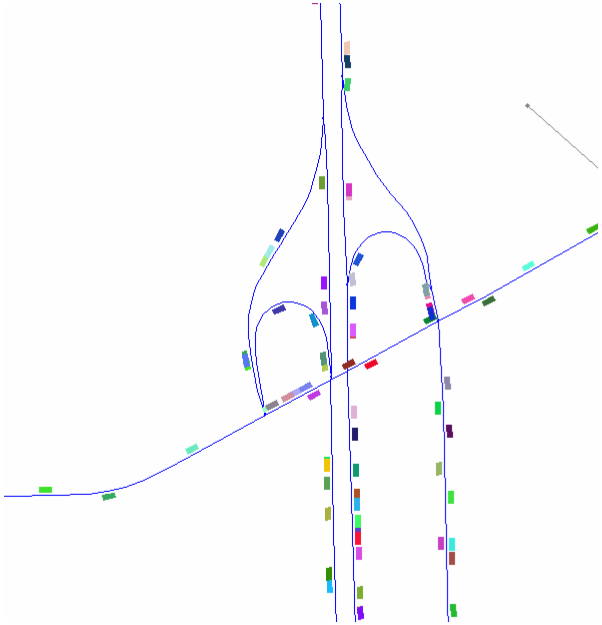
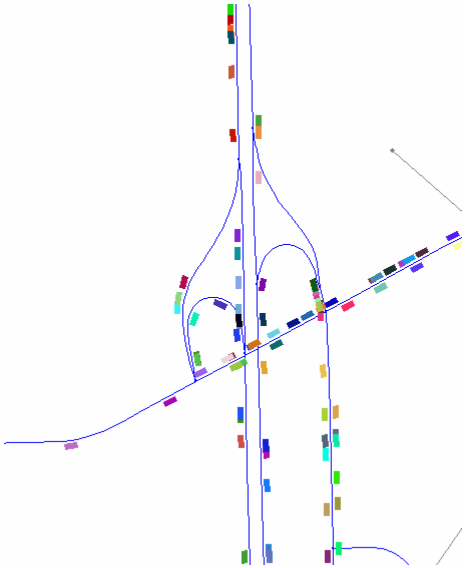


Rice PM

4:00 –
4:40 PM



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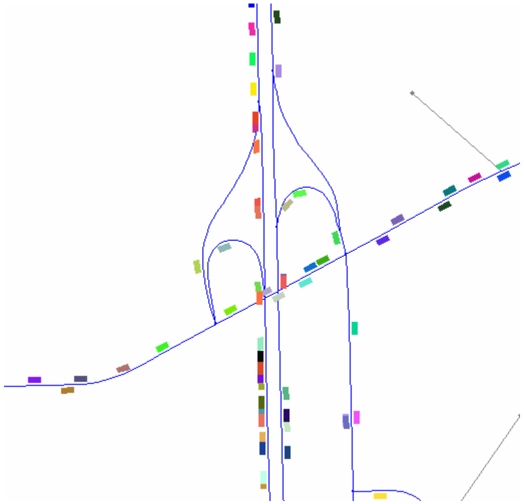

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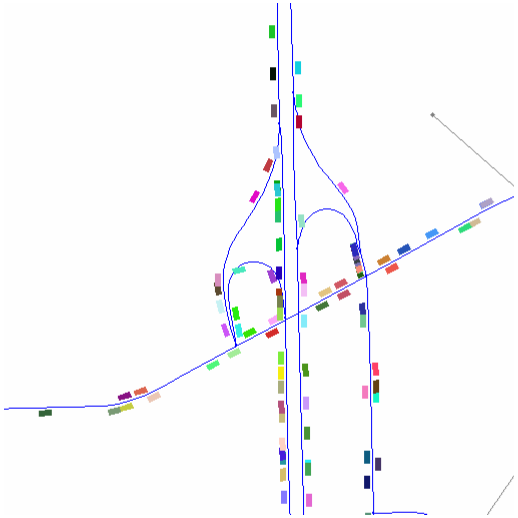
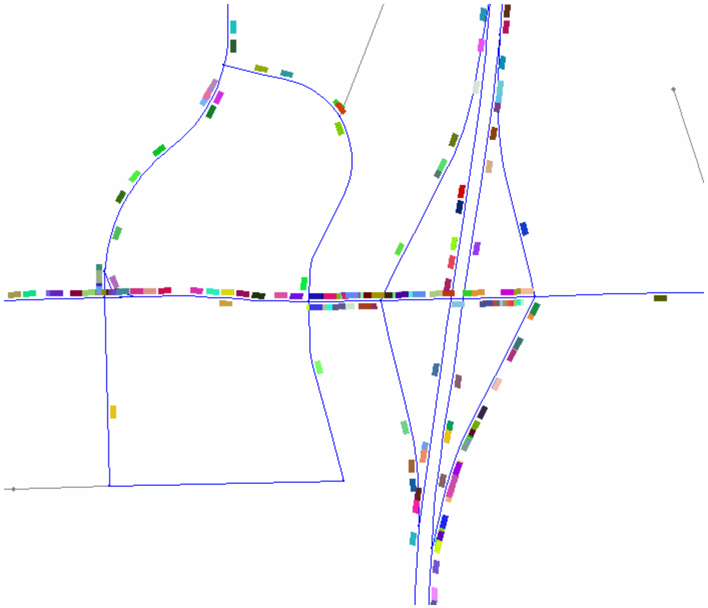


Benson AM

7:00 –
7:40 AM



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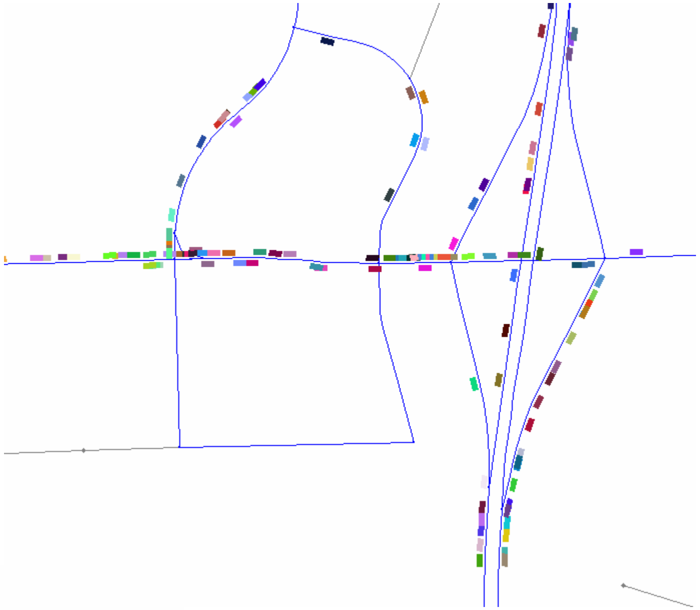
9:00 AM



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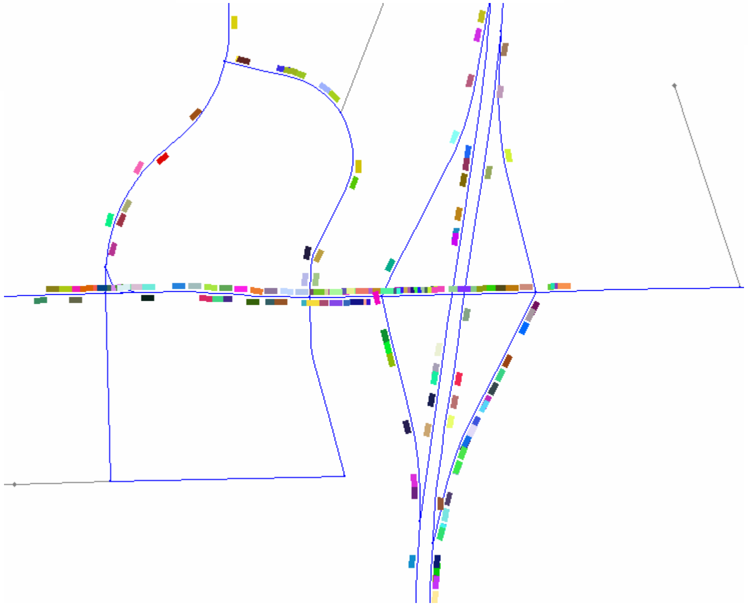
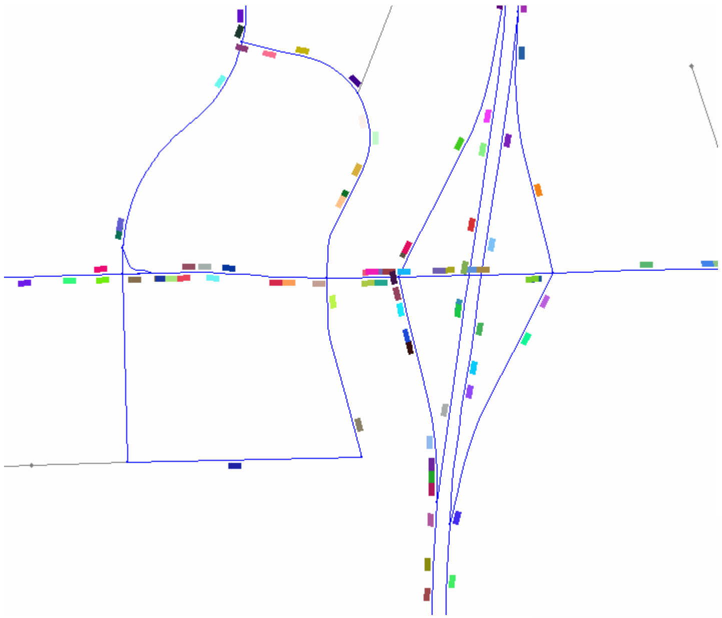
8:20 AM



Benson PM

4:00 –
4:40 PM



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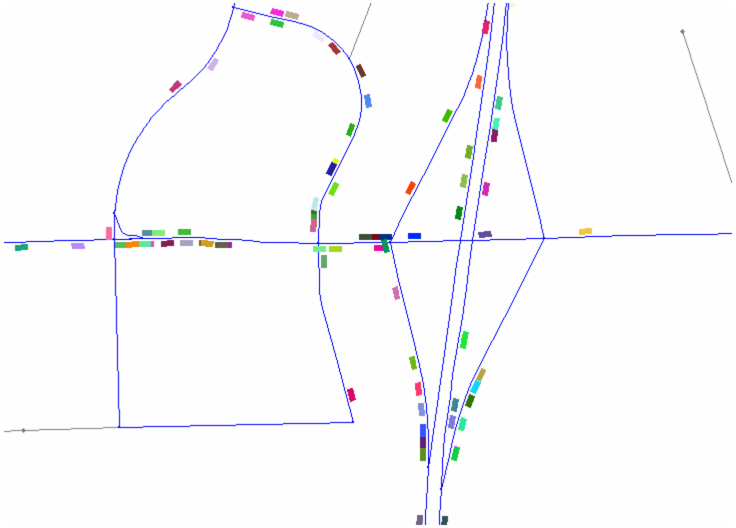
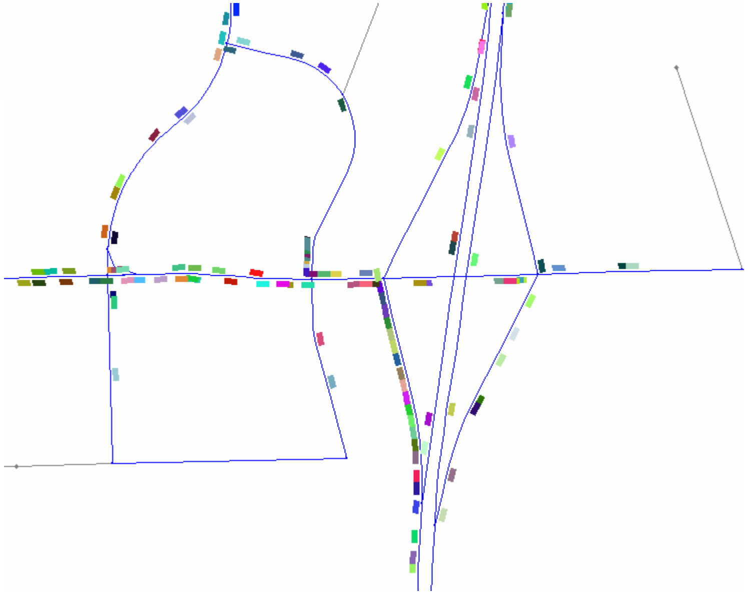


4:40 –
5:20 PM



Appendix E1. Traffic Capacity Analysis Methodologies

Traffic operational analysis involves the development of input parameters, the use of traffic flow models to determine measures of effectiveness based on the inputs, and the evaluation of those measures of effectiveness. The input development requires information on levels of traffic, vehicle classification, facility geometry, signal timing data, and speed data. Many of these input parameters were identified and collected as described as part of the data collection efforts, while some required assumptions or processed data to develop the best input parameters for traffic analysis.

Level of Service

After identifying the proper input data, level of service (LOS) analyses for the existing conditions were performed for the basic freeway segments, weave segments, freeway merge and diverge segments, and key intersections (including ramp terminal intersections) using procedures from the ***Highway Capacity Manual*** (***HCM***). Highway Capacity Software 2010 (HCS 2010) version 6.50, a computerized analytical tool based on the ***HCM***, was utilized for the freeway segment and intersection operational analysis. HCS 2010 is representative of macroscopic models that describe traffic flow in the aggregate and is based on deterministic relationships developed through past research on traffic flow.

The following sections further describe the methodologies used and the types of HCS analyses applied.

Basic Freeway Segment Level of Service

LOS analyses for the basic freeway elements were performed following Chapter 11 procedures (Basic Freeway Segments) of the ***HCM***. For freeway segments, LOS is defined in terms of traffic stream density, as shown in ***Table 1***. By definition, basic freeway segments are segments of the freeway that are outside of the influence area of ramps or weaving sections. Per ***HCM*** definition, freeway ramps have an influence distance of 1,500 feet upstream or downstream of ramp junctions. The influence distance of a weaving section between ramp junctions varies based on geometry and volume. Only freeway segments outside of the influence area of ramp junctions and weaving sections were evaluated as basic freeway segments, unless noted otherwise.

Table 1. Freeway LOS Definitions

LOS	Density Range (pc/mi/ln*)
A	0-11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	Demand exceeds capacity >45

** Passenger cars per mile per lane*

Weave Segment Level of Service

Weave segments were analyzed based on Chapter 12 procedures (Freeway Weaving Segments) of the ***HCM***. Weaving is defined as the crossing of two or more traffic streams traveling in the same direction. Weaving areas generally occur when a merge area is closely followed by a diverge area, or when an entrance ramp is closely followed by an exit ramp connected by an auxiliary lane. LOS for weaving operations is related to the average density of all vehicles in the section. For locations with weaving traffic, ramp-to-ramp flows were estimated based on the Sioux Falls travel demand model. Based on the assumed ramp-to-ramp flows, ramp-to-freeway, freeway-to-ramp, and freeway-to-freeway flows could be calculated using flow conservation from the balanced sub-area volume set. The density range for 'Freeway Weaving Segments' shown in ***Table 2*** was used when evaluating weaving segments bounded by entry/exit ramps.

Table 2. Weaving LOS Definitions

LOS	Density Range (pc/mi/ln*)	
	Freeway Weaving Segments	Weaving Segments on Multilane Highways or C-D Roadways
A	≤10	≤12
B	>10-20	>12-24
C	>20-28	>24-32
D	>28-35	>32-36
E	>35	>36
F	Demand Exceeds Capacity	Demand Exceeds Capacity

** Passenger cars per mile per lane*

Freeway Merge and Diverge Segment Level of Service

Freeway merge and diverge segments were analyzed based on ***HCM*** Chapter 13 procedures (Freeway Merge and Diverge Segments). Acceleration and deceleration length of a freeway merge or diverge segment is measured from the point at which the edges of the ramp and freeway lanes converge (gore) to the end of the taper segment connecting the ramp to the freeway. By definition, the LOS for a typical freeway merge or diverge segment is based on the average density of vehicles in the influence area (defined by the ***HCM*** as 1,500 feet upstream or downstream) of the ramp, as described in ***Table 3.***

Table 3. Freeway Merge and Diverge LOS Definitions

LOS	Density Range (pc/mi/ln*)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	Demand Exceeds Capacity

** Passenger cars per mile per lane*

For this study, LOS C was determined to be the critical threshold for mainline and ramp locations.

Signalized Intersection Level of Service

Key signalized intersections were analyzed based on ***HCM*** Chapter 18 procedures (Signalized Intersections). LOS for signalized intersections is evaluated based on control delay per vehicle (in seconds per vehicle), shown in ***Table 4***. Control delay is the portion of the total delay attributed to traffic signal operation and includes initial deceleration delay, queue move-up time, stopped delay and final acceleration delay.

Table 4. Signalized Intersection LOS Definitions

Control Delay per Vehicle (s/veh*)	LOS by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	v/c > 1.0
≤10	A	F
>10-20	B	F
>20-35	C	F
>35-55	D	F
>55-80	E	F
>80	F	F

** Seconds per vehicle*

Unsignalized Intersection Level of Service

Key unsignalized intersections were analyzed based on ***HCM*** Chapters 19 procedures (Two-Way Stop-Controlled Intersections). LOS for unsignalized intersections is evaluated based on control delay per vehicle (in seconds per vehicle), shown in ***Table 5***. For two-way stop-controlled intersections with stop control on the side-street, the LOS is measured separately for each individual movement. Results of the two-way stop controlled intersection analysis were reported as the worst-case stop-controlled approach.

Table 5. Unsignalized Intersection LOS Definitions

Control Delay per Vehicle (s/veh*)	LOS by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	v/c > 1.0
≤10	A	F
>10-15	B	F
>15-25	C	F
>25-35	D	F
>35-50	E	F
>50	F	F

** Seconds per vehicle*

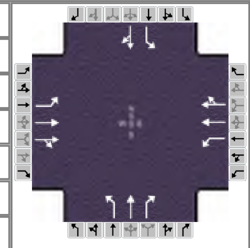
LOS ‘C’ is typically preferred for the average intersection operations during the peak period traffic conditions of a project horizon year (beyond 20 years from existing), though LOS ‘D’ has generally been considered acceptable. For this study, LOS ‘D’ was used as the worst allowable LOS for future year intersection operations when identifying proposed improvements.

APPENDIX E2 -

EXISTING HCS 2010 REPORTS

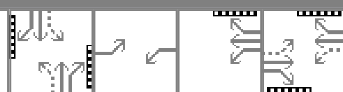
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	9/11/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Solberg Ave & 57th St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Solberg_AM.xus				
Project Description	Existing AM				

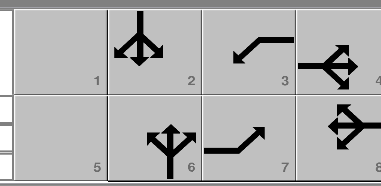


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	38	1213	82	385	516	57	13	6	50	69	94	31

Signal Information			
Cycle, s	80.1	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	10.3	2.0	10.0	36.4	0.0	0.0
Yellow	3.8	4.0	4.0	4.0	0.0	0.0
Red	2.0	1.0	1.0	1.6	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8		6		2
Case Number	1.1	4.0	1.1	4.0		5.0		6.0
Phase Duration, s	7.0	42.0	22.0	57.0		16.1		16.1
Change Period, (Y+R_c), s	5.0	5.6	5.0	5.6		5.8		5.8
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0		4.1		4.1
Queue Clearance Time (g_s), s	3.2	38.4	19.0	9.5		10.1		9.1
Green Extension Time (g_e), s	0.0	0.0	0.0	14.3		0.2		0.3
Phase Call Probability	0.65	1.00	1.00	1.00		1.00		1.00
Max Out Probability	1.00	1.00	1.00	0.19		1.00		1.00

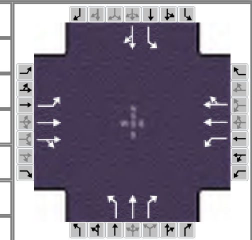
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (v), veh/h	48	815	804	481	364	352	16	8	0	86	156	
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1725	1681	1765	1703	1225	1765	1496	1402	1689	
Queue Service Time (g_s), s	1.2	36.4	36.4	17.0	7.5	7.5	1.0	0.3	0.0	4.6	7.1	
Cycle Queue Clearance Time (g_c), s	1.2	36.4	36.4	17.0	7.5	7.5	8.1	0.3	0.0	4.9	7.1	
Green Ratio (g/C)	0.48	0.45	0.45	0.69	0.64	0.64	0.13	0.13	0.13	0.13	0.13	
Capacity (c), veh/h	464	802	784	447	1132	1092	139	227	193	265	217	
Volume-to-Capacity Ratio (X)	0.102	1.016	1.026	1.078	0.322	0.322	0.117	0.033	0.000	0.325	0.718	
Available Capacity (c_a), veh/h	464	802	784	447	1132	1092	168	269	228	298	257	
Back of Queue (Q), veh/ln (95th percentile)	0.7	28.8	29.2	23.5	4.2	4.1	0.6	0.2	0.0	2.8	5.8	
Queue Storage Ratio (RQ) (95th percentile)	0.19	0.73	0.74	5.96	0.11	0.10	0.14	0.00	0.00	0.35	0.15	
Uniform Delay (d_1), s/veh	11.2	21.9	21.9	24.9	6.5	6.5	37.4	30.5	0.0	32.7	33.5	
Incremental Delay (d_2), s/veh	0.1	35.8	38.9	65.1	0.8	0.8	0.4	0.1	0.0	0.7	7.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	11.3	57.7	60.8	89.9	7.2	7.3	37.8	30.6	0.0	33.4	41.2	
Level of Service (LOS)	B	F	F	F	A	A	D	C		C	D	
Approach Delay, s/veh / LOS	57.9	E		40.5	D		35.5	D		38.4	D	
Intersection Delay, s/veh / LOS	49.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.2	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.9	A	1.5	A	0.5	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:23:34 PM

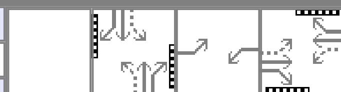
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	9/11/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Solberg Ave & 57th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Solberg_PM.xus				
Project Description	Existing PM				

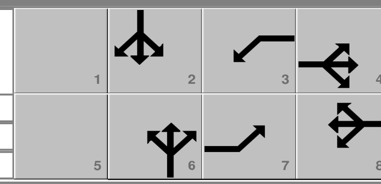


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	59	865	33	120	1072	71	147	59	381	65	26	76

Signal Information			
Cycle, s	88.7	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	18.9	2.0	51.4	0.0	0.0	0.0
Yellow	3.8	4.0	4.0	0.0	0.0	0.0
Red	2.0	1.0	1.6	0.0	0.0	0.0



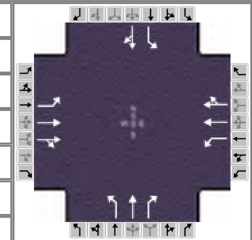
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8		6		2
Case Number	1.1	4.0	1.1	4.0		5.0		6.0
Phase Duration, s	7.0	57.0	7.0	57.0		24.7		24.7
Change Period, ($Y+R_c$), s	5.0	5.6	5.0	5.6		5.8		5.8
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0		4.2		4.2
Queue Clearance Time (g_s), s	3.4	16.2	4.0	22.3		17.9		8.6
Green Extension Time (g_e), s	0.0	11.5	0.0	10.9		1.0		1.3
Phase Call Probability	0.79	1.00	0.96	1.00		1.00		1.00
Max Out Probability	1.00	0.18	1.00	0.25		0.15		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (v), veh/h	63	486	480	129	621	608	158	63	0	70	110	
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1742	1681	1765	1726	1278	1765	1496	1333	1556	
Queue Service Time (g_s), s	1.4	14.2	14.2	2.0	20.2	20.3	10.6	2.6	0.0	4.0	5.3	
Cycle Queue Clearance Time (g_c), s	1.4	14.2	14.2	2.0	20.2	20.3	15.9	2.6	0.0	6.6	5.3	
Green Ratio (g/C)	0.60	0.58	0.58	0.60	0.58	0.58	0.21	0.21	0.21	0.21	0.21	
Capacity (c), veh/h	267	1023	1009	349	1023	1000	278	376	319	326	331	
Volume-to-Capacity Ratio (X)	0.237	0.475	0.475	0.370	0.607	0.608	0.569	0.169	0.000	0.214	0.331	
Available Capacity (c_a), veh/h	267	1023	1009	349	1023	1000	383	521	442	436	460	
Back of Queue (Q), veh/ln (95th percentile)	0.8	8.9	8.8	1.7	12.0	11.8	5.9	1.9	0.0	2.3	3.5	
Queue Storage Ratio (RQ) (95th percentile)	0.21	0.23	0.22	0.44	0.30	0.30	1.51	0.01	0.00	0.29	0.09	
Uniform Delay (d_1), s/veh	10.6	10.8	10.8	12.3	12.1	12.1	36.2	28.5	0.0	31.2	29.5	
Incremental Delay (d_2), s/veh	0.5	1.6	1.6	0.7	2.7	2.7	1.8	0.2	0.0	0.3	0.6	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	11.0	12.4	12.4	12.9	14.8	14.9	38.1	28.7	0.0	31.5	30.1	
Level of Service (LOS)	B	B	B	B	B	B	D	C		C	C	
Approach Delay, s/veh / LOS	12.3		B	14.6		B	35.4		D	30.7		C
Intersection Delay, s/veh / LOS	16.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.2	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.3	A	1.6	A	0.9	A	0.8	A

HCS 2010 Signalized Intersection Results Summary

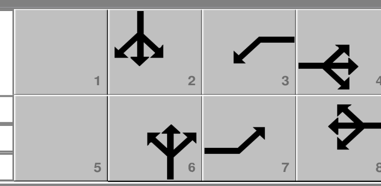
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst		Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM	PHF	0.92
Intersection	Solberg Ave & 57th St	Analysis Year	2013	Analysis Period	1> 7:00
File Name	Existing_Solberg_Tallgrass_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	0	0	0	0	0	0	0	0	0	0	0	0

Signal Information			
Cycle, s	0.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	3.8	4.0	4.0	0.0	0.0	0.0
Red	2.0	1.0	1.6	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8		6		2
Case Number	1.1	4.0	1.1	4.0		5.0		6.0
Phase Duration, s	0.0	0.0	0.0	0.0		0.0		0.0
Change Period, ($Y+R_c$), s	5.0	5.6	5.0	5.6		5.8		5.8
Max Allow Headway (*MAH*), s	0.0	0.0	0.0	0.0		0.0		0.0
Queue Clearance Time (g_s), s								
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability								
Max Out Probability								

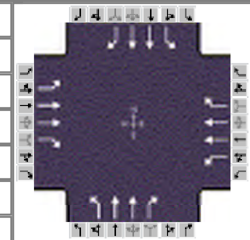
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (*v*), veh/h	0	0	0	0	0	0	0	0	0	0	0	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1714	1800	0	1714	1800	0	1714	1800	1525	1714	0	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Cycle Queue Clearance Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Green Ratio (*g/C*)									0.00			
Capacity (*c*), veh/h	14739 12	71930		14740 43	71930		14385 95	35965	30479	14385 95		
Volume-to-Capacity Ratio (*X*)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Available Capacity (c_a), veh/h	21247 05	26182 431		72626 76	36971 895		76036 26	43877 15	37184 03	76036 26		
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		
Queue Storage Ratio (*RQ*) (95th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Uniform Delay (d_1), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		
Incremental Delay (d_2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0		
Level of Service (LOS)												
Approach Delay, s/veh / LOS	0.0			0.0			0.0			0.0		
Intersection Delay, s/veh / LOS										F		

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.5	B	3.1	C	3.1	C
Bicycle LOS Score / LOS	0.5	A	0.5	A	0.5	A	0.5	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:43:07 PM

HCS 2010 Signalized Intersection Results Summary

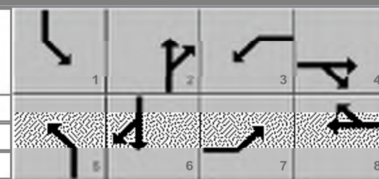
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst		Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM	PHF	0.92
Intersection	Tallgrass Avenue & W 69th	Analysis Year	2013	Analysis Period	1> 7:00
File Name	Existing_Solberg_Tallgrass_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	0	0	0	0	0	0	0	0	0	0	0	0

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	95.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	0.0	0.0	0.0	0.0	0.0
Red	1.0	0.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase						2		6
Case Number						3.0		3.0
Phase Duration, s						100.0		100.0
Change Period, ($Y+R_c$), s						5.0		5.0
Max Allow Headway (*MAH*), s						0.0		0.0
Queue Clearance Time (g_s), s								
Green Extension Time (g_e), s						0.0		0.0
Phase Call Probability								
Max Out Probability								

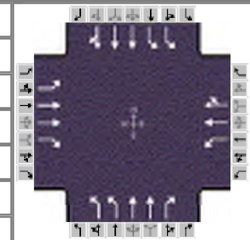
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h								0	0		0	0
Adjusted Saturation Flow Rate (s), veh/h/ln								1714	1525		1714	1525
Queue Service Time (g_s), s								0.0	0.0		0.0	0.0
Cycle Queue Clearance Time (g_c), s								0.0	0.0		0.0	0.0
Green Ratio (g/C)								0.95	0.95		0.95	0.95
Capacity (c), veh/h								3256	1449		3256	1449
Volume-to-Capacity Ratio (X)								0.000	0.000		0.000	0.000
Available Capacity (c_a), veh/h								3256	1449		3256	1449
Back of Queue (Q), veh/ln (95th percentile)												
Queue Storage Ratio (RQ) (95th percentile)												
Uniform Delay (d_1), s/veh								0.0	0.0		0.0	0.0
Incremental Delay (d_2), s/veh								0.0	0.0		0.0	0.0
Initial Queue Delay (d_3), s/veh								0.0	0.0		0.0	0.0
Control Delay (d), s/veh												
Level of Service (LOS)												
Approach Delay, s/veh / LOS												
Intersection Delay, s/veh / LOS												

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS								
Bicycle LOS Score / LOS								

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 10:37:54 AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Louise Ave & 57th St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Louise_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	108	698	579	89	440	138	573	592	94	120	339	63

Signal Information				
Cycle, s	126.0	Reference Phase	6
Offset, s	15	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.3	21.7	23.0	7.8	1.3	34.9
Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Red	2.0	2.0	2.0	1.0	0.0	2.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	14.1	42.2	12.8	40.9	29.0	56.7	14.3	42.0
Change Period, ($Y+R_c$), s	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (MAH), s	4.1	6.1	4.1	6.1	5.1	0.0	5.2	0.0
Queue Clearance Time (g_s), s	9.2	38.2	7.9	25.4	25.0		7.7	
Green Extension Time (g_e), s	0.1	0.0	0.1	8.4	0.0	0.0	0.7	0.0
Phase Call Probability	0.99	1.00	0.98	1.00	1.00		0.99	
Max Out Probability	1.00	1.00	1.00	0.95	1.00		0.00	

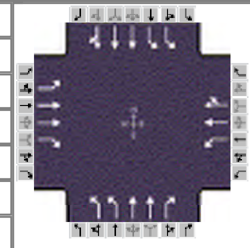
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	135	873	545	111	358	334	716	740	86	150	314	153
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1680	1496	1681	1765	1639	1632	1680	1496	1632	1765	1681
Queue Service Time (g_s), s	7.2	31.5	36.2	5.9	23.2	23.4	23.0	21.5	4.0	5.7	8.8	9.0
Cycle Queue Clearance Time (g_c), s	7.2	31.5	36.2	5.9	23.2	23.4	23.0	21.5	4.0	5.7	8.8	9.0
Green Ratio (g/C)	0.35	0.29	0.47	0.34	0.28	0.28	0.18	0.40	0.46	0.07	0.29	0.29
Capacity (c), veh/h	247	965	702	169	488	453	596	1351	694	216	1009	480
Volume-to-Capacity Ratio (X)	0.546	0.905	0.776	0.657	0.734	0.738	1.202	0.548	0.124	0.695	0.311	0.318
Available Capacity (c_a), veh/h	272	965	702	212	488	453	596	1351	694	622	1009	480
Back of Queue (Q), veh/ln (95th percentile)	5.4	20.6	12.2	4.7	16.2	15.4	26.1	12.9	3.2	4.5	7.0	7.1
Queue Storage Ratio (RQ) (95th percentile)	0.68	0.52	0.73	0.95	0.41	0.39	3.32	0.57	0.27	0.66	0.18	0.18
Uniform Delay (d_1), s/veh	31.7	43.3	14.7	34.2	41.4	41.4	52.4	29.3	18.4	57.6	35.3	35.4
Incremental Delay (d_2), s/veh	1.9	12.3	6.3	5.0	6.9	7.5	103.0	1.2	0.3	5.6	0.8	1.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	33.5	55.6	21.1	39.3	48.2	49.0	155.4	30.6	18.6	63.2	36.1	37.1
Level of Service (LOS)	C	E	C	D	D	D	F	C	B	E	D	D
Approach Delay, s/veh / LOS	41.6	D		47.3	D		87.8	F		42.9	D	
Intersection Delay, s/veh / LOS	58.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.1	C	2.9	C	3.2	C
Bicycle LOS Score / LOS	1.8	A	1.2	A	1.8	A	0.8	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 10:40:16 AM

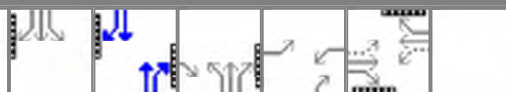
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 57th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Louise_PM.xus				
Project Description	Existing PM				

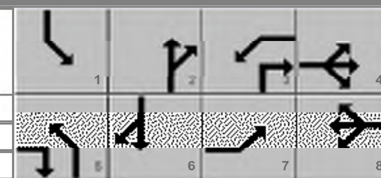


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	164	593	545	131	593	217	516	790	120	278	916	158

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	98	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.2	9.8	19.5	7.5	23.0	0.0
Yellow	4.0	4.0	4.0	4.0	4.0	0.0
Red	2.0	2.0	2.0	1.0	2.0	0.0



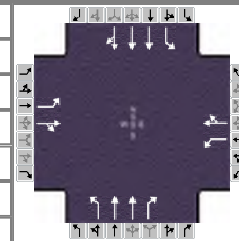
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	12.5	29.0	12.5	29.0	25.5	41.3	17.2	33.0
Change Period, (*Y+R*c), s	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.1	4.1	4.1	4.1	4.1	0.0	4.2	0.0
Queue Clearance Time (g_s), s	9.5	25.0	8.4	25.0	18.4		11.0	
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	1.1	0.0	0.3	0.0
Phase Call Probability	0.99	1.00	0.98	1.00	1.00		1.00	
Max Out Probability	1.00	1.00	1.00	1.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	176	638	538	141	442	405	555	849	73	299	771	360
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	1681	1765	1614	1632	1680	1496	1632	1765	1645
Queue Service Time (g_s), s	7.5	18.0	23.0	6.4	23.0	23.0	16.4	21.5	2.6	9.0	20.4	20.5
Cycle Queue Clearance Time (g_c), s	7.5	18.0	23.0	6.4	23.0	23.0	16.4	21.5	2.6	9.0	20.4	20.5
Green Ratio (*g/C*)	0.31	0.23	0.42	0.31	0.23	0.23	0.19	0.35	0.43	0.11	0.27	0.27
Capacity (*c*), veh/h	198	773	635	213	406	371	636	1185	640	366	953	444
Volume-to-Capacity Ratio (*X*)	0.889	0.825	0.846	0.663	1.089	1.091	0.873	0.717	0.114	0.817	0.809	0.812
Available Capacity (c_a), veh/h	198	773	635	213	406	371	653	1185	640	424	953	444
Back of Queue (*Q*), veh/ln (95th percentile)	8.8	12.5	9.7	5.2	25.6	24.0	10.6	12.3	1.6	7.4	14.6	15.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.11	0.32	0.58	1.06	0.65	0.61	1.34	0.55	0.13	1.08	0.37	0.38
Uniform Delay (d_1), s/veh	30.8	36.6	11.8	28.8	38.5	38.5	37.4	26.4	14.9	43.4	34.1	34.1
Incremental Delay (d_2), s/veh	35.1	7.3	10.3	7.5	70.9	73.4	9.3	2.8	0.3	10.5	7.4	14.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	65.9	43.9	22.2	36.3	109.4	111.9	46.7	29.2	15.1	53.9	41.5	49.0
Level of Service (LOS)	E	D	C	D	F	F	D	C	B	D	D	D
Approach Delay, s/veh / LOS	38.1	D		100.0	F		35.1	D		45.9	D	
Intersection Delay, s/veh / LOS	51.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	C	3.1	C	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.6	A	1.3	A	1.7	A	1.3	A

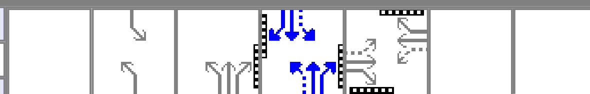
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency	HDR			Duration, h	0.25	
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other	
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80	
Intersection	Louise Ave & 59th St	Analysis Year	2013	Analysis Period	1> 7:15	
File Name	Existing_Louise_AM.xus					
Project Description	Existing AM					

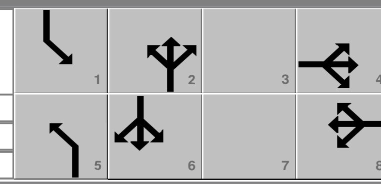


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	64	13	147	82	13	57	156	1138	157	57	875	75

Signal Information			
Cycle, s	126.0	Reference Phase	2
Offset, s	107	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.7	0.4	78.9	27.0	0.0	0.0
Yellow	3.0	3.0	3.5	3.5	0.0	0.0
Red	0.0	0.0	1.5	1.5	0.0	0.0



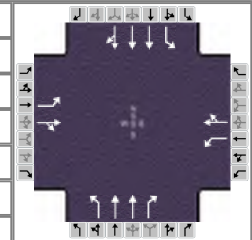
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		6.0		6.0	1.1	3.0	1.1	4.0
Phase Duration, s		32.0		32.0	10.1	87.3	6.7	83.9
Change Period, ($Y+R_c$), s		5.0		5.0	3.0	5.0	3.0	5.0
Max Allow Headway (MAH), s		5.4		5.4	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s		17.1		27.9	6.8		3.9	
Green Extension Time (g_e), s		2.0		0.0	0.3	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		0.92	
Max Out Probability		0.31		1.00	0.46		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	80	200		103	88		195	1422	196	71	803	385
Adjusted Saturation Flow Rate (s), veh/h/ln	1304	1514		1178	1539		1681	1680	1496	1681	1765	1691
Queue Service Time (g_s), s	6.9	15.1		10.9	6.0		4.8	21.0	5.7	1.9	4.2	4.2
Cycle Queue Clearance Time (g_c), s	12.8	15.1		25.9	6.0		4.8	21.0	5.7	1.9	4.2	4.2
Green Ratio (g/C)	0.21	0.21		0.21	0.21		0.70	0.65	0.65	0.66	0.63	0.63
Capacity (c), veh/h	275	324		169	330		431	2195	977	252	2210	1059
Volume-to-Capacity Ratio (X)	0.291	0.616		0.608	0.265		0.453	0.648	0.201	0.282	0.363	0.364
Available Capacity (c_a), veh/h	275	324		169	330		496	2195	977	297	2210	1059
Back of Queue (Q), veh/ln (95th percentile)	4.1	10.1		6.4	4.2		3.0	7.7	3.2	1.3	2.2	2.3
Queue Storage Ratio (RQ) (95th percentile)	0.70	0.26		1.63	0.18		0.77	0.24	0.80	0.26	0.10	0.10
Uniform Delay (d_1), s/veh	46.6	44.8		56.6	41.2		6.9	6.0	7.3	10.0	2.5	2.5
Incremental Delay (d_2), s/veh	0.8	4.1		7.3	0.6		0.5	1.1	0.3	0.5	0.4	0.8
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	47.4	48.9		63.8	41.8		7.4	7.1	7.7	10.5	2.9	3.3
Level of Service (LOS)	D	D		E	D		A	A	A	B	A	A
Approach Delay, s/veh / LOS	48.5		D	53.7		D	7.2		A	3.4		A
Intersection Delay, s/veh / LOS	11.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	2.2	B	2.2	B
Bicycle LOS Score / LOS	0.9	A	0.8	A	2.0	A	1.2	A

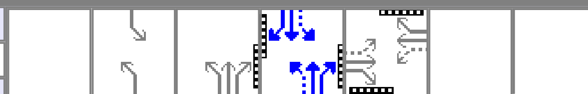
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 59th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Louise_PM.xus				
Project Description	Existing PM				

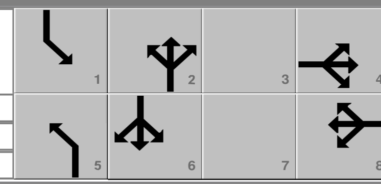


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	93	22	185	93	26	76	147	1257	109	72	1394	126

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	88	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.5	2.4	56.8	24.2	0.0	0.0
Yellow	3.0	0.0	3.5	3.5	0.0	0.0
Red	0.0	0.0	1.5	1.5	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		6.0		6.0	1.1	3.0	1.1	4.0
Phase Duration, s		29.2		29.2	8.9	64.2	6.5	61.8
Change Period, ($Y+R_c$), s		5.0		5.0	3.0	5.0	3.0	5.0
Max Allow Headway (*MAH*), s		4.5		4.5	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s		15.0		23.4	5.7		3.9	
Green Extension Time (g_e), s		1.8		0.8	0.3	0.0	0.1	0.0
Phase Call Probability		1.00		1.00	0.99		0.88	
Max Out Probability		0.08		1.00	0.00		0.14	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	100	223		100	110		158	1352	117	77	1106	529
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1278	1520		1154	1556		1681	1680	1496	1681	1765	1687
Queue Service Time (g_s), s	6.9	13.0		8.4	5.7		3.7	20.7	3.7	1.9	6.7	6.0
Cycle Queue Clearance Time (g_c), s	12.6	13.0		21.4	5.7		3.7	20.7	3.7	1.9	6.7	6.0
Green Ratio (*g/C*)	0.24	0.24		0.24	0.24		0.64	0.59	0.59	0.60	0.57	0.57
Capacity (*c*), veh/h	309	368		202	377		325	1990	886	263	2006	959
Volume-to-Capacity Ratio (*X*)	0.324	0.604		0.495	0.291		0.486	0.679	0.132	0.295	0.551	0.552
Available Capacity (c_a), veh/h	344	410		234	420		507	1990	886	367	2006	959
Back of Queue (*Q*), veh/ln (95th percentile)	3.9	8.6		4.5	3.9		2.2	8.0	2.1	1.2	2.6	2.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.67	0.22		1.14	0.17		0.57	0.25	0.52	0.24	0.12	0.11
Uniform Delay (d_1), s/veh	36.0	33.6		43.1	30.9		7.9	7.8	9.6	11.2	2.7	2.4
Incremental Delay (d_2), s/veh	0.6	2.1		1.9	0.4		0.8	1.4	0.2	0.3	0.5	1.1
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	36.6	35.7		45.0	31.3		8.8	9.2	9.8	11.5	3.2	3.5
Level of Service (LOS)	D	D		D	C		A	A	A	B	A	A
Approach Delay, s/veh / LOS	36.0	D		37.8	D		9.2	A		3.7	A	
Intersection Delay, s/veh / LOS	10.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	2.2	B	2.2	B
Bicycle LOS Score / LOS	1.0	A	0.8	A	1.8	A	1.4	A

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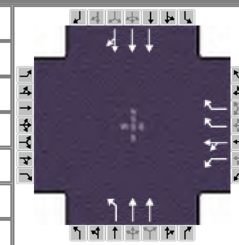
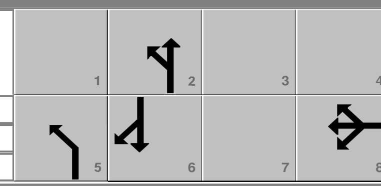
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Louise & I-229 SB ramps	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Louise_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				188	0	565	225	886			946	158

Signal Information										
Cycle, s	126.0	Reference Phase	2							
Offset, s	15	Reference Point	Begin	Green	13.3	61.8	36.9	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	3.5	3.5	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				9.0	1.0	4.0		8.3
Phase Duration, s				41.9	17.3	84.1		66.8
Change Period, ($Y+R_c$), s				5.0	4.0	5.0		5.0
Max Allow Headway (MAH), s				5.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				31.8	12.6			
Green Extension Time (g_e), s				5.0	0.7	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.33	0.03			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h				235	0	706	281	1107			1183	0
Adjusted Saturation Flow Rate (s), veh/h/ln				1625	1739	1407	1608	1722			1760	0
Queue Service Time (g_s), s				15.1	0.0	29.8	10.6	22.5			17.9	0.0
Cycle Queue Clearance Time (g_c), s				15.1	0.0	29.8	10.6	22.5			17.9	0.0
Green Ratio (g/C)				0.29	0.29	0.29	0.61	0.63			0.49	
Capacity (c), veh/h				476	509	824	391	2162			2588	
Volume-to-Capacity Ratio (X)				0.494	0.000	0.857	0.719	0.512			0.457	0.000
Available Capacity (c_a), veh/h				580	621	1005	516	2162			2588	
Back of Queue (Q), veh/ln (95th percentile)				10.1	0.0	16.3	6.6	12.8			11.2	
Queue Storage Ratio (RQ) (95th percentile)				0.26	0.00	0.41	0.84	0.23			0.36	0.00
Uniform Delay (d_1), s/veh				36.8	0.0	42.1	14.9	13.2			19.8	
Incremental Delay (d_2), s/veh				1.1	0.0	6.9	3.0	0.8			0.5	0.0
Initial Queue Delay (d_3), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (d), s/veh				38.0	0.0	49.0	17.8	13.9			20.4	
Level of Service (LOS)				D		D	B	B			C	
Approach Delay, s/veh / LOS	0.0			46.3	D		14.7	B		20.4	C	
Intersection Delay, s/veh / LOS	25.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.1	C	2.1	B	1.9	A
Bicycle LOS Score / LOS			2.0	B	1.6	A	1.1	A

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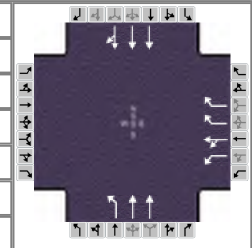
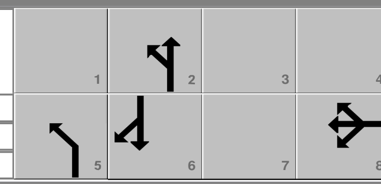
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise & I-229 SB ramps	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Louise_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				360	0	670	164	843			1318	354

Signal Information									
Cycle, s	100.0	Reference Phase	2						
Offset, s	12	Reference Point	Begin	Green	51.0	4.0	30.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	4.0	3.5	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.0	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				9.0	1.0	4.0		8.3
Phase Duration, s				35.0	9.0	65.0		56.0
Change Period, ($Y+R_c$), s				5.0	5.0	5.0		5.0
Max Allow Headway (MAH), s				4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				32.0	2.0			
Green Extension Time (g_e), s				0.0	1.1	0.0		0.0
Phase Call Probability				1.00	0.99			
Max Out Probability				1.00	1.00			

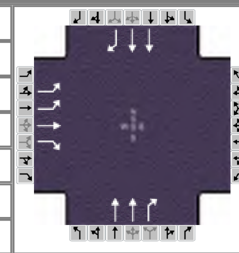
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h				232	0	875	176	906			1417	0
Adjusted Saturation Flow Rate (s), veh/h/ln				1606	1719	1429	1556	1665			1754	0
Queue Service Time (g_s), s				11.8	0.0	30.0	0.0	14.7			15.4	0.0
Cycle Queue Clearance Time (g_c), s				11.8	0.0	30.0	0.0	14.7			15.4	0.0
Green Ratio (g/C)				0.30	0.30	0.30	0.53	0.60			0.51	
Capacity (c), veh/h				482	516	858	256	1998			2685	
Volume-to-Capacity Ratio (X)				0.482	0.000	1.021	0.688	0.454			0.528	0.000
Available Capacity (c_a), veh/h				482	516	858	257	1998			2685	
Back of Queue (Q), veh/ln (95th percentile)				7.9	0.0	20.6	8.0	8.4			8.3	
Queue Storage Ratio (RQ) (95th percentile)				0.20	0.00	0.52	1.01	0.15			0.26	0.00
Uniform Delay (d_1), s/veh				28.6	0.0	35.0	34.1	10.7			12.4	
Incremental Delay (d_2), s/veh				0.7	0.0	36.1	7.0	0.7			0.6	0.0
Initial Queue Delay (d_3), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (d), s/veh				29.4	0.0	71.1	41.1	11.4			13.0	
Level of Service (LOS)				C		F	D	B			B	
Approach Delay, s/veh / LOS	0.0			62.3	E		16.2	B		13.0	B	
Intersection Delay, s/veh / LOS	29.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.4	C	2.1	B	2.0	A
Bicycle LOS Score / LOS			2.3	B	1.4	A	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:49:04 PM

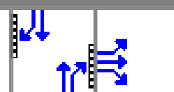
HCS 2010 Signalized Intersection Results Summary

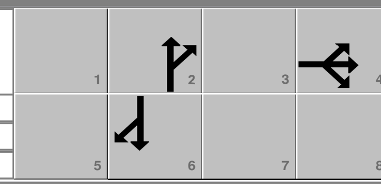
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Louise Ave & I-229 NB Off-	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Louise_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	175	0	214					936	516		711	423

Signal Information									
Cycle, s	126.0	Reference Phase	2						
Offset, s	1	Reference Point	End	Green	94.0	22.0	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.5	0.0	0.0	0.0	0.0





Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				7.0		7.0
Phase Duration, s		27.0				99.0		99.0
Change Period, ($Y+R_c$), s		5.0				5.0		5.0
Max Allow Headway (*MAH*), s		4.1				0.0		0.0
Queue Clearance Time (g_s), s		10.0						
Green Extension Time (g_e), s		0.6				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		0.00						

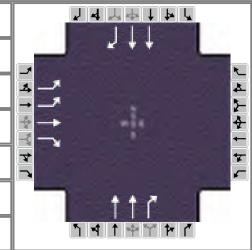
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12		6	16
Adjusted Flow Rate (*v*), veh/h	219	0	0					1170	0		889	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1533	1690	1438					1731	1403		1689	1403
Queue Service Time (g_s), s	8.0	0.0	0.0					16.3	0.0		5.7	0.0
Cycle Queue Clearance Time (g_c), s	8.0	0.0	0.0					16.3	0.0		5.7	0.0
Green Ratio (g/C)	0.17	0.17	0.17					0.75	0.75		0.75	0.75
Capacity (*c*), veh/h	535	295	251					2583	1047		2521	1047
Volume-to-Capacity Ratio (*X*)	0.409	0.000	0.000					0.453	0.000		0.353	0.000
Available Capacity (c_a), veh/h	535	295	251					2583	1047		2521	1047
Back of Queue (*Q*), veh/ln (95th percentile)	5.7	0.0	0.0					7.2	0.0		2.6	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.15	0.00	0.00					0.13	0.00		0.05	0.00
Uniform Delay (d_1), s/veh	46.2	0.0	0.0					6.1	0.0		2.2	0.0
Incremental Delay (d_2), s/veh	2.3	0.0	0.0					0.2	0.0		0.3	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0					0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	48.5	0.0	0.0					6.4	0.0		2.6	0.0
Level of Service (LOS)	D							A			A	
Approach Delay, s/veh / LOS	48.5	D		0.0			6.4	A		2.6	A	
Intersection Delay, s/veh / LOS	8.9						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.6	D	3.5	C	1.9	A	2.8	C
Bicycle LOS Score / LOS	0.8	A			1.5	A	1.2	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:44:43 PM

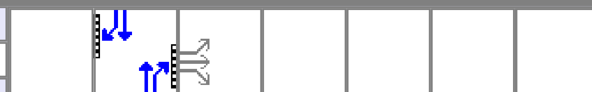
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & I-229 NB Off-	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Louise_PM.xus				
Project Description	Existing PM				

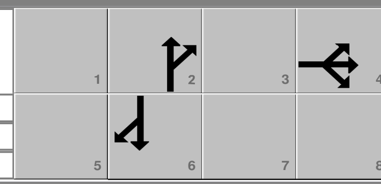


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	136	0	228					871	299		1204	474

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	47	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	82.0	7.0	0.0	0.0	0.0	0.0
Yellow	3.5	4.0	0.0	0.0	0.0	0.0
Red	1.5	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				7.0		7.0
Phase Duration, s		13.0				87.0		87.0
Change Period, ($Y+R_c$), s		6.0				5.0		5.0
Max Allow Headway (*MAH*), s		4.1				0.0		0.0
Queue Clearance Time (g_s), s		6.7						
Green Extension Time (g_e), s		0.4				0.0		0.0
Phase Call Probability		0.98						
Max Out Probability		0.00						

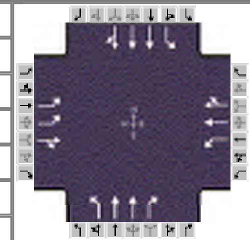
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12		6	16
Adjusted Flow Rate (*v*), veh/h	146	0	0					937	0		1295	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1516	1671	1421					1669	1403		1710	1403
Queue Service Time (g_s), s	4.7	0.0	0.0					7.0	0.0		29.9	0.0
Cycle Queue Clearance Time (g_c), s	4.7	0.0	0.0					7.0	0.0		29.9	0.0
Green Ratio (g/C)	0.07	0.07	0.07					0.82	0.82		0.50	0.50
Capacity (*c*), veh/h	212	117	100					2736	1151		1726	1151
Volume-to-Capacity Ratio (*X*)	0.688	0.000	0.000					0.342	0.000		0.750	0.000
Available Capacity (c_a), veh/h	637	351	298					2736	1151		1726	1151
Back of Queue (*Q*), veh/ln (95th percentile)	3.3	0.0	0.0					2.1	0.0		16.1	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.08	0.00	0.00					0.04	0.00		0.29	0.00
Uniform Delay (d_1), s/veh	45.4	0.0	0.0					2.3	0.0		10.2	0.0
Incremental Delay (d_2), s/veh	3.9	0.0	0.0					0.2	0.0		2.4	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0					0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	49.4	0.0	0.0					2.5	0.0		12.6	0.0
Level of Service (LOS)	D							A			B	
Approach Delay, s/veh / LOS	49.4	D		0.0			2.5	A		12.6	B	
Intersection Delay, s/veh / LOS	10.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.5	D	1.8	A	2.8	C
Bicycle LOS Score / LOS	0.7	A			1.3	A	1.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:49:04 PM

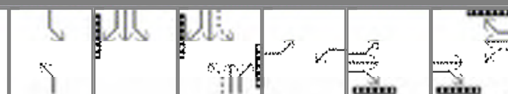
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Louise Ave & 69th St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Louise_AM.xus				
Project Description	Existing AM				

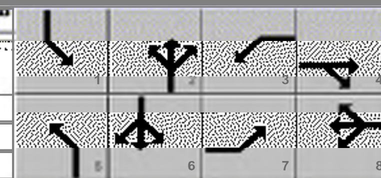


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	213	44	6	63	89	346	38	893	150	239	258	213

Signal Information			
Cycle, s	117.2	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.2	8.7	44.2	6.0	1.0	20.2
Yellow	4.0	4.0	4.3	4.0	4.0	4.3
Red	1.0	1.0	2.8	1.0	1.0	2.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	4.0	1.1	4.0	1.1	3.0	1.1	4.0
Phase Duration, s	17.0	32.9	11.0	27.0	8.2	51.3	21.9	65.0
Change Period, (Y+R_c), s	5.0	6.8	5.0	6.8	5.0	7.1	5.0	7.1
Max Allow Headway (MAH), s	4.1	4.2	4.1	4.2	4.1	4.0	4.1	4.0
Queue Clearance Time (g_s), s	11.3	5.3	6.5	19.5	4.0	38.3	15.9	9.6
Green Extension Time (g_e), s	0.7	1.5	0.1	0.7	0.0	0.0	0.9	9.7
Phase Call Probability	1.00	1.00	0.92	1.00	0.79	1.00	1.00	1.00
Max Out Probability	0.05	0.00	0.21	0.80	0.09	1.00	0.00	0.01

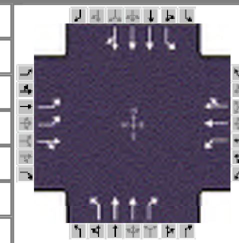
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	266	60		79	111	229	48	1116	91	299	323	170
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1739		1681	1765	1496	1681	1680	1496	1681	1765	1496
Queue Service Time (g_s), s	9.3	3.3		4.5	6.5	17.5	2.0	36.3	4.7	13.9	6.0	7.6
Cycle Queue Clearance Time (g_c), s	9.3	3.3		4.5	6.5	17.5	2.0	36.3	4.7	13.9	6.0	7.6
Green Ratio (g/C)	0.10	0.22		0.22	0.17	0.17	0.40	0.38	0.38	0.54	0.49	0.49
Capacity (c), veh/h	334	388		378	304	258	446	1267	564	334	1744	739
Volume-to-Capacity Ratio (X)	0.796	0.155		0.208	0.366	0.888	0.106	0.881	0.162	0.894	0.185	0.230
Available Capacity (c_a), veh/h	557	478		464	364	309	544	1267	564	522	1744	739
Back of Queue (Q), veh/ln (95th percentile)	7.1	2.5		3.3	5.2	12.6	1.4	22.3	3.1	10.4	4.3	4.8
Queue Storage Ratio (RQ) (95th percentile)	0.45	0.06		0.34	0.13	0.32	0.18	0.57	0.19	1.50	0.08	0.09
Uniform Delay (d_1), s/veh	51.4	36.6		37.0	42.9	47.4	21.4	34.1	24.2	29.8	16.5	16.9
Incremental Delay (d_2), s/veh	4.3	0.2		0.3	0.7	22.7	0.1	9.0	0.6	11.4	0.2	0.7
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	55.7	36.8		37.3	43.6	70.1	21.5	43.1	24.8	41.2	16.7	17.6
Level of Service (LOS)	E	D		D	D	E	C	D	C	D	B	B
Approach Delay, s/veh / LOS	52.3	D		56.9	E		40.9	D		26.2	C	
Intersection Delay, s/veh / LOS	40.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.1	C	2.7	B	2.8	C
Bicycle LOS Score / LOS	1.0	A	0.8	A	1.5	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 10:40:16 AM

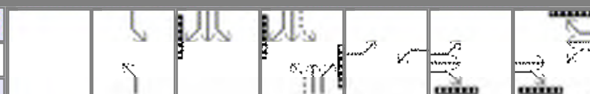
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 69th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Louise_PM.xus				
Project Description	Existing PM				

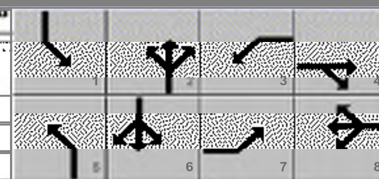


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	315	81	33	186	43	315	12	500	97	365	886	179

Signal Information			
Cycle, s	113.4	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.3	13.3	39.6	12.0	2.2	16.0
Yellow	4.0	4.0	4.3	4.0	0.0	4.3
Red	1.0	1.0	2.8	1.0	0.0	2.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	4.0	1.1	4.0	1.1	3.0	1.1	4.0
Phase Duration, s	19.2	25.0	17.0	22.8	6.3	46.7	24.6	65.0
Change Period, ($Y+R_c$), s	5.0	6.8	5.0	6.8	5.0	7.1	5.0	7.1
Max Allow Headway (MAH), s	4.1	4.2	4.1	4.2	4.1	4.0	4.1	4.0
Queue Clearance Time (g_s), s	13.5	8.6	13.5	15.2	2.6	16.0	18.5	12.7
Green Extension Time (g_e), s	0.7	1.2	0.0	0.8	0.0	7.6	1.1	8.8
Phase Call Probability	1.00	1.00	1.00	1.00	0.33	1.00	1.00	1.00
Max Out Probability	0.25	0.00	1.00	0.09	0.00	0.15	0.03	0.01

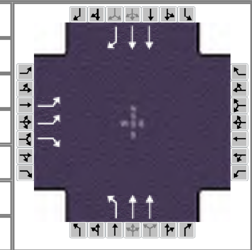
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	339	111		200	46	178	13	538	45	392	743	348
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1699		1681	1765	1496	1681	1680	1496	1681	1765	1647
Queue Service Time (g_s), s	11.5	6.6		11.5	2.6	13.2	0.6	14.0	2.3	16.5	10.6	10.7
Cycle Queue Clearance Time (g_c), s	11.5	6.6		11.5	2.6	13.2	0.6	14.0	2.3	16.5	10.6	10.7
Green Ratio (g/C)	0.13	0.16		0.25	0.14	0.14	0.36	0.35	0.35	0.54	0.51	0.51
Capacity (c), veh/h	410	274		350	249	211	263	1175	523	541	1802	841
Volume-to-Capacity Ratio (X)	0.827	0.405		0.572	0.185	0.845	0.049	0.458	0.086	0.726	0.412	0.414
Available Capacity (c_a), veh/h	576	483		350	377	319	392	1175	523	695	1802	841
Back of Queue (Q), veh/ln (95th percentile)	8.6	5.1		8.4	2.1	9.4	0.4	9.6	1.5	8.3	5.8	5.7
Queue Storage Ratio (RQ) (95th percentile)	0.55	0.13		0.86	0.05	0.24	0.05	0.24	0.09	1.21	0.11	0.10
Uniform Delay (d_1), s/veh	48.4	42.7		36.7	42.9	47.5	23.3	28.5	24.7	16.6	10.5	10.6
Incremental Delay (d_2), s/veh	6.8	1.0		2.2	0.4	12.2	0.1	1.3	0.3	1.6	0.4	0.9
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	55.2	43.7		38.9	43.3	59.7	23.4	29.8	25.1	18.2	10.9	11.4
Level of Service (LOS)	E	D		D	D	E	C	C	C	B	B	B
Approach Delay, s/veh / LOS	52.4	D		48.1	D		29.3	C		13.0	B	
Intersection Delay, s/veh / LOS	27.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.0	C	2.6	B	2.8	C
Bicycle LOS Score / LOS	1.2	A	0.8	A	1.0	A	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 10:46:29 AM

HCS 2010 Signalized Intersection Results Summary

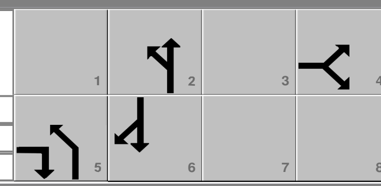
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 15, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Western Ave & 49th St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Western_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	251		175				490	1000			454	156

Signal Information			
Cycle, s	80.0	Reference Phase	2
Offset, s	21	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	21.4	31.9	11.5	0.0	0.0	0.0
Yellow	4.0	3.9	3.6	0.0	0.0	0.0
Red	0.0	2.0	1.7	0.0	0.0	0.0



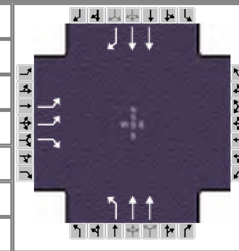
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		9.0			1.0	4.0		7.3
Phase Duration, s		16.8			25.4	63.2		37.8
Change Period, ($Y+R_c$), s		5.3			4.0	5.9		5.9
Max Allow Headway (*MAH*), s		4.2			4.1	0.0		0.0
Queue Clearance Time (g_s), s		10.1			19.9			
Green Extension Time (g_e), s		1.4			1.5	0.0		0.0
Phase Call Probability		1.00			1.00			
Max Out Probability		0.28			0.36			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (*v*), veh/h	314		219				582	1188			568	195
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1632		1496				1681	1680			1680	1496
Queue Service Time (g_s), s	7.3		8.1				17.9	10.3			9.8	7.2
Cycle Queue Clearance Time (g_c), s	7.3		8.1				17.9	10.3			9.8	7.2
Green Ratio (*g/C*)	0.14		0.41				0.69	0.72			0.40	0.40
Capacity (*c*), veh/h	469		615				734	2407			1340	596
Volume-to-Capacity Ratio (*X*)	0.669		0.356				0.793	0.493			0.424	0.327
Available Capacity (c_a), veh/h	722		731				855	2407			1340	596
Back of Queue (*Q*), veh/ln (95th percentile)	5.2		4.7				3.7	3.8			6.6	4.6
Queue Storage Ratio (*RQ*) (95th percentile)	0.13		0.12				0.41	0.06			0.17	0.52
Uniform Delay (d_1), s/veh	32.5		16.2				5.2	3.7			17.4	16.6
Incremental Delay (d_2), s/veh	1.7		0.3				1.9	0.3			1.0	1.5
Initial Queue Delay (d_3), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	34.1		16.6				7.2	4.0			18.4	18.1
Level of Service (LOS)	C		B				A	A			B	B
Approach Delay, s/veh / LOS	26.9	C		0.0			5.1	A		18.3	B	
Intersection Delay, s/veh / LOS	12.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	0.6	A	2.4	B
Bicycle LOS Score / LOS		F			2.0	B	1.1	A

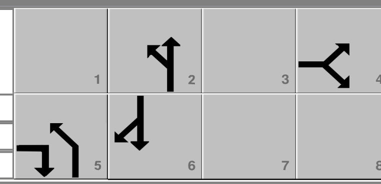
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 15, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & 49th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Western_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	344		453				419	778			957	322

Signal Information										
Cycle, s	94.0	Reference Phase	2							
Offset, s	43	Reference Point	Begin	Green	16.7	41.4	20.7	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	3.9	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	2.0	1.7	0.0	0.0	0.0



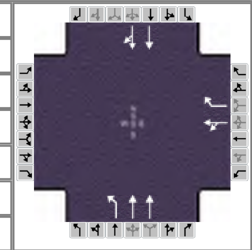
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4			5	2		6
Case Number		9.0			1.0	4.0		7.3
Phase Duration, s		26.0			20.7	68.0		47.3
Change Period, ($Y+R_c$), s		5.3			4.0	5.9		5.9
Max Allow Headway (MAH), s		4.3			4.1	0.0		0.0
Queue Clearance Time (g_s), s		22.7			15.6			
Green Extension Time (g_e), s		0.0			1.0	0.0		0.0
Phase Call Probability		1.00			1.00			
Max Out Probability		1.00			0.15			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14				5	2			6	16
Adjusted Flow Rate (v), veh/h	370		487				407	756			1029	346
Adjusted Saturation Flow Rate (s), veh/h/ln	1632		1496				1681	1680			1680	1496
Queue Service Time (g_s), s	9.4		20.7				13.6	13.4			23.2	15.8
Cycle Queue Clearance Time (g_c), s	9.4		20.7				13.6	13.4			23.2	15.8
Green Ratio (g/C)	0.22		0.40				0.64	0.66			0.44	0.44
Capacity (c), veh/h	719		595				451	2220			1480	659
Volume-to-Capacity Ratio (X)	0.515		0.819				0.903	0.340			0.695	0.525
Available Capacity (c_a), veh/h	719		595				582	2220			1480	659
Back of Queue (Q), veh/ln (95th percentile)	6.6		15.9				9.8	8.5			14.0	9.6
Queue Storage Ratio (RQ) (95th percentile)	0.17		0.40				1.10	0.13			0.36	1.09
Uniform Delay (d_1), s/veh	32.2		25.3				22.1	12.1			21.2	19.1
Incremental Delay (d_2), s/veh	0.6		8.8				10.4	0.3			2.7	3.0
Initial Queue Delay (d_3), s/veh	0.0		0.0				0.0	0.0			0.0	0.0
Control Delay (d), s/veh	32.9		34.1				32.5	12.4			23.9	22.1
Level of Service (LOS)	C		C				C	B			C	C
Approach Delay, s/veh / LOS	33.6	C		0.0			19.4	B		23.5	C	
Intersection Delay, s/veh / LOS	24.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	0.7	A	2.4	B
Bicycle LOS Score / LOS		F			1.5	A	1.6	A

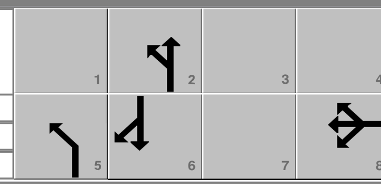
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 15, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Western Ave & I-229 SB ra	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Western_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				308	0	546	81	944			541	88

Signal Information										
Cycle, s	80.0	Reference Phase	2							
Offset, s	66	Reference Point	Begin	Green	22.0	3.5	36.5	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				11.0	1.0	4.0		8.3
Phase Duration, s				42.5	9.5	37.5		28.0
Change Period, ($Y+R_c$), s				6.0	6.0	6.0		6.0
Max Allow Headway (*MAH*), s				4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				34.5	2.0			
Green Extension Time (g_e), s				2.0	1.2	0.0		0.0
Phase Call Probability				1.00	0.87			
Max Out Probability				0.95	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h					385	683	93	1087			396	390
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1629	1594	1528	1661			1718	1687
Queue Service Time (g_s), s					13.5	32.5	0.0	24.9			18.2	17.4
Cycle Queue Clearance Time (g_c), s					13.5	32.5	0.0	24.9			18.2	17.4
Green Ratio (*g/C*)					0.46	0.46	0.29	0.39			0.27	0.27
Capacity (*c*), veh/h					744	728	171	1307			472	463
Volume-to-Capacity Ratio (*X*)					0.518	0.938	0.546	0.832			0.840	0.842
Available Capacity (c_a), veh/h					794	777	181	1307			472	463
Back of Queue (*Q*), veh/ln (95th percentile)					8.0	20.3	3.1	14.5			13.7	13.0
Queue Storage Ratio (*RQ*) (95th percentile)					0.20	2.06	0.26	0.53			0.21	0.20
Uniform Delay (d_1), s/veh					15.5	20.6	35.6	28.1			28.3	26.7
Incremental Delay (d_2), s/veh					0.6	18.2	1.4	3.1			15.4	15.7
Initial Queue Delay (d_3), s/veh					0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh					16.0	38.9	37.0	31.1			43.7	42.4
Level of Service (LOS)					B	D	D	C			D	D
Approach Delay, s/veh / LOS	0.0			30.6	C		31.6	C		43.0	D	
Intersection Delay, s/veh / LOS	34.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.7	B	1.7	A	1.9	A
Bicycle LOS Score / LOS			2.2	B	1.5	A	1.1	A

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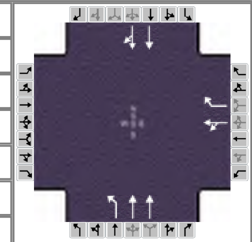
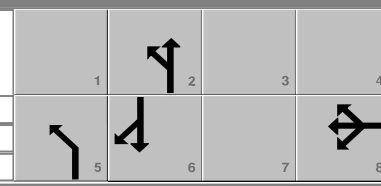
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 15, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & I-229 SB ra	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Western_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				306	0	457	104	740			1197	213

Signal Information										
Cycle, s	94.0	Reference Phase	2							
Offset, s	90	Reference Point	Begin	Green	48.3	3.7	24.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				11.0	1.0	4.0		8.3
Phase Duration, s				30.0	9.7	64.0		54.3
Change Period, ($Y+R_c$), s				6.0	6.0	6.0		6.0
Max Allow Headway (MAH), s				4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				26.0	2.0			
Green Extension Time (g_e), s				0.0	0.9	0.0		0.0
Phase Call Probability				1.00	0.94			
Max Out Probability				1.00	1.00			

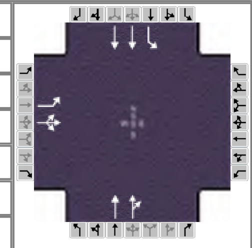
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h					329	491	106	751			738	778
Adjusted Saturation Flow Rate (s), veh/h/ln					1629	1594	1535	1643			1693	1784
Queue Service Time (g_s), s					17.7	24.0	0.0	13.4			36.6	33.3
Cycle Queue Clearance Time (g_c), s					17.7	24.0	0.0	13.4			36.6	33.3
Green Ratio (g/C)					0.26	0.26	0.53	0.62			0.51	0.51
Capacity (c), veh/h					416	407	171	2028			869	916
Volume-to-Capacity Ratio (X)					0.791	1.207	0.616	0.370			0.849	0.850
Available Capacity (c_a), veh/h					416	407	175	2028			869	916
Back of Queue (Q), veh/ln (95th percentile)					12.4	32.5	4.3	8.1			19.4	17.0
Queue Storage Ratio (RQ) (95th percentile)					0.31	3.30	0.37	0.30			0.30	0.27
Uniform Delay (d_1), s/veh					32.7	35.0	39.6	12.7			19.9	15.6
Incremental Delay (d_2), s/veh					10.0	114.3	4.2	0.4			7.0	6.7
Initial Queue Delay (d_3), s/veh					0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (d), s/veh					42.6	149.3	43.8	13.0			26.9	22.3
Level of Service (LOS)					D	F	D	B			C	C

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		106.5	F	16.8	B	24.5	C
Intersection Delay, s/veh / LOS	43.5				D			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.7	B	1.6	A	1.9	A
Bicycle LOS Score / LOS			1.8	A	1.2	A	1.7	A

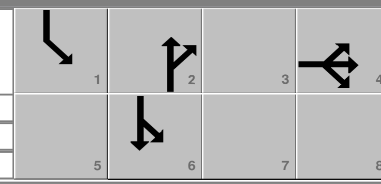
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 15, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Western Ave & I-229 NB ra	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Western_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	239	0	113					786	377	182	667	

Signal Information										
Cycle, s	80.0	Reference Phase	6							
Offset, s	57	Reference Point	Begin	Green	7.0	42.3	13.8	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.8	1.8	1.9	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		19.3				48.0	12.7	60.7
Change Period, ($Y+R_c$), s		5.5				5.7	5.7	5.7
Max Allow Headway (MAH), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		12.9					6.7	
Green Extension Time (g_e), s		0.9				0.0	0.4	0.0
Phase Call Probability		1.00					0.99	
Max Out Probability		0.34					0.51	

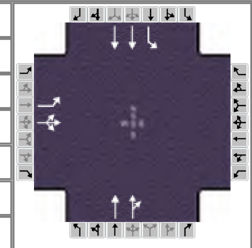
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	224	224						682	659	228	834	
Adjusted Saturation Flow Rate (s), veh/h/ln	1591	1591						1771	1697	1558	1639	
Queue Service Time (g_s), s	10.9	10.9						30.4	24.0	4.7	12.5	
Cycle Queue Clearance Time (g_c), s	10.9	10.9						30.4	24.0	4.7	12.5	
Green Ratio (g/C)	0.17	0.17						0.53	0.53	0.64	0.69	
Capacity (c), veh/h	274	274						936	897	285	2254	
Volume-to-Capacity Ratio (X)	0.817	0.817						0.729	0.735	0.798	0.370	
Available Capacity (c_a), veh/h	388	388						936	897	382	2254	
Back of Queue (Q), veh/ln (95th percentile)	8.1	8.1						10.5	10.3	4.7	7.1	
Queue Storage Ratio (RQ) (95th percentile)	0.69	0.69						0.36	0.35	0.40	0.26	
Uniform Delay (d_1), s/veh	31.9	31.9						14.5	14.5	17.7	9.4	
Incremental Delay (d_2), s/veh	9.0	9.0						1.0	1.1	5.3	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	40.8	40.8						15.5	15.6	23.0	9.7	
Level of Service (LOS)	D	D						B	B	C	A	
Approach Delay, s/veh / LOS	41.4		D	0.0			15.5		B	12.6		B
Intersection Delay, s/veh / LOS	18.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.2	A			1.7	A	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:51:39 PM

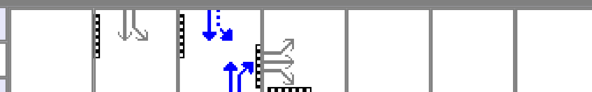
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 15, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & I-229 NB ra	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Western_PM.xus				
Project Description	Existing PM				

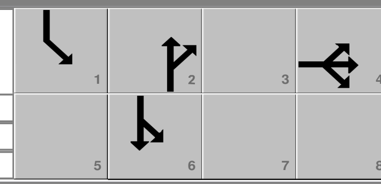


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	142	0	114					702	284	479	1024	

Signal Information			
Cycle, s	94.0	Reference Phase	6
Offset, s	82	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	22.9	42.1	12.1	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.8	1.8	1.9	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		17.6				47.8	28.6	76.4
Change Period, ($Y+R_c$), s		5.5				5.7	5.7	5.7
Max Allow Headway (MAH), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		11.6					21.2	
Green Extension Time (g_e), s		0.5				0.0	1.7	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.20					0.08	

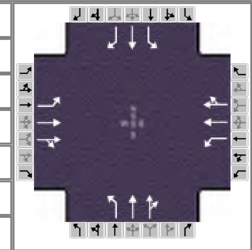
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	115	115						490	498	515	1101	
Adjusted Saturation Flow Rate (s), veh/h/ln	1571	1571						1665	1692	1647	1680	
Queue Service Time (g_s), s	6.4	6.4						26.9	21.6	19.2	6.0	
Cycle Queue Clearance Time (g_c), s	6.4	6.4						26.9	21.6	19.2	6.0	
Green Ratio (g/C)	0.13	0.13						0.45	0.45	0.71	0.75	
Capacity (c), veh/h	202	202						746	759	571	2527	
Volume-to-Capacity Ratio (X)	0.566	0.566						0.657	0.656	0.902	0.436	
Available Capacity (c_a), veh/h	309	309						746	759	744	2527	
Back of Queue (Q), veh/ln (95th percentile)	4.6	4.6						9.3	9.4	17.3	2.1	
Queue Storage Ratio (RQ) (95th percentile)	0.39	0.39						0.32	0.32	1.46	0.08	
Uniform Delay (d_1), s/veh	38.5	38.5						20.3	20.3	27.0	1.7	
Incremental Delay (d_2), s/veh	2.5	2.5						0.4	0.4	5.7	0.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	41.0	41.0						20.7	20.7	32.7	2.0	
Level of Service (LOS)	D	D						C	C	C	A	
Approach Delay, s/veh / LOS	46.4	D		0.0			20.7	C		11.8	B	
Intersection Delay, s/veh / LOS	18.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	0.9	A			1.4	A	1.8	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:54:12 PM

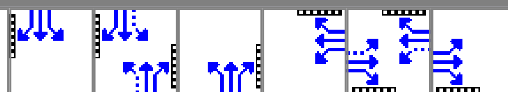
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 15, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Western Ave & 57th St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Western_AM.xus				
Project Description	Existing AM				

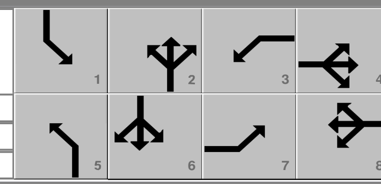


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	289	365	138	75	490	270	164	604	44	120	409	251

Signal Information			
Cycle, s	94.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.1	13.1	11.1	4.1	12.1	12.1
Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Red	2.0	2.0	2.0	2.0	2.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.3	4.0	1.2	4.0	1.3	4.0	1.2	3.0
Phase Duration, s	18.0	36.0	10.0	28.0	17.0	36.0	12.0	31.0
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Max Allow Headway (*MAH*), s	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	14.1	16.2	6.1	24.1	8.9	21.8	8.1	27.1
Green Extension Time (g_e), s	0.0	3.1	0.0	0.0	1.0	2.7	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	0.12	1.00	1.00	1.00	0.44	1.00	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	361	307	287	94	478	427	205	410	400	150	511	175
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1669	1712	1575	1595	1748	1551	1625	1733	1691	1610	1756	1433
Queue Service Time (g_s), s	12.1	14.0	14.2	4.1	22.1	22.1	6.9	19.8	19.8	6.1	25.1	9.6
Cycle Queue Clearance Time (g_c), s	12.1	14.0	14.2	4.1	22.1	22.1	6.9	19.8	19.8	6.1	25.1	9.6
Green Ratio (*g/C*)	0.24	0.32	0.32	0.19	0.24	0.24	0.24	0.32	0.32	0.23	0.27	0.27
Capacity (*c*), veh/h	292	548	504	146	411	365	269	555	541	181	469	383
Volume-to-Capacity Ratio (*X*)	1.239	0.560	0.568	0.641	1.163	1.171	0.763	0.738	0.739	0.828	1.091	0.457
Available Capacity (c_a), veh/h	292	548	504	146	411	365	269	555	541	181	469	383
Back of Queue (*Q*), veh/ln (95th percentile)	26.3	10.0	9.6	4.6	29.7	27.5	9.7	14.1	13.9	4.2	27.2	6.4
Queue Storage Ratio (*RQ*) (95th percentile)	3.34	0.25	0.24	0.67	0.75	0.70	2.46	0.36	0.35	0.70	0.92	0.22
Uniform Delay (d_1), s/veh	39.4	26.5	26.6	35.0	36.0	36.0	38.3	28.4	28.5	34.4	34.5	28.8
Incremental Delay (d_2), s/veh	133.5	4.1	4.6	19.6	96.9	102.3	18.4	8.5	8.8	31.5	66.8	3.6
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	172.8	30.6	31.1	54.6	132.9	138.3	56.8	37.0	37.2	65.9	101.3	32.4
Level of Service (LOS)	F	C	C	D	F	F	E	D	D	E	F	C
Approach Delay, s/veh / LOS	84.6	F		127.9	F		41.1	D		80.5	F	
Intersection Delay, s/veh / LOS	83.4						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	3.0	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.3	A	1.3	A	1.3	A	1.9	A

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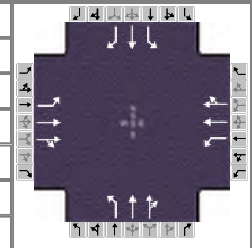
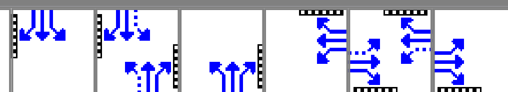
HCS 2010 Signalized Intersection Results Summary

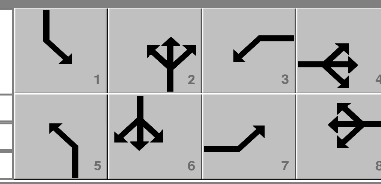
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 15, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & 57th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Western_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	288	685	158	97	479	186	179	512	65	255	577	306

Signal Information										
Cycle, s	94.0	Reference Phase	6							
Offset, s	88	Reference Point	Begin	Green	21.1	6.1	6.1	7.1	11.1	7.1
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	2.0	2.0	2.0





Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.3	4.0	1.2	4.0	1.3	4.0	1.2	3.0
Phase Duration, s	13.0	30.0	13.0	30.0	12.0	24.0	27.0	39.0
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Max Allow Headway (MAH), s	4.0	4.0	4.1	4.1	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	9.1	26.1	6.9	19.9	8.1	17.9	14.6	35.0
Green Extension Time (g_e), s	0.0	0.0	0.0	1.1	0.0	0.1	0.5	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	1.00	1.00	0.95	1.00	1.00	0.26	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	310	453	427	104	356	329	192	304	296	274	620	192
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1664	1681	1765	1614	1681	1765	1713	1681	1765	1496
Queue Service Time (g_s), s	7.1	24.1	24.1	4.9	17.7	17.9	6.1	15.8	15.9	12.6	33.0	9.0
Cycle Queue Clearance Time (g_c), s	7.1	24.1	24.1	4.9	17.7	17.9	6.1	15.8	15.9	12.6	33.0	9.0
Green Ratio (g/C)	0.17	0.26	0.26	0.21	0.26	0.26	0.11	0.19	0.19	0.31	0.35	0.35
Capacity (c), veh/h	238	452	427	204	452	414	186	340	330	454	621	527
Volume-to-Capacity Ratio (X)	1.304	1.000	1.001	0.512	0.788	0.794	1.037	0.894	0.898	0.604	0.998	0.365
Available Capacity (c_a), veh/h	238	452	427	204	452	414	186	340	330	454	621	527
Back of Queue (Q), veh/ln (95th percentile)	24.8	21.5	20.6	4.3	13.7	13.0	12.9	14.2	14.1	9.2	25.8	5.9
Queue Storage Ratio (RQ) (95th percentile)	3.15	0.55	0.52	0.63	0.35	0.33	3.29	0.36	0.36	1.55	0.87	0.20
Uniform Delay (d_1), s/veh	41.5	35.0	35.0	31.8	32.6	32.6	42.7	37.0	37.0	27.0	30.4	22.6
Incremental Delay (d_2), s/veh	163.8	42.4	43.7	8.9	13.0	14.5	76.0	28.1	29.3	5.2	33.7	1.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	205.3	77.3	78.7	40.7	45.6	47.1	118.7	65.1	66.3	32.3	64.1	24.4
Level of Service (LOS)	F	F	F	D	D	D	F	E	E	C	E	C
Approach Delay, s/veh / LOS	111.1	F		45.6	D		78.6	E		49.1	D	
Intersection Delay, s/veh / LOS	73.5						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	3.0	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.5	A	1.1	A	1.1	A	2.3	B

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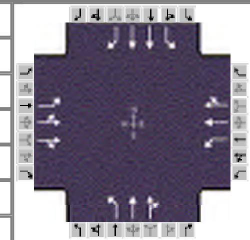
HCS 2010 Signalized Intersection Results Summary

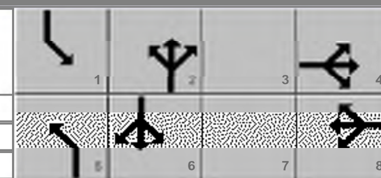
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Minnesota Ave & 41st St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Minnesota_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	346	194	101	132	220	57	150	1252	82	63	598	232

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	51	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.4	36.1	3.8	13.5	24.0	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	1.0	2.3	2.3	2.1	2.5	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		10.0		10.0	1.2	4.0	1.3	3.0
Phase Duration, s		30.1		19.2	15.0	57.0	9.7	51.7
Change Period, ($Y+R_c$), s		6.1		5.7	4.6	5.9	5.9	5.9
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s		24.0		13.2	10.7		3.0	
Green Extension Time (g_e), s		0.0		0.3	0.0	0.0	1.1	0.0
Phase Call Probability		1.00		1.00	1.00		0.92	
Max Out Probability		1.00		1.00	1.00		1.00	

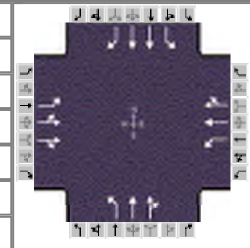
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	324	269	154	165	166	161	186	826	818	79	748	239
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1731	1627	1681	1765	1667	1664	1748	1714	1664	1664	1481
Queue Service Time (g_s), s	22.0	16.9	9.6	11.2	10.7	11.0	8.7	51.1	51.1	1.0	17.6	11.3
Cycle Queue Clearance Time (g_c), s	22.0	16.9	9.6	11.2	10.7	11.0	8.7	51.1	51.1	1.0	17.6	11.3
Green Ratio (*g/C*)	0.21	0.21	0.21	0.12	0.12	0.12	0.42	0.44	0.44	0.33	0.39	0.39
Capacity (*c*), veh/h	348	358	337	195	205	194	301	770	756	116	1312	584
Volume-to-Capacity Ratio (*X*)	0.932	0.751	0.457	0.845	0.811	0.832	0.618	1.072	1.082	0.679	0.570	0.409
Available Capacity (c_a), veh/h	349	359	337	212	223	210	301	770	756	135	1312	584
Back of Queue (*Q*), veh/ln (95th percentile)	17.8	12.7	7.1	10.0	9.7	9.7	5.3	37.0	37.3	4.6	10.6	7.0
Queue Storage Ratio (*RQ*) (95th percentile)	3.02	0.32	0.18	1.45	0.25	0.25	1.09	0.68	0.68	1.18	0.27	1.80
Uniform Delay (d_1), s/veh	45.2	43.2	40.3	50.2	50.0	50.1	23.1	27.9	27.4	53.8	20.8	19.3
Incremental Delay (d_2), s/veh	31.2	8.5	1.0	24.3	18.7	22.4	1.8	44.6	48.3	10.6	1.8	2.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	76.4	51.7	41.2	74.5	68.7	72.5	24.9	72.5	75.8	64.4	22.6	21.4
Level of Service (LOS)	E	D	D	E	E	E	C	F	F	E	C	C
Approach Delay, s/veh / LOS	60.3		E	71.9		E	69.1		E	25.4		C
Intersection Delay, s/veh / LOS	56.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	0.9	A	2.0	B	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 9:19:14 AM

HCS 2010 Signalized Intersection Results Summary

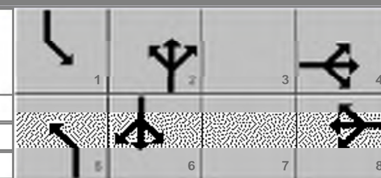
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & 41st St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Minnesota_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	392	267	251	250	288	50	217	735	97	50	1084	386

Signal Information			
Cycle, s	128.0	Reference Phase	2
Offset, s	43	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	15.7	35.8	3.5	19.9	24.9	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	1.0	2.3	2.3	2.1	2.5	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		10.0		10.0	1.2	4.0	1.3	3.0
Phase Duration, s		31.0		25.6	20.3	62.0	9.4	51.1
Change Period, (Y+R_c), s		6.1		5.7	4.6	5.9	5.9	5.9
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s		26.9		21.9	15.5		2.0	
Green Extension Time (g_e), s		0.0		0.0	0.2	0.0	2.1	0.0
Phase Call Probability		1.00		1.00	1.00		0.85	
Max Out Probability		1.00		1.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	337	346	233	269	178	174	233	445	430	54	1166	370
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1744	1521	1681	1765	1691	1664	1748	1688	1664	1664	1481
Queue Service Time (g_s), s	24.9	24.9	18.7	19.9	12.1	12.4	13.5	28.2	28.8	0.0	44.5	25.4
Cycle Queue Clearance Time (g_c), s	24.9	24.9	18.7	19.9	12.1	12.4	13.5	28.2	28.8	0.0	44.5	25.4
Green Ratio (*g/C*)	0.19	0.19	0.19	0.16	0.16	0.16	0.42	0.44	0.44	0.29	0.35	0.35
Capacity (*c*), veh/h	327	339	296	261	274	263	260	766	740	225	1175	523
Volume-to-Capacity Ratio (*X*)	1.031	1.019	0.788	1.030	0.650	0.661	0.896	0.581	0.581	0.239	0.992	0.707
Available Capacity (c_a), veh/h	327	339	296	261	274	263	295	766	740	246	1175	523
Back of Queue (*Q*), veh/ln (95th percentile)	22.6	22.7	12.9	19.2	9.7	9.6	10.7	17.9	17.9	2.6	27.7	14.5
Queue Storage Ratio (*RQ*) (95th percentile)	3.83	0.58	0.33	2.79	0.25	0.24	2.18	0.33	0.33	0.68	0.71	3.70
Uniform Delay (d_1), s/veh	51.5	51.5	49.0	54.1	50.8	50.9	39.7	36.6	38.5	41.7	33.7	28.6
Incremental Delay (d_2), s/veh	58.0	53.7	13.2	63.6	5.3	6.0	18.0	2.0	2.1	0.5	24.3	7.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	109.5	105.2	62.3	117.7	56.1	56.9	57.7	38.6	40.6	42.2	58.0	36.4
Level of Service (LOS)	F	F	E	F	E	E	E	D	D	D	E	D
Approach Delay, s/veh / LOS	95.9	F		83.0	F		43.4	D		52.5	D	
Intersection Delay, s/veh / LOS	64.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.1	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	1.0	A	1.4	A	1.8	A

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TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & 43rd St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 43rd Street
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	75	1465	145	7	811	13
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	93	1831	181	8	1013	16
Percent Heavy Vehicles	3	--	--	3	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	13	6	13	6	6	31
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	16	7	16	7	7	38
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			Yes /1
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	93	8		39			52	
C(m) (vph)	723	499		5			7	
v/c	0.13	0.02		7.80			7.43	
95% queue length	0.44	0.05		6.50			8.05	
Control Delay	10.7	12.3		4461			3918	
LOS	B	B		F			F	
Approach Delay				4461			3918	
Approach LOS				F			F	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & 43rd St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 43rd Street
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	75	1465	145	7	811	13
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	23	458	45	2	253	4
Hourly Flow Rate, HFR	93	1831	181	8	1013	16
Percent Heavy Vehicles	3	--	--	3	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	13	6	13	6	6	31
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	4	2	4	2	2	10
Hourly Flow Rate, HFR	16	7	16	7	7	38
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			Yes /1
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	725
	Through	1585	1800	4	84	116	30	725
S5	Left-Turn	0	1800	3	0	116	30	675
	Through	598	1800	4	46	116	30	675

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.2	7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3	3	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.5	6.5	6.2	7.5	6.5	6.2
	2-stage	4.2	4.2	6.5	5.5	6.2	6.5	5.5	6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3	3	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	1585	0	598	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	84	0	46	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.966	0.000	0.529	0.000
g(q1)	1.8	0.0	9.1	0.0
g(q2)	2.5	0.0	2.6	0.0
g(q)	4.3	0.0	11.7	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	16.440		15.306	
Smoothing Factor, F	0.190		0.201	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	2135	0	3338	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	80.2	0.0	11.4	0.0
Proportion time blocked, p	0.691		0.098	

Computation 3-Platoon Event Periods	Result
p(2)	0.691
p(5)	0.098
p(dom)	0.691
p(subo)	0.098
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.902		
p(4)	0.309		
p(7)	0.260	0.309	0.902
p(8)	0.260	0.309	0.902
p(9)	0.309		
p(10)	0.260	0.902	0.309
p(11)	0.260	0.902	0.309
p(12)	0.902		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1029	2012	2634	3153	1006	2141	3235	514
s	3000	3000	3000	3000	3000	3000	3000	3000
Px	0.902	0.309	0.260	0.260	0.309	0.260	0.260	0.902
V c,u,x	815	0	1592	3589	0	0	3904	243
C r,x	802	1614	72	5	1084	1023	3	794
C plat,x	723	499	19	1	335	266	1	716

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	2108	526	2108	1045	1037	1104	1037	2198
s	3000	3000	3000	3000	3000	3000	3000	3000
P(x)	0.309	0.902	0.309	0.902	0.902	0.309	0.902	0.309
V(c,u,x)	114	257	114	832	823	0	823	405
C(r,x)	879	725	800	382	334	1023	386	597
C(plat,x)	272	654	247	345	301	316	348	184

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	1006	514
Potential Capacity	335	716
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	335	716
Probability of Queue free St.	0.95	0.95

Step 2: LT from Major St.	4	1
Conflicting Flows	2012	1029
Potential Capacity	499	723
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	499	723
Probability of Queue free St.	0.98	0.87
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	3153	3235
Potential Capacity	1	1
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.86	0.86
Movement Capacity	1	1
Probability of Queue free St.	0.00	0.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2634	2141
Potential Capacity	19	266
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	0.00
Maj. L, Min T Adj. Imp Factor.	0.00	0.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity	0	0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows	2108	1037
Potential Capacity	247	348
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.98
Movement Capacity	215	342
Probability of Queue free St.	0.97	0.98

Part 2 - Second Stage		
Conflicting Flows	1045	2198
Potential Capacity	345	184
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.87
Movement Capacity	339	160

Part 3 - Single Stage		
Conflicting Flows	3153	3235
Potential Capacity	1	1
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.86	0.86
Movement Capacity	1	1

Result for 2 stage process:		
a	0.91	0.91
y		
C t	1	1
Probability of Queue free St.	0.00	0.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows	2108	1037
Potential Capacity	272	301
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.98
Movement Capacity	237	296

Part 2 - Second Stage		
Conflicting Flows	526	1104
Potential Capacity	654	316
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.91	0.80
Movement Capacity	597	254

Part 3 - Single Stage		
Conflicting Flows	2634	2141
Potential Capacity	19	266
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	0.00
Maj. L, Min T Adj. Imp Factor.	0.00	0.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity	0	0

Results for Two-stage process:		
a	0.91	0.91
y	0.47	1.20
C t	147	123

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	16	7	16	7	7	38
Movement Capacity (vph)	147	1	335	123	1	716
Shared Lane Capacity (vph)		5			7	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	147	1	335	123	1	716
Volume	16	7	16	7	7	38
Delay	32.5	8583.0	16.3	36.0	8583.0	10.3
Q sep	0.14	16.69	0.07	0.07	16.69	0.11
Q sep +1	1.14	17.69	1.07	1.07	17.69	1.11
round (Qsep +1)	1	18	1	1	18	1
n max		18			18	
C sh		5			7	
SUM C sep		5			7	
n		1			1	
C act		5			7	

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	93	8		39			52	
C(m) (vph)	723	499		5			7	
v/c	0.13	0.02		7.80			7.43	
95% queue length	0.44	0.05		6.50			8.05	
Control Delay	10.7	12.3		4461			3918	
LOS	B	B		F			F	
Approach Delay				4461			3918	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.87	0.98
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	10.7	12.3
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & 43rd St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 43rd Street
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	32	1023	26	16	1552	17
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	34	1099	27	17	1668	18
Percent Heavy Vehicles	3	--	--	3	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	26	4	22	4	4	164
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	27	4	23	4	4	176
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			Yes /1
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	34	17		54			184	
C(m) (vph)	423	610		91			344	
v/c	0.08	0.03		0.59			0.53	
95% queue length	0.26	0.09		2.75			3.00	
Control Delay	14.3	11.1		90.7			26.9	
LOS	B	B		F			D	
Approach Delay				90.7			26.9	
Approach LOS				F			D	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & 43rd St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 43rd Street
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	32	1023	26	16	1552	17
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	9	275	7	4	417	5
Hourly Flow Rate, HFR	34	1099	27	17	1668	18
Percent Heavy Vehicles	3	--	--	3	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	26	4	22	4	4	164
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	7	1	6	1	1	44
Hourly Flow Rate, HFR	27	4	23	4	4	176
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			Yes /1			Yes /1
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	128	30	725
	Through	930	1800	4	96	128	30	725
S5	Left-Turn	0	1800	3	0	128	30	675
	Through	1084	1800	4	45	128	30	675

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.2	7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3	3	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.5	6.5	6.2	7.5	6.5	6.2
	2-stage	4.2	4.2	6.5	5.5	6.2	6.5	5.5	6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3	3	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	930	0	1084	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	96	0	45	0
Cycle Length, C (sec)	128	128	128	128
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	1.000	0.000	0.469	0.000
g(q1)	0.0	0.0	20.5	0.0
g(q2)	0.0	0.0	13.7	0.0
g(q)	0.0	0.0	34.2	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	16.440		15.306	
Smoothing Factor, F	0.190		0.201	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	0	0	3598	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	36.6	0.0
Proportion time blocked, p	0.000		0.286	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.286
p(dom)	0.286
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.714		
p(4)	1.000		
p(7)	0.714	1.000	0.714
p(8)	0.714	1.000	0.714
p(9)	1.000		
p(10)	0.714	0.714	1.000
p(11)	0.714	0.714	1.000
p(12)	0.714		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1686	1126	2050	2900	563	2330	2905	843
s	3000	3000	3000	3000	3000	3000	3000	3000
Px	0.714	1.000	0.714	0.714	1.000	0.714	0.714	0.714
V c,u,x	1159	1126	1669	2860	563	2061	2867	0
C r,x	593	610	63	17	524	32	16	1084
C plat,x	423	610	45	12	524	23	11	774

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	1180	870	1180	1720	1711	619	1711	1194
s	3000	3000	3000	3000	3000	3000	3000	3000
P(x)	1.000	0.714	1.000	0.714	0.714	1.000	0.714	1.000
V(c,u,x)	1180	16	1180	1207	1194	619	1194	1194
C(r,x)	202	1001	262	254	198	443	258	258
C(plat,x)	202	714	262	181	141	443	184	258

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	563	843
Potential Capacity	524	774
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	524	774
Probability of Queue free St.	0.96	0.77

Step 2: LT from Major St.	4	1
Conflicting Flows	1126	1686
Potential Capacity	610	423
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	610	423
Probability of Queue free St.	0.97	0.92
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2900	2905
Potential Capacity	12	11
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity	11	10
Probability of Queue free St.	0.64	0.60

Step 4: LT from Minor St.	7	10
Conflicting Flows	2050	2330
Potential Capacity	45	23
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.54	0.57
Maj. L, Min T Adj. Imp Factor.	0.64	0.66
Cap. Adj. factor due to Impeding mvmnt	0.49	0.63
Movement Capacity	22	15

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows	1180	1711
Potential Capacity	262	184
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.97
Movement Capacity	241	179
Probability of Queue free St.	0.98	0.98

Part 2 - Second Stage		
Conflicting Flows	1720	1194
Potential Capacity	181	258
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.92
Movement Capacity	176	237
Part 3 - Single Stage		
Conflicting Flows	2900	2905
Potential Capacity	12	11
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity	11	10
Result for 2 stage process:		
a	0.91	0.91
y		
C t	11	10
Probability of Queue free St.	0.64	0.60
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows	1180	1711
Potential Capacity	202	141
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.97
Movement Capacity	186	137
Part 2 - Second Stage		
Conflicting Flows	870	619
Potential Capacity	714	443
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.73	0.86
Movement Capacity	524	383
Part 3 - Single Stage		
Conflicting Flows	2050	2330
Potential Capacity	45	23
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.54	0.57
Maj. L, Min T Adj. Imp Factor.	0.64	0.66
Cap. Adj. factor due to Impeding mvmnt	0.49	0.63
Movement Capacity	22	15
Results for Two-stage process:		
a	0.91	0.91
y	0.35	0.35
C t	131	96

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	27	4	23	4	4	176
Movement Capacity (vph)	131	11	524	96	10	774
Shared Lane Capacity (vph)		88			275	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	131	11	524	96	10	774
Volume	27	4	23	4	4	176
Delay	39.5	461.2	12.2	44.1	518.1	11.0
Q sep	0.30	0.51	0.08	0.05	0.58	0.54
Q sep +1	1.30	1.51	1.08	1.05	1.58	1.54
round (Qsep +1)	1	2	1	1	2	2
n max		2			2	
C sh		88			275	
SUM C sep		94			414	
n		1			1	
C act		91			344	

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	34	17		54			184	
C(m) (vph)	423	610		91			344	
v/c	0.08	0.03		0.59			0.53	
95% queue length	0.26	0.09		2.75			3.00	
Control Delay	14.3	11.1		90.7			26.9	
LOS	B	B		F			D	
Approach Delay				90.7			26.9	
Approach LOS				F			D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.92	0.97
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	14.3	11.1
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & 49th St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 49th St
North/South Street: Minnesota Ave
Intersection Orientation: NS   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	132	1679			817	38
Peak-Hour Factor, PHF	0.80	0.80			0.80	0.80
Hourly Flow Rate, HFR	164	2098			1021	47
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				6		64
Peak Hour Factor, PHF				0.80		0.80
Hourly Flow Rate, HFR				7		79
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	164					7		79
C(m) (vph)	687					156		667
v/c	0.24					0.04		0.12
95% queue length	0.93					0.14		0.40
Control Delay	11.9					29.2		11.1
LOS	B					D		B
Approach Delay							12.6	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & 49th St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 49th St
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	132	1679			817	38
Peak-Hour Factor, PHF	0.80	0.80			0.80	0.80
Peak-15 Minute Volume	41	525			255	12
Hourly Flow Rate, HFR	164	2098			1021	47
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				6		64
Peak Hour Factor, PHF				0.80		0.80
Peak-15 Minute Volume				2		20
Hourly Flow Rate, HFR				7		79
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	225
	Through	1585	1800	4	84	116	30	225
S5	Left-Turn	0	1800	3	0	116	30	1170
	Through	598	1800	4	46	116	30	1170

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage	4.2					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	1585	0	598	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	84	0	46	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.966	0.000	0.529	0.000
g(q1)	1.8	0.0	9.1	0.0
g(q2)	2.5	0.0	2.6	0.0
g(q)	4.3	0.0	11.7	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	5.102		26.531	
Smoothing Factor, F	0.431		0.127	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3274	0	2861	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	82.6	0.0	9.7	0.0
Proportion time blocked, p	0.712		0.083	

Computation 3-Platoon Event Periods	Result
p(2)	0.712
p(5)	0.083
p(dom)	0.712
p(subo)	0.083
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	0.917		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.247	0.917	0.288
p(11)			
p(12)	0.917		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1068					2421		534
s	3000					3000		3000
Px	0.917					0.247		0.917
V c,u,x	892					652		310
C r,x	750					401		728
C plat,x	687					99		667

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					1044	1377		
s					3000	3000		
P(x)					0.917	0.288		
V(c,u,x)					866	0		
C(r,x)					372	1023		
C(plat,x)					341	295		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		534
Potential Capacity		667
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		667
Probability of Queue free St.	1.00	0.88

Step 2: LT from Major St.	4	1
Conflicting Flows		1068
Potential Capacity		687
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		687
Probability of Queue free St.	1.00	0.76
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		2421
Potential Capacity		99
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.76	
Maj. L, Min T Adj. Imp Factor.	0.82	
Cap. Adj. factor due to Impeding mvmnt	0.72	0.76
Movement Capacity		75

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	92	342
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	1.00
Movement Capacity	70	342
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	333	92
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.76
Movement Capacity	333	70

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		1044
Potential Capacity	92	341
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	1.00
Movement Capacity	70	341

Part 2 - Second Stage		
Conflicting Flows		1377
Potential Capacity	683	295
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.76
Movement Capacity	602	225

Part 3 - Single Stage		
Conflicting Flows		2421
Potential Capacity		99
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.76	
Maj. L, Min T Adj. Imp Factor.	0.82	
Cap. Adj. factor due to Impeding mvmnt	0.72	0.76
Movement Capacity		75

Results for Two-stage process:		
a	0.91	0.91
y		1.77
C t		156

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				7		79
Movement Capacity (vph)				156		667
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				156		667
Volume				7		79
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	164					7		79
C(m) (vph)	687					156		667
v/c	0.24					0.04		0.12
95% queue length	0.93					0.14		0.40
Control Delay	11.9					29.2		11.1
LOS	B					D		B
Approach Delay							12.6	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.76	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	11.9	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & 49th St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 49th St
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	49	1077			1720	22
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Hourly Flow Rate, HFR	52	1158			1849	23
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				4		135
Peak Hour Factor, PHF				0.93		0.93
Hourly Flow Rate, HFR				4		145
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	52					4		145
C(m) (vph)	338					100		704
v/c	0.15					0.04		0.21
95% queue length	0.54					0.12		0.77
Control Delay	17.6					42.5		11.4
LOS	C					E		B
Approach Delay							12.3	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & 49th St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 49th St
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	49	1077			1720	22
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Peak-15 Minute Volume	13	290			462	6
Hourly Flow Rate, HFR	52	1158			1849	23
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				4		135
Peak Hour Factor, PHF				0.93		0.93
Peak-15 Minute Volume				1		36
Hourly Flow Rate, HFR				4		145
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	128	30	225
	Through	930	1800	4	96	128	30	225
S5	Left-Turn	0	1800	3	0	128	30	1170
	Through	1084	1800	4	45	128	30	1170

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage	4.2					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	930	0	1084	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	96	0	45	0
Cycle Length, C (sec)	128	128	128	128
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	1.000	0.000	0.469	0.000
g(q1)	0.0	0.0	20.5	0.0
g(q2)	0.0	0.0	13.7	0.0
g(q)	0.0	0.0	34.2	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	5.102		26.531	
Smoothing Factor, F	0.431		0.127	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	0	0	3565	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	38.1	0.0
Proportion time blocked, p	0.000		0.298	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.298
p(dom)	0.298
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.702		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.702	0.702	1.000
p(11)			
p(12)	0.702		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	1872					2543		936
s	3000					3000		3000
Px	0.702					0.702		0.702
V c,u,x	1394					2349		61
C r,x	481					30		1003
C plat,x	338					21		704

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					1860	683		
s					3000	3000		
P(x)					0.702	1.000		
V(c,u,x)					1377	683		
C(r,x)					199	463		
C(plat,x)					140	463		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		936
Potential Capacity		704
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		704
Probability of Queue free St.	1.00	0.79

Step 2: LT from Major St.	4	1
Conflicting Flows		1872
Potential Capacity		338
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		338
Probability of Queue free St.	1.00	0.85
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.85	0.85
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		2543
Potential Capacity		21
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.85	
Maj. L, Min T Adj. Imp Factor.	0.88	
Cap. Adj. factor due to Impeding mvmnt	0.70	0.85
Movement Capacity		18

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	243	150
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity	206	150
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	147	243
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.85
Movement Capacity	147	206

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.85	0.85
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		1860
Potential Capacity	234	140
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity	198	140
Part 2 - Second Stage		
Conflicting Flows		683
Potential Capacity	687	463
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	0.85
Movement Capacity	546	392
Part 3 - Single Stage		
Conflicting Flows		2543
Potential Capacity		21
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.85	
Maj. L, Min T Adj. Imp Factor.	0.88	
Cap. Adj. factor due to Impeding mvmnt	0.70	0.85
Movement Capacity		18
Results for Two-stage process:		
a	0.91	0.91
y		0.33
C t		100

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				4		145
Movement Capacity (vph)				100		704
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				100		704
Volume				4		145
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

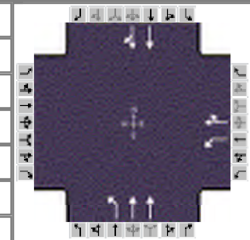
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	52					4		145
C(m) (vph)	338					100		704
v/c	0.15					0.04		0.21
95% queue length	0.54					0.12		0.77
Control Delay	17.6					42.5		11.4
LOS	C					E		B
Approach Delay							12.3	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.85	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	17.6	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS 2010 Signalized Intersection Results Summary

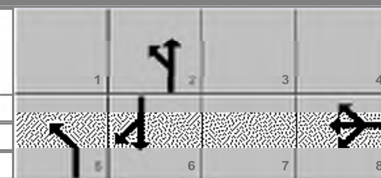
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Minnesota Ave & I-229 SB	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Minnesota_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				150	0	226	113	1585			585	296

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	5	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.9	68.8	25.2	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	2.2	1.7	0.0	0.0	0.0



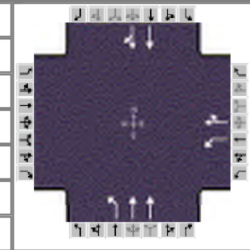
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				10.0	1.0	4.0		8.3
Phase Duration, s				30.9	10.5	85.1		74.6
Change Period, ($Y+R_c$), s				5.7	4.6	5.8		5.8
Max Allow Headway (*MAH*), s				4.2	4.1	0.0		0.0
Queue Clearance Time (g_s), s				24.1	5.6			
Green Extension Time (g_e), s				1.1	0.4	0.0		0.0
Phase Call Probability				1.00	0.99			
Max Out Probability				0.31	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				188	283		140	1967			566	535
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1617	1444		1601	1800			1681	1581
Queue Service Time (g_s), s				11.9	22.1		3.6	47.1			30.0	32.0
Cycle Queue Clearance Time (g_c), s				11.9	22.1		3.6	47.1			30.0	32.0
Green Ratio (*g/C*)				0.22	0.22		0.66	0.68			0.59	0.59
Capacity (*c*), veh/h				351	314		298	2462			997	937
Volume-to-Capacity Ratio (*X*)				0.534	0.901		0.471	0.799			0.567	0.571
Available Capacity (c_a), veh/h				436	390		513	2462			997	937
Back of Queue (*Q*), veh/ln (95th percentile)				8.3	14.5		1.9	19.6			17.1	18.7
Queue Storage Ratio (*RQ*) (95th percentile)				1.71	0.37		0.38	0.72			0.31	0.34
Uniform Delay (d_1), s/veh				40.2	44.2		15.2	15.4			20.4	25.8
Incremental Delay (d_2), s/veh				1.3	20.3		0.1	0.3			1.8	1.9
Initial Queue Delay (d_3), s/veh				0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				41.5	64.5		15.3	15.7			22.2	27.7
Level of Service (LOS)				D	E		B	B			C	C
Approach Delay, s/veh / LOS	0.0			55.3	E		15.7	B		24.9	C	
Intersection Delay, s/veh / LOS	23.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	1.6	A	1.9	A
Bicycle LOS Score / LOS			1.3	A	2.2	B	1.4	A

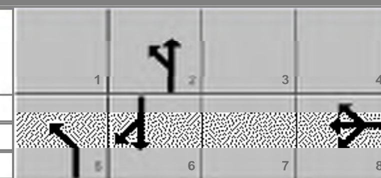
 HCS 2010™ Streets Version 6.50 Generated: 5/20/2016 8:47:38 AM

HCS 2010 Signalized Intersection Results Summary



General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & I-229 SB	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Minnesota_PM.xus				
Project Description	Existing PM				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				202	0	196	109	930			1365	490



Signal Information										
Cycle, s	128.0	Reference Phase	2							
Offset, s	58	Reference Point	Begin	Green	4.9	86.6	20.4	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.2	1.7	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				10.0	1.0	4.0		8.3
Phase Duration, s				26.1	9.5	101.9		92.4
Change Period, (Y+R_c), s				5.7	4.6	5.8		5.8
Max Allow Headway (*MAH*), s				4.2	4.1	0.0		0.0
Queue Clearance Time (g_s), s				20.2	4.8			
Green Extension Time (g_e), s				0.2	0.2	0.0		0.0
Phase Call Probability				1.00	0.98			
Max Out Probability				1.00	0.02			

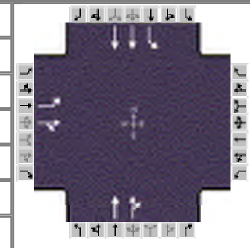
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				217	211		117	1000			981	1006
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1635	1460		1597	1691			1842	1733
Queue Service Time (g_s), s				16.5	18.2		2.8	33.6			70.7	46.2
Cycle Queue Clearance Time (g_c), s				16.5	18.2		2.8	33.6			70.7	46.2
Green Ratio (*g/C*)				0.16	0.16		0.73	0.43			0.68	0.68
Capacity (*c*), veh/h				260	232		143	1466			1247	1173
Volume-to-Capacity Ratio (*X*)				0.835	0.907		0.819	0.682			0.787	0.858
Available Capacity (c_a), veh/h				272	243		248	1466			1247	1173
Back of Queue (*Q*), veh/ln (95th percentile)				12.7	13.5		5.0	20.4			18.5	13.4
Queue Storage Ratio (*RQ*) (95th percentile)				2.60	0.35		1.02	0.75			0.34	0.24
Uniform Delay (d_1), s/veh				52.2	52.9		33.1	22.3			12.0	8.2
Incremental Delay (d_2), s/veh				19.1	33.3		8.6	2.0			0.8	1.4
Initial Queue Delay (d_3), s/veh				0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				71.2	86.1		41.8	24.3			12.8	9.7
Level of Service (LOS)				E	F		D	C			B	A
Approach Delay, s/veh / LOS	0.0			78.6	E		26.2	C		11.2	B	
Intersection Delay, s/veh / LOS	24.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	1.6	A	1.9	A
Bicycle LOS Score / LOS			1.2	A	1.4	A	2.1	B

 HCS 2010™ Streets Version 6.50 Generated: 5/20/2016 8:49:42 AM

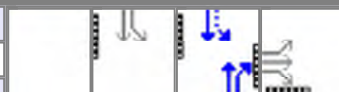
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Minnesota Ave & I-229 NB	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Minnesota_AM.xus				
Project Description	Existing AM				

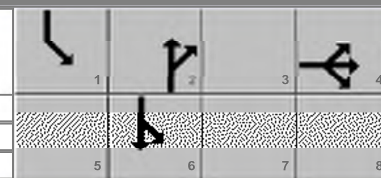


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	390	0	101					1308	225	113	622	

Signal Information			
Cycle, s	116.0	Reference Phase	6
Offset, s	100	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.7	60.1	33.4	0.0	0.0	0.0
Yellow	4.3	4.3	4.0	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



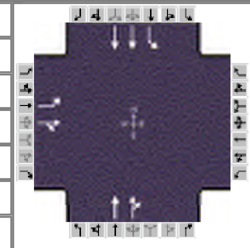
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		39.0				66.0	11.0	77.0
Change Period, (Y+R_c), s		5.6				5.9	5.3	5.9
Max Allow Headway (MAH), s		4.1				0.0	4.1	0.0
Queue Clearance Time (g_s), s		34.5					7.7	
Green Extension Time (g_e), s		0.0				0.0	0.0	0.0
Phase Call Probability		1.00					0.99	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	488	126						949	967	141	778	
Adjusted Saturation Flow Rate (s), veh/h/ln	1726	1542						1851	1799	1601	1649	
Queue Service Time (g_s), s	32.5	7.4						71.0	60.1	5.7	13.3	
Cycle Queue Clearance Time (g_c), s	32.5	7.4						71.0	60.1	5.7	13.3	
Green Ratio (g/C)	0.29	0.29						0.52	0.52	0.58	0.61	
Capacity (c), veh/h	497	444						959	932	141	2021	
Volume-to-Capacity Ratio (X)	0.981	0.284						0.990	1.037	1.004	0.385	
Available Capacity (c_a), veh/h	497	444						959	932	141	2021	
Back of Queue (Q), veh/ln (95th percentile)	25.2	4.9						31.9	36.4	10.7	7.6	
Queue Storage Ratio (RQ) (95th percentile)	5.17	0.13						0.25	0.29	2.18	0.28	
Uniform Delay (d_1), s/veh	41.0	32.0						27.7	28.0	33.2	10.7	
Incremental Delay (d_2), s/veh	35.4	0.3						13.4	26.5	69.1	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	76.4	32.4						41.0	54.4	102.3	11.1	
Level of Service (LOS)	E	C						D	F	F	B	
Approach Delay, s/veh / LOS	67.3		E	0.0			47.8		D	25.1		C
Intersection Delay, s/veh / LOS	45.2						D					

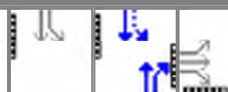
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS	1.5	A			2.1	B	1.2	A

HCS 2010 Signalized Intersection Results Summary

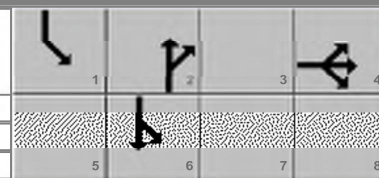
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & I-229 NB	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Minnesota_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	245	0	104					794	146	315	1252	



Signal Information										
Cycle, s	128.0	Reference Phase	6							
Offset, s	89	Reference Point	Begin	Green	13.0	75.1	23.2	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.3	4.3	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.6	1.6	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		28.8				81.0	18.3	99.2
Change Period, (*Y+R*c), s		5.6				5.9	5.3	5.9
Max Allow Headway (*MAH*), s		6.1				0.0	4.1	0.0
Queue Clearance Time (g_s), s		21.9					12.1	
Green Extension Time (g_e), s		1.3				0.0	0.9	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		1.00					0.03	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	263	112						517	494	338	1342	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1653	1476						1769	1681	1682	1744	
Queue Service Time (g_s), s	19.9	8.6						26.4	22.0	10.1	15.9	
Cycle Queue Clearance Time (g_c), s	19.9	8.6						26.4	22.0	10.1	15.9	
Green Ratio (*g/C*)	0.18	0.18						0.59	0.59	0.70	0.73	
Capacity (*c*), veh/h	299	267						1037	986	438	2543	
Volume-to-Capacity Ratio (*X*)	0.880	0.418						0.499	0.501	0.771	0.528	
Available Capacity (c_a), veh/h	354	316						1037	986	569	2543	
Back of Queue (*Q*), veh/ln (95th percentile)	15.1	5.9						13.0	12.6	6.0	6.3	
Queue Storage Ratio (*RQ*) (95th percentile)	3.10	0.15						0.10	0.10	1.23	0.23	
Uniform Delay (d_1), s/veh	51.1	46.4						15.5	15.5	14.1	4.7	
Incremental Delay (d_2), s/veh	22.6	2.2						1.4	1.5	2.3	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	73.7	48.7						16.9	17.0	16.4	5.0	
Level of Service (LOS)	E	D						B	B	B	A	
Approach Delay, s/veh / LOS	66.2	E		0.0			16.9	B		7.3	A	
Intersection Delay, s/veh / LOS	17.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.1	A			1.3	A	1.9	A

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & Yankton Trails
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Yankton Trails Park
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	6	1527			718	5
Peak-Hour Factor, PHF	0.80	0.80			0.80	0.80
Hourly Flow Rate, HFR	7	1908			897	6
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		No			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				6		6
Peak Hour Factor, PHF				0.80		0.80
Hourly Flow Rate, HFR				7		7
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	7					7		7
C(m) (vph)	771					190		670
v/c	0.01					0.04		0.01
95% queue length	0.03					0.11		0.03
Control Delay	9.7					24.7		10.4
LOS	A					C		B
Approach Delay							17.6	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & Yankton Trails
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Yankton Trails Park
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	6	1527			718	5
Peak-Hour Factor, PHF	0.80	0.80			0.80	0.80
Peak-15 Minute Volume	2	477			224	2
Hourly Flow Rate, HFR	7	1908			897	6
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		No			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				6		6
Peak Hour Factor, PHF				0.80		0.80
Peak-15 Minute Volume				2		2
Hourly Flow Rate, HFR				7		7
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	116	40	200
	Through	622	1800	4	71	116	40	200

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1	4	7	8	9	10	11	12
		L	L	L	T	R	L	T	R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage	4.2					5.8		6.2

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog			622	0

Total Saturation Flow Rate, s (vph)	3600	3600
Arrival Type	4	3
Effective Green, g (sec)	71	0
Cycle Length, C (sec)	116	116
Rp (from Exhibit 16-11)	1.333	1.000
Proportion vehicles arriving on green P	0.816	0.000
g(q1)	3.7	0.0
g(q2)	1.1	0.0
g(q)	4.8	0.0

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.350	
beta			0.741	
Travel time, t(a) (sec)			3.401	
Smoothing Factor, F			0.531	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			3505	0
Min platooned flow, V(c,min)			2000	2000
Duration of blocked period, t(p)			4.8	0.0
Proportion time blocked, p	0.000		0.041	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.041
p(dom)	0.041
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	0.959		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.959	0.959	1.000
p(11)			
p(12)	0.959		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	903					1868		452
s	3000					3000		3000
Px	0.959					0.959		0.959
V c,u,x	812					1819		342
C r,x	804					69		699
C plat,x	771					66		670

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					900	968		
s					3000	3000		
P(x)					0.959	1.000		
V(c,u,x)					809	968		
C(r,x)					398	329		
C(plat,x)					381	329		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		452
Potential Capacity		670
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		670
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		903
Potential Capacity		771
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		771
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1868
Potential Capacity		66
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.98	0.99
Movement Capacity		65

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	116	380
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	115	380
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	379	116
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity	379	115

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		900
Potential Capacity	103	381
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	102	381

Part 2 - Second Stage		
Conflicting Flows		968
Potential Capacity	671	329
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	664	326

Part 3 - Single Stage		
Conflicting Flows		1868
Potential Capacity		66
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.98	0.99
Movement Capacity		65

Results for Two-stage process:		
a	0.91	0.91
y		1.21
C t		190

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				7		7
Movement Capacity (vph)				190		670
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				190		670
Volume				7		7
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	7					7		7
C(m) (vph)	771					190		670
v/c	0.01					0.04		0.01
95% queue length	0.03					0.11		0.03
Control Delay	9.7					24.7		10.4
LOS	A					C		B
Approach Delay							17.6	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.7	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & Yankton Trails
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Yankton Trails Park
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	12	936			1344	12
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Hourly Flow Rate, HFR	12	1006			1445	12
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		No			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume				4		5
Peak Hour Factor, PHF				0.93		0.93
Hourly Flow Rate, HFR				4		5
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	12					4		5
C(m) (vph)	460					144		446
v/c	0.03					0.03		0.01
95% queue length	0.08					0.09		0.03
Control Delay	13.0					30.7		13.2
LOS	B					D		B
Approach Delay							21.0	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & Yankton Trails
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Yankton Trails Park
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	12	936			1344	12
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Peak-15 Minute Volume	3	252			361	3
Hourly Flow Rate, HFR	12	1006			1445	12
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				4		5
Peak Hour Factor, PHF				0.93		0.93
Peak-15 Minute Volume				1		1
Hourly Flow Rate, HFR				4		5
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	128	40	200
	Through	1252	1800	4	93	128	40	200

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage	4.2					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog			1252	0

Total Saturation Flow Rate, s (vph)	3600	3600
Arrival Type	4	3
Effective Green, g (sec)	93	0
Cycle Length, C (sec)	128	128
Rp (from Exhibit 16-11)	1.333	1.000
Proportion vehicles arriving on green P	0.969	0.000
g(q1)	1.4	0.0
g(q2)	1.2	0.0
g(q)	2.6	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.350	
beta			0.741	
Travel time, t(a) (sec)			3.401	
Smoothing Factor, F			0.531	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			3096	0
Min platooned flow, V(c,min)			2000	2000
Duration of blocked period, t(p)			3.5	0.0
Proportion time blocked, p	0.000		0.027	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.027
p(dom)	0.027
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.973		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.973	0.973	1.000
p(11)			
p(12)	0.973		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1457					1978		728
s	3000					3000		3000
Px	0.973					0.973		0.973
V c,u,x	1414					1950		665
C r,x	473					56		458
C plat,x	460					54		446

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					1451	527		
s					3000	3000		
P(x)					0.973	1.000		
V(c,u,x)					1408	527		
C(r,x)					192	557		
C(plat,x)					187	557		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		728
Potential Capacity		446
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		446
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		1457
Potential Capacity		460
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		460
Probability of Queue free St.	1.00	0.97
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1978
Potential Capacity		54
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	
Maj. L, Min T Adj. Imp Factor.	0.98	
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		53

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	313	201
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	1.00
Movement Capacity	305	201
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	200	313
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.97
Movement Capacity	200	305

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		1451
Potential Capacity	310	187
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	1.00
Movement Capacity	302	187
Part 2 - Second Stage		
Conflicting Flows		527
Potential Capacity	469	557
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.97
Movement Capacity	464	542
Part 3 - Single Stage		
Conflicting Flows		1978
Potential Capacity		54
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	
Maj. L, Min T Adj. Imp Factor.	0.98	
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		53
Results for Two-stage process:		
a	0.91	0.91
y		0.27
C t		144

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				4		5
Movement Capacity (vph)				144		446
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				144		446
Volume				4		5
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	12					4		5
C(m) (vph)	460					144		446
v/c	0.03					0.03		0.01
95% queue length	0.08					0.09		0.03
Control Delay	13.0					30.7		13.2
LOS	B					D		B
Approach Delay							21.0	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	13.0	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & Lotta St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Lotta St
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1377	13	57	667	
Peak-Hour Factor, PHF		0.80	0.80	0.80	0.80	
Hourly Flow Rate, HFR		1721	16	71	833	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		No			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	13		156			
Peak Hour Factor, PHF	0.80		0.80			
Hourly Flow Rate, HFR	16		194			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	1		1			
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		71	16		194			
C(m) (vph)		354	99		350			
v/c		0.20	0.16		0.55			
95% queue length		0.74	0.55		3.20			
Control Delay		17.7	48.2		27.4			
LOS		C	E		D			
Approach Delay				28.9				
Approach LOS				D				

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                  HCS+: Unsignalized Intersections Release 5.6




Phone:                                        Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/13/2013
Analysis Time Period: AM Peak
Intersection:         Minnesota Ave & Lotta St
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2013
Project ID:  I-229 MIS - Minnesota Corridor
East/West Street:     Lotta St
North/South Street:   Minnesota Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments_______________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R
______________________________________________________________________________
Volume                             1377   13     57     667
Peak-Hour Factor, PHF              0.80   0.80   0.80   0.80
Peak-15 Minute Volume              430    4      18     208
Hourly Flow Rate, HFR              1721   16     71     833
Percent Heavy Vehicles             --     --     3      --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                              2    0          1   2
Configuration                      T   TR           L  T
Upstream Signal?                   No                   Yes
______________________________________________________________________________
Minor Street Movements      7      8      9      10     11     12
                            L      T      R      L      T      R
______________________________________________________________________________
Volume                     13            156
Peak Hour Factor, PHF      0.80          0.80
Peak-15 Minute Volume      4             49
Hourly Flow Rate, HFR      16            194
Percent Heavy Vehicles     2             2
Percent Grade (%)                  0                    0
Flared Approach:  Exists?/Storage              /                    /
RT Channelized?                          No
Lanes                         1       1
Configuration                  L      R
______________________________________________________________________________

______________________Pedestrian Volumes and Adjustments______________________
Movements                    13     14     15     16
______________________________________________________________________________
Flow (ped/hr)                 0      0      0      0
```

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	116	40	1100
	Through	622	1800	4	71	116	40	1100

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.5		6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			3	2		2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2	6.8		6.2			
	2-stage		4.2	5.8		6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		3	2		2			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog			622	0

Total Saturation Flow Rate, s (vph)	3600	3600
Arrival Type	4	3
Effective Green, g (sec)	71	0
Cycle Length, C (sec)	116	116
Rp (from Exhibit 16-11)	1.333	1.000
Proportion vehicles arriving on green P	0.816	0.000
g(q1)	3.7	0.0
g(q2)	1.1	0.0
g(q)	4.8	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.350	
beta			0.741	
Travel time, t(a) (sec)			18.707	
Smoothing Factor, F			0.171	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			2133	0
Min platooned flow, V(c,min)			2000	2000
Duration of blocked period, t(p)			1.0	0.0
Proportion time blocked, p	0.000		0.009	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.009
p(dom)	0.009
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	1.000		
p(7)	0.991	1.000	0.991
p(8)			
p(9)	1.000		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		1737	2287		868			
s		3000	3000		3000			
Px		1.000	0.991		1.000			
V c,u,x		1737	2281		868			
C r,x		354	34		350			
C plat,x		354	34		350			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	1729	558						
s	3000	3000						
P(x)	1.000	0.991						
V(c,u,x)	1729	536						
C(r,x)	128	551						
C(plat,x)	128	546						

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	868	
Potential Capacity	350	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	350	
Probability of Queue free St.	0.45	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	1737	
Potential Capacity	354	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	354	
Probability of Queue free St.	0.80	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.80	0.80
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2287	
Potential Capacity	34	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.80
Maj. L, Min T Adj. Imp Factor.		0.85
Cap. Adj. factor due to Impeding mvmnt	0.80	0.38
Movement Capacity	27	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	144	336
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.80
Movement Capacity	144	269
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	336	143
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.80	1.00
Movement Capacity	269	143

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.80	0.80
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows	1729	
Potential Capacity	128	335
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.80
Movement Capacity	128	268
Part 2 - Second Stage		
Conflicting Flows	558	
Potential Capacity	546	380
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.80	0.45
Movement Capacity	436	169
Part 3 - Single Stage		
Conflicting Flows	2287	
Potential Capacity	34	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.80
Maj. L, Min T Adj. Imp Factor.		0.85
Cap. Adj. factor due to Impeding mvmnt	0.80	0.38
Movement Capacity	27	
Results for Two-stage process:		
a	0.91	0.91
y	0.25	
C t	99	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	16		194			
Movement Capacity (vph)	99		350			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	99		350			
Volume	16		194			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		71	16		194			
C(m) (vph)		354	99		350			
v/c		0.20	0.16		0.55			
95% queue length		0.74	0.55		3.20			
Control Delay		17.7	48.2		27.4			
LOS		C	E		D			
Approach Delay				28.9				
Approach LOS				D				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.80
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		17.7
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & Lotta St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Lotta St
North/South Street: Minnesota Ave
Intersection Orientation: NS   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		868	26	163	1186	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Hourly Flow Rate, HFR		933	27	175	1275	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		No			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	12		80			
Peak Hour Factor, PHF	0.93		0.93			
Hourly Flow Rate, HFR	12		86			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	1		1			
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		175	12		86			
C(m) (vph)		706	148		584			
v/c		0.25	0.08		0.15			
95% queue length		0.97	0.26		0.51			
Control Delay		11.8	31.5		12.2			
LOS		B	D		B			
Approach Delay				14.6				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.6

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Phone:                                       Fax:
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_____________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:                 JKM
Agency/Co.:              HDR
Date Performed:          11/13/2013
Analysis Time Period: PM Peak
Intersection:            Minnesota Ave & Lotta St
Jurisdiction:            Sioux Falls, SD
Units: U. S. Customary
Analysis Year:           2013
Project ID:  I-229 MIS - Minnesota Corridor
East/West Street:        Lotta St
North/South Street:      Minnesota Ave
Intersection Orientation: NS                 Study period (hrs):  0.25

_______________________Vehicle Volumes and Adjustments_______________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R
_____________________________________________________________________________
Volume                             868    26     163    1186
Peak-Hour Factor, PHF              0.93   0.93   0.93   0.93
Peak-15 Minute Volume              233    7      44     319
Hourly Flow Rate, HFR              933    27     175    1275
Percent Heavy Vehicles             --     --     3      --     --
Median Type/Storage         TWLTL                  / 1
RT Channelized?
Lanes                              2   0            1   2
Configuration                      T   TR            L  T
Upstream Signal?                   No                   Yes
_____________________________________________________________________________
Minor Street Movements      7      8      9      10     11     12
                            L      T      R      L      T      R
_____________________________________________________________________________
Volume                     12            80
Peak Hour Factor, PHF      0.93          0.93
Peak-15 Minute Volume      3             22
Hourly Flow Rate, HFR      12            86
Percent Heavy Vehicles     2             2
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage              /                    /
RT Channelized?                          No
Lanes                         1       1
Configuration                  L      R
_____________________________________________________________________________

_____________________Pedestrian Volumes and Adjustments______________________
Movements                     13     14     15     16
_____________________________________________________________________________
Flow (ped/hr)                 0      0      0      0
```

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	128	40	1100
	Through	1252	1800	4	93	128	40	1100

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.5		6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			3	2		2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2	6.8		6.2			
	2-stage		4.2	5.8		6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		3	2		2			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog			1252	0

Total Saturation Flow Rate, s (vph)	3600	3600
Arrival Type	4	3
Effective Green, g (sec)	93	0
Cycle Length, C (sec)	128	128
Rp (from Exhibit 16-11)	1.333	1.000
Proportion vehicles arriving on green P	0.969	0.000
g(q1)	1.4	0.0
g(q2)	1.2	0.0
g(q)	2.6	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.350	
beta			0.741	
Travel time, t(a) (sec)			18.707	
Smoothing Factor, F			0.171	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			1386	0
Min platooned flow, V(c,min)			2000	2000
Duration of blocked period, t(p)			0.0	0.0
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	1.000		
p(7)	1.000	1.000	1.000
p(8)			
p(9)	1.000		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		960	1933		480			
s		3000	3000		3000			
Px		1.000	1.000		1.000			
V c,u,x		960	1933		480			
C r,x		706	58		584			
C plat,x		706	58		584			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	946	987						
s	3000	3000						
P(x)	1.000	1.000						
V(c,u,x)	946	987						
C(r,x)	338	322						
C(plat,x)	338	322						

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	480	
Potential Capacity	584	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	584	
Probability of Queue free St.	0.85	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	960	
Potential Capacity	706	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	706	
Probability of Queue free St.	0.75	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.75	0.75
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1933	
Potential Capacity	58	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.75
Maj. L, Min T Adj. Imp Factor.		0.81
Cap. Adj. factor due to Impeding mvmnt	0.75	0.69
Movement Capacity	44	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	343	162
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.75
Movement Capacity	343	122
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	162	338
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.75	1.00
Movement Capacity	122	338

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.75	0.75
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows	946	
Potential Capacity	338	149
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.75
Movement Capacity	338	112
Part 2 - Second Stage		
Conflicting Flows	987	
Potential Capacity	322	604
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.75	0.85
Movement Capacity	242	515
Part 3 - Single Stage		
Conflicting Flows	1933	
Potential Capacity	58	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.75
Maj. L, Min T Adj. Imp Factor.		0.81
Cap. Adj. factor due to Impeding mvmnt	0.75	0.69
Movement Capacity	44	
Results for Two-stage process:		
a	0.91	0.91
y	1.48	
C t	148	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	12		86			
Movement Capacity (vph)	148		584			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	148		584			
Volume	12		86			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		175	12		86			
C(m) (vph)		706	148		584			
v/c		0.25	0.08		0.15			
95% queue length		0.97	0.26		0.51			
Control Delay		11.8	31.5		12.2			
LOS		B	D		B			
Approach Delay				14.6				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.75
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		11.8
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & Batcheller Ln
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Batcheller Ln
North/South Street: Minnesota Ave
Intersection Orientation: NS   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	6	1371			674	6
Peak-Hour Factor, PHF	0.80	0.80			0.80	0.80
Hourly Flow Rate, HFR	7	1713			842	7
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				19		6
Peak Hour Factor, PHF				0.80		0.80
Hourly Flow Rate, HFR				23		7
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0		0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	7						30	
C(m) (vph)	778						298	
v/c	0.01						0.10	
95% queue length	0.03						0.33	
Control Delay	9.7						18.4	
LOS	A						C	
Approach Delay							18.4	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & Batcheller Ln
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Batcheller Ln
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	6	1371			674	6
Peak-Hour Factor, PHF	0.80	0.80			0.80	0.80
Peak-15 Minute Volume	2	428			211	2
Hourly Flow Rate, HFR	7	1713			842	7
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				19		6
Peak Hour Factor, PHF				0.80		0.80
Peak-15 Minute Volume				6		2
Hourly Flow Rate, HFR				23		7
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	109	40	1350
	Through	925	1800	3	41	109	40	1350
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage	4.2					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	925	0		

Total Saturation Flow Rate, s (vph)	3600	3600
Arrival Type	3	3
Effective Green, g (sec)	41	0
Cycle Length, C (sec)	109	109
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.376	0.000
g(q1)	17.5	0.0
g(q2)	6.0	0.0
g(q)	23.5	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350			
beta	0.741			
Travel time, t(a) (sec)	22.959			
Smoothing Factor, F	0.144			
Proportion of conflicting flow, f	1.000	1.000		
Max platooned flow, V(c,max)	3507	0		
Min platooned flow, V(c,min)	2000	2000		
Duration of blocked period, t(p)	23.9	0.0		
Proportion time blocked, p	0.220		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.220
p(5)	0.000
p(dom)	0.220
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.780	1.000	0.780
p(11)			
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	849					1716		424
s	3000					3000		3000
Px	1.000					0.780		1.000
V c,u,x	849					1355		424
C r,x	778					141		628
C plat,x	778					110		628

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					846	870		
s					3000	3000		
P(x)					1.000	0.780		
V(c,u,x)					846	271		
C(r,x)					381	750		
C(plat,x)					381	585		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		424
Potential Capacity		628
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		628
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		849
Potential Capacity		778
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		778
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1716
Potential Capacity		110
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.98	0.99
Movement Capacity		109

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	169	381
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	167	381
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	380	169
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity	380	167
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		846
Potential Capacity	160	381
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	159	381
Part 2 - Second Stage		
Conflicting Flows		870
Potential Capacity	636	585
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	629	580
Part 3 - Single Stage		
Conflicting Flows		1716
Potential Capacity		110
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.98	0.99
Movement Capacity		109
Results for Two-stage process:		
a	0.91	0.91
y		0.58
C t		257

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				23		7
Movement Capacity (vph)				257		628
Shared Lane Capacity (vph)					298	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				257		628
Volume				23		7
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					298	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	7						30	
C(m) (vph)	778						298	
v/c	0.01						0.10	
95% queue length	0.03						0.33	
Control Delay	9.7						18.4	
LOS	A						C	
Approach Delay							18.4	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.7	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & Batcheller Ln
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Batcheller Ln
North/South Street: Minnesota Ave
Intersection Orientation: NS   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	4	882			1166	32
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Hourly Flow Rate, HFR	4	948			1253	34
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				12		4
Peak Hour Factor, PHF				0.93		0.93
Hourly Flow Rate, HFR				12		4
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0		0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	4						16	
C(m) (vph)	529						217	
v/c	0.01						0.07	
95% queue length	0.02						0.24	
Control Delay	11.9						22.9	
LOS	B						C	
Approach Delay							22.9	
Approach LOS							C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & Batcheller Ln
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: Batcheller Ln
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	4	882			1166	32
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Peak-15 Minute Volume	1	237			313	9
Hourly Flow Rate, HFR	4	948			1253	34
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				12		4
Peak Hour Factor, PHF				0.93		0.93
Peak-15 Minute Volume				3		1
Hourly Flow Rate, HFR				12		4
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	110	40	1350
	Through	533	1800	3	36	110	40	1350
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage	4.2					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	533	0		

Total Saturation Flow Rate, s (vph)	3600	3600
Arrival Type	3	3
Effective Green, g (sec)	36	0
Cycle Length, C (sec)	110	110
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.327	0.000
g(q1)	11.0	0.0
g(q2)	1.9	0.0
g(q)	12.9	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350			
beta	0.741			
Travel time, t(a) (sec)	22.959			
Smoothing Factor, F	0.144			
Proportion of conflicting flow, f	1.000	1.000		
Max platooned flow, V(c,max)	3111	0		
Min platooned flow, V(c,min)	2000	2000		
Duration of blocked period, t(p)	11.3	0.0		
Proportion time blocked, p	0.102		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.102
p(5)	0.000
p(dom)	0.102
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.898	1.000	0.898
p(11)			
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1287					1752		644
s	3000					3000		3000
Px	1.000					0.898		1.000
V c,u,x	1287					1610		644
C r,x	529					95		471
C plat,x	529					85		471

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					1270	482		
s					3000	3000		
P(x)					1.000	0.898		
V(c,u,x)					1270	195		
C(r,x)					228	819		
C(plat,x)					228	735		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		644
Potential Capacity		471
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		471
Probability of Queue free St.	1.00	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		1287
Potential Capacity		529
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		529
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1752
Potential Capacity		85
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		84

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	390	241
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	387	241
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	237	390
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity	237	387

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		1270
Potential Capacity	401	228
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	398	228
Part 2 - Second Stage		
Conflicting Flows		482
Potential Capacity	501	735
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	497	729
Part 3 - Single Stage		
Conflicting Flows		1752
Potential Capacity		85
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		84
Results for Two-stage process:		
a	0.91	0.91
y		0.22
C t		184

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				12		4
Movement Capacity (vph)				184		471
Shared Lane Capacity (vph)					217	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				184		471
Volume				12		4
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					217	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

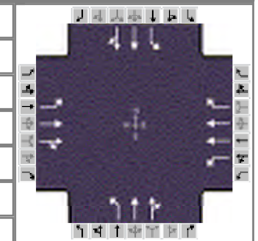
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	4						16	
C(m) (vph)	529						217	
v/c	0.01						0.07	
95% queue length	0.02						0.24	
Control Delay	11.9						22.9	
LOS	B						C	
Approach Delay							22.9	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	11.9	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS 2010 Signalized Intersection Results Summary

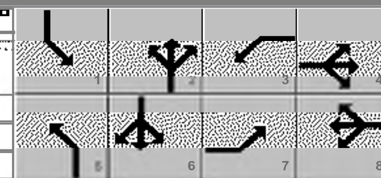
General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Minnesota Ave & 57th St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Minnesota_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	194	264	108	50	610	258	201	925	31	108	452	120

Signal Information			
Cycle, s	109.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.9	4.7	36.6	4.3	4.7	24.1
Yellow	4.0	0.0	3.9	4.0	4.0	4.3
Red	1.0	0.0	1.9	1.0	1.0	1.6



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	19.1	39.7	9.3	30.0	17.6	47.1	12.9	42.4
Change Period, (Y+R_c), s	5.0	5.9	5.0	5.9	5.0	5.8	5.0	5.8
Max Allow Headway (*MAH*), s	4.1	5.6	3.1	5.6	3.6	5.5	3.6	5.5
Queue Clearance Time (g_s), s	13.6	14.3	5.1	26.1	12.3	37.5	7.7	21.6
Green Extension Time (g_e), s	0.5	13.4	0.0	0.0	0.2	1.5	0.3	15.0
Phase Call Probability	1.00	1.00	0.85	1.00	1.00	1.00	0.98	1.00
Max Out Probability	0.12	0.39	1.00	1.00	0.94	1.00	0.00	0.49

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	243	241	224	63	763	323	251	601	594	135	370	345
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1592	1681	1680	1496	1664	1748	1727	1664	1748	1621
Queue Service Time (g_s), s	11.6	11.9	12.3	3.1	24.1	23.3	10.3	35.5	35.5	5.7	19.5	19.6
Cycle Queue Clearance Time (g_c), s	11.6	11.9	12.3	3.1	24.1	23.3	10.3	35.5	35.5	5.7	19.5	19.6
Green Ratio (g/C)	0.37	0.31	0.31	0.26	0.22	0.22	0.47	0.38	0.38	0.41	0.34	0.34
Capacity (c), veh/h	283	548	494	299	743	331	371	662	654	202	586	544
Volume-to-Capacity Ratio (X)	0.857	0.441	0.453	0.209	1.026	0.975	0.677	0.908	0.908	0.668	0.631	0.634
Available Capacity (c_a), veh/h	390	649	586	309	743	331	423	662	654	555	869	806
Back of Queue (Q), veh/ln (95th percentile)	9.3	8.7	8.3	2.3	20.3	18.1	7.4	24.1	23.9	4.1	12.7	12.0
Queue Storage Ratio (RQ) (95th percentile)	1.89	0.22	0.21	0.38	0.52	3.07	1.89	0.62	0.61	0.70	0.10	0.09
Uniform Delay (d_1), s/veh	28.5	30.0	30.2	31.0	42.5	42.2	21.5	32.1	32.1	26.7	30.5	30.6
Incremental Delay (d_2), s/veh	12.9	1.0	1.1	0.1	39.9	42.9	3.2	16.9	17.1	2.7	1.8	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	41.5	31.0	31.3	31.2	82.4	85.1	24.6	48.9	49.2	29.4	32.3	32.5
Level of Service (LOS)	D	C	C	C	F	F	C	D	D	C	C	C
Approach Delay, s/veh / LOS	34.7		C	80.4		F	44.8		D	32.0		C
Intersection Delay, s/veh / LOS	50.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.9	C	2.8	C
Bicycle LOS Score / LOS	1.1	A	1.4	A	1.7	A	1.2	A

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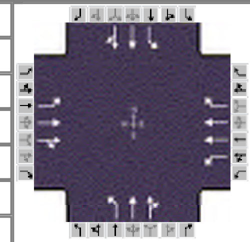
HCS 2010 Signalized Intersection Results Summary

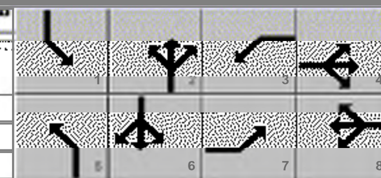
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/1/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & 57th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Minnesota_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	224	718	174	50	415	129	147	533	50	251	740	179

Signal Information			
Cycle, s	109.8	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.0	0.7	36.5	2.0	7.2	23.7
Yellow	4.0	4.0	3.9	4.0	4.0	4.3
Red	1.0	1.0	1.9	1.0	1.0	1.6



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	19.2	41.8	7.0	29.6	13.0	42.3	18.7	48.0
Change Period, ($Y+R_c$), s	5.0	5.9	5.0	5.9	5.0	5.8	5.0	5.8
Max Allow Headway (MAH), s	4.1	5.6	3.1	5.6	3.6	5.5	3.6	5.5
Queue Clearance Time (g_s), s	13.7	30.9	4.0	15.2	8.9	18.4	13.1	29.8
Green Extension Time (g_e), s	0.5	4.9	0.0	4.4	0.0	9.9	0.6	12.4
Phase Call Probability	1.00	1.00	0.81	1.00	0.99	1.00	1.00	1.00
Max Out Probability	0.13	0.85	1.00	0.98	1.00	0.66	0.00	0.41

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	241	496	463	54	446	139	158	318	309	269	510	475
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1645	1681	1680	1496	1664	1748	1695	1664	1748	1629
Queue Service Time (g_s), s	11.7	28.9	28.9	2.0	13.2	8.8	6.9	16.3	16.4	11.1	27.8	27.8
Cycle Queue Clearance Time (g_c), s	11.7	28.9	28.9	2.0	13.2	8.8	6.9	16.3	16.4	11.1	27.8	27.8
Green Ratio (g/C)	0.36	0.33	0.33	0.23	0.22	0.22	0.41	0.33	0.33	0.48	0.38	0.38
Capacity (c), veh/h	362	577	538	122	726	323	250	581	563	418	672	627
Volume-to-Capacity Ratio (X)	0.666	0.861	0.861	0.439	0.615	0.429	0.631	0.547	0.549	0.644	0.759	0.759
Available Capacity (c_a), veh/h	466	644	601	122	726	323	250	581	563	680	910	849
Back of Queue (Q), veh/ln (95th percentile)	8.3	19.8	18.8	1.0	9.4	6.0	5.2	11.2	10.9	7.2	16.8	15.9
Queue Storage Ratio (RQ) (95th percentile)	1.69	0.50	0.48	0.17	0.24	1.01	1.34	0.29	0.28	1.24	0.13	0.13
Uniform Delay (d_1), s/veh	27.5	34.6	34.6	39.6	38.9	37.2	25.1	29.9	29.9	20.3	29.4	29.4
Incremental Delay (d_2), s/veh	2.4	11.6	12.3	0.9	2.0	1.5	4.6	1.6	1.7	1.0	3.1	3.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	29.8	46.2	46.9	40.6	40.9	38.7	29.7	31.5	31.6	21.4	32.4	32.7
Level of Service (LOS)	C	D	D	D	D	D	C	C	C	C	C	C
Approach Delay, s/veh / LOS	43.2	D		40.4	D		31.2	C		30.2	C	
Intersection Delay, s/veh / LOS	36.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	3.0	C	2.8	C
Bicycle LOS Score / LOS	1.5	A	1.0	A	1.1	A	1.5	A

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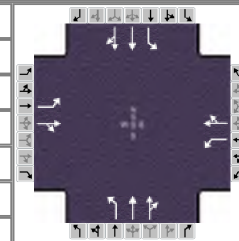
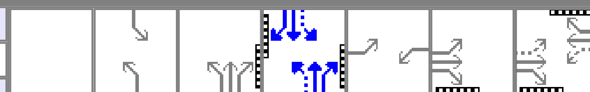
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Cliff Ave & 33rd St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Cliff_AM.xus				
Project Description	Existing AM				

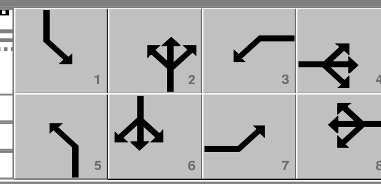


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	63	76	38	50	187	20	101	760	13	19	365	69

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	26	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.9	3.5	51.9	4.2	1.0	17.7
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5



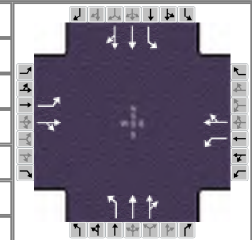
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.8	23.8	8.8	22.8	10.1	60.9	6.5	57.4
Change Period, (Y+R_c), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (MAH), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	5.8	9.6	5.0	16.6	5.4		2.7	
Green Extension Time (g_e), s	0.0	1.4	0.0	1.1	0.3	0.0	0.0	0.0
Phase Call Probability	0.89	1.00	0.82	1.00	0.97		0.48	
Max Out Probability	1.00	0.00	1.00	0.05	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	79	143		63	259		126	485	482	24	277	265
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1665		1664	1718		1664	1748	1737	1664	1748	1651
Queue Service Time (g_s), s	3.8	7.6		3.0	14.6		3.4	9.7	9.6	0.7	6.2	6.3
Cycle Queue Clearance Time (g_c), s	3.8	7.6		3.0	14.6		3.4	9.7	9.6	0.7	6.2	6.3
Green Ratio (g/C)	0.23	0.19		0.22	0.18		0.58	0.55	0.55	0.54	0.52	0.52
Capacity (c), veh/h	194	311		253	304		551	968	962	355	906	856
Volume-to-Capacity Ratio (X)	0.407	0.458		0.247	0.851		0.229	0.501	0.501	0.067	0.306	0.310
Available Capacity (c_a), veh/h	248	468		323	466		757	968	962	620	906	856
Back of Queue (Q), veh/ln (95th percentile)	2.9	5.7		2.3	11.1		2.3	5.1	5.1	0.4	4.1	4.0
Queue Storage Ratio (RQ) (95th percentile)	0.37	0.14		0.46	0.29		0.59	0.06	0.06	0.11	0.11	0.10
Uniform Delay (d_1), s/veh	32.4	36.2		32.1	39.9		10.2	5.7	5.6	11.1	8.4	8.4
Incremental Delay (d_2), s/veh	1.4	1.1		0.5	9.0		0.1	1.3	1.3	0.1	0.9	0.9
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	33.7	37.2		32.6	48.9		10.3	7.0	6.9	11.2	9.3	9.3
Level of Service (LOS)	C	D		C	D		B	A	A	B	A	A
Approach Delay, s/veh / LOS	36.0		D	45.8		D	7.3		A	9.4		A
Intersection Delay, s/veh / LOS	16.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.2	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.0	A	1.4	A	1.0	A

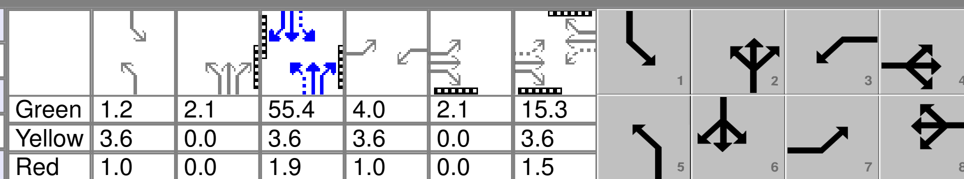
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Cliff_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	87	173	59	55	124	12	59	381	55	12	795	104

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	16	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.2	2.1	55.4	4.0	2.1	15.3
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.8	22.6	8.6	20.4	7.9	63.0	5.8	60.9
Change Period, ($Y+R_c$), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (MAH), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	6.6	16.3	5.0	9.9	3.6		2.3	
Green Extension Time (g_e), s	0.0	1.1	0.0	1.3	0.1	0.0	0.0	0.0
Phase Call Probability	0.93	1.00	0.81	1.00	0.83		0.30	
Max Out Probability	1.00	0.03	1.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	94	249		59	146		63	238	231	13	493	473
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1687		1664	1720		1664	1748	1670	1664	1748	1676
Queue Service Time (g_s), s	4.6	14.3		3.0	7.9		1.6	6.0	5.7	0.3	11.8	11.8
Cycle Queue Clearance Time (g_c), s	4.6	14.3		3.0	7.9		1.6	6.0	5.7	0.3	11.8	11.8
Green Ratio (g/C)	0.21	0.17		0.19	0.15		0.59	0.57	0.57	0.57	0.55	0.55
Capacity (c), veh/h	268	295		152	264		377	1005	960	543	968	928
Volume-to-Capacity Ratio (X)	0.349	0.846		0.389	0.554		0.168	0.237	0.240	0.024	0.510	0.510
Available Capacity (c_a), veh/h	306	477		225	450		641	1005	960	843	968	928
Back of Queue (Q), veh/ln (95th percentile)	3.5	10.7		2.3	6.2		1.0	4.1	3.7	0.2	6.9	6.6
Queue Storage Ratio (RQ) (95th percentile)	0.44	0.27		0.46	0.16		0.27	0.05	0.05	0.06	0.18	0.17
Uniform Delay (d_1), s/veh	33.0	40.0		34.8	39.2		9.5	9.1	8.4	9.6	7.4	7.4
Incremental Delay (d_2), s/veh	0.8	7.6		1.6	1.8		0.2	0.5	0.6	0.0	1.9	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	33.7	47.6		36.4	41.0		9.7	9.6	9.0	9.6	9.3	9.4
Level of Service (LOS)	C	D		D	D		A	A	A	A	A	A
Approach Delay, s/veh / LOS	43.8	D		39.7	D		9.4	A		9.3	A	
Intersection Delay, s/veh / LOS	18.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.2	B	2.2	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	0.9	A	1.3	A

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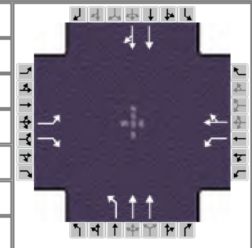
HCS 2010 Signalized Intersection Results Summary

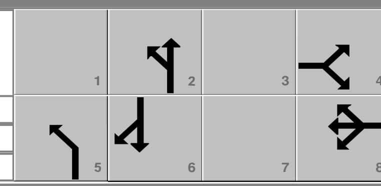
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Cliff_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	101		163	108	68	44	188	1176			471	89

Signal Information				
Cycle, s	100.0	Reference Phase	2
Offset, s	71	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.4	55.1	20.8	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		25.9		25.9	13.0	74.1		61.2
Change Period, ($Y+R_c$), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0		0.0
Queue Clearance Time (g_s), s		20.1		9.8	8.2			
Green Extension Time (g_e), s		0.7		1.3	0.2	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		0.77		0.01	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	126		0	135	140		235	1470			359	341
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1188		1435	1593	1565		1622	1714			1711	1614
Queue Service Time (g_s), s	10.3		0.0	7.3	7.8		6.2	31.0			12.1	13.7
Cycle Queue Clearance Time (g_c), s	18.1		0.0	7.3	7.8		6.2	31.0			12.1	13.7
Green Ratio (g/C)	0.21		0.21	0.21	0.21		0.65	0.62			0.55	0.55
Capacity (*c*), veh/h	227		298	403	325		504	2130			942	889
Volume-to-Capacity Ratio (*X*)	0.557		0.000	0.335	0.431		0.466	0.690			0.381	0.384
Available Capacity (c_a), veh/h	276		357	469	390		539	2130			942	889
Back of Queue (*Q*), veh/ln (95th percentile)	5.7		0.0	5.1	5.3		2.8	14.7			9.0	9.2
Queue Storage Ratio (*RQ*) (95th percentile)	0.72		0.00	1.04	0.14		0.72	0.47			0.11	0.11
Uniform Delay (d_1), s/veh	42.3		0.0	34.3	34.5		8.3	13.7			14.6	15.6
Incremental Delay (d_2), s/veh	2.1		0.0	0.5	0.9		0.2	0.5			1.1	1.2
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	44.5		0.0	34.8	35.4		8.5	14.2			15.7	16.9
Level of Service (LOS)	D			C	D		A	B			B	B
Approach Delay, s/veh / LOS	44.5		D	35.1		D	13.4		B	16.3		B
Intersection Delay, s/veh / LOS				17.7						B		

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.6	A	2.5	B
Bicycle LOS Score / LOS		F	0.9	A	1.9	A	1.1	A

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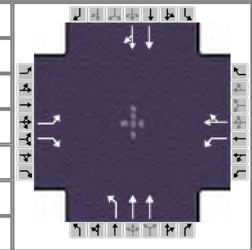
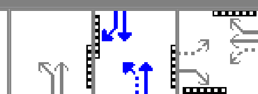
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Cliff_PM.xus				
Project Description	Existing PM				

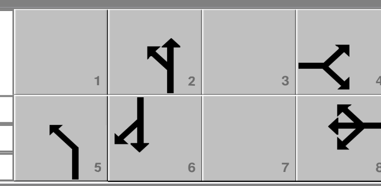


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	115		332	299	71	22	120	538			1056	135

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	62	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.0	57.6	21.6	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		26.7		26.7	9.6	73.3		63.7
Change Period, (Y+R_c), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (MAH), s		4.1		4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s		16.4		20.8	5.0			
Green Extension Time (g_e), s		1.4		0.9	0.1	0.0		0.0
Phase Call Probability		1.00		1.00	0.97			
Max Out Probability		0.20		0.99	0.68			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h	124		0	322	100		129	579			652	629
Adjusted Saturation Flow Rate (s), veh/h/ln	1220		1420	1664	1678		1591	1614			1780	1705
Queue Service Time (g_s), s	9.4		0.0	18.8	5.0		3.0	8.2			28.0	28.2
Cycle Queue Clearance Time (g_c), s	14.4		0.0	18.8	5.0		3.0	8.2			28.0	28.2
Green Ratio (g/C)	0.22		0.22	0.22	0.22		0.65	0.67			0.58	0.58
Capacity (c), veh/h	275		307	432	363		271	2168			1024	981
Volume-to-Capacity Ratio (X)	0.449		0.000	0.745	0.276		0.476	0.267			0.636	0.641
Available Capacity (c_a), veh/h	315		354	486	418		345	2168			1024	981
Back of Queue (Q), veh/ln (95th percentile)	5.2		0.0	12.6	3.6		2.2	4.9			17.2	17.2
Queue Storage Ratio (RQ) (95th percentile)	0.66		0.00	2.57	0.09		0.56	0.16			0.22	0.22
Uniform Delay (d_1), s/veh	38.6		0.0	38.1	32.7		14.4	7.8			18.2	19.0
Incremental Delay (d_2), s/veh	1.1		0.0	5.4	0.4		1.2	0.3			2.5	2.7
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (d), s/veh	39.8		0.0	43.5	33.1		15.6	8.1			20.7	21.7
Level of Service (LOS)	D			D	C		B	A			C	C

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	39.8	D	41.0	D	9.4	A	21.2	C
Intersection Delay, s/veh / LOS	22.1				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.6	A	2.7	B
Bicycle LOS Score / LOS		F	1.2	A	1.1	A	1.5	A

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_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:                 JKM
Agency/Co.:              HDR
Date Performed:          11/15/2013
Analysis Time Period: AM Peak
Intersection:            Cliff Ave & I-229 SB On-Ramp
Jurisdiction:            Sioux Falls, SD
Units: U. S. Customary
Analysis Year:           2013
Project ID:  I-229 MIS
East/West Street:        I-229 SB On-Ramp
North/South Street:      Cliff Ave
Intersection Orientation: NS                   Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments__________________________
Major Street:  Approach        Northbound              Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                      327    1364                   541    201
Peak-Hour Factor, PHF       0.80   0.80                   0.80   0.80
Hourly Flow Rate, HFR       408    1704                   676    251
Percent Heavy Vehicles      2      --     --              --     --
Median Type/Storage         TWLTL                / 1
RT Channelized?
Lanes                          1   2                      2    0
Configuration                   L  T                      T   TR
Upstream Signal?                   Yes                    Yes
______________________________________________________________________________
Minor Street:  Approach        Westbound               Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                             0             0
Peak Hour Factor, PHF                              0.80          0.80
Hourly Flow Rate, HFR                              0             0
Percent Heavy Vehicles                             2             2
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage               /              No     /
Lanes                                                 0        0
Configuration                                             LR
______________________________________________________________________________

_________________Delay, Queue Length, and Level of Service_____________________
Approach             NB     SB          Westbound             Eastbound
Movement             1      4   |  7      8      9     |  10     11     12
Lane Config          L          |                      |         LR
______________________________________________________________________________
v (vph)              408                                         0
C(m) (vph)           759
v/c                  0.54
95% queue length     3.25
Control Delay        15.1
LOS                   C
Approach Delay
Approach LOS
______________________________________________________________________________
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Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/15/2013
Analysis Time Period: AM Peak
Intersection: Cliff Ave & I-229 SB On-Ramp
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS
East/West Street: I-229 SB On-Ramp
North/South Street: Cliff Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	327	1364			541	201
Peak-Hour Factor, PHF	0.80	0.80			0.80	0.80
Peak-15 Minute Volume	102	426			169	63
Hourly Flow Rate, HFR	408	1704			676	251
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				0		0
Peak Hour Factor, PHF				0.80		0.80
Peak-15 Minute Volume				0		0
Hourly Flow Rate, HFR				0		0
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	100	30	600
	Through	1320	1800	4	52	100	30	600
S5	Left-Turn	0	1800	3	0	100	30	200
	Through	471	1800	4	55	100	30	200

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		2					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.8		6.2
	2-stage	4.1					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	2					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	1320	0	471	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	52	0	55	0
Cycle Length, C (sec)	100	100	100	100
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.693	0.000	0.733	0.000
g(q1)	11.2	0.0	3.5	0.0
g(q2)	10.8	0.0	0.7	0.0
g(q)	22.0	0.0	4.2	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	13.605		4.535	
Smoothing Factor, F	0.221		0.460	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3585	0	3333	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	26.9	0.0	4.0	0.0
Proportion time blocked, p	0.269		0.040	

Computation 3-Platoon Event Periods	Result
p(2)	0.269
p(5)	0.040
p(dom)	0.269
p(subo)	0.040
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	0.960		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.711	0.960	0.731
p(11)			
p(12)	0.960		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	927					2470		464
s	3000					3000		3000
Px	0.960					0.711		0.960
V c,u,x	840					2255		358
C r,x	791					35		685
C plat,x	759					25		658

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					802	1668		
s					3000	3000		
P(x)					0.960	0.731		
V(c,u,x)					710	1178		
C(r,x)					448	255		
C(plat,x)					430	186		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		464
Potential Capacity		658
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		658
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		927
Potential Capacity		759
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		759
Probability of Queue free St.	1.00	0.46
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.46	0.46
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		2470
Potential Capacity		25
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.46	
Maj. L, Min T Adj. Imp Factor.	0.58	
Cap. Adj. factor due to Impeding mvmnt	0.58	0.46
Movement Capacity		12

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	51	422
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.46	1.00
Movement Capacity	24	422
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	369	51
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.46
Movement Capacity	369	24

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.46	0.46
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		802
Potential Capacity	44	430
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.46	1.00
Movement Capacity	20	430

Part 2 - Second Stage		
Conflicting Flows		1668
Potential Capacity	763	186
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.46
Movement Capacity	763	86

Part 3 - Single Stage		
Conflicting Flows		2470
Potential Capacity		25
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.46	
Maj. L, Min T Adj. Imp Factor.	0.58	
Cap. Adj. factor due to Impeding mvmnt	0.58	0.46
Movement Capacity		12

Results for Two-stage process:		
a	0.91	0.91
y		5.65
C t		68

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				0		0
Movement Capacity (vph)				68		658
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				68		658
Volume				0		0
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	408						0	
C(m) (vph)	759							
v/c	0.54							
95% queue length	3.25							
Control Delay	15.1							
LOS	C							
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.46	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	15.1	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/15/2013
Analysis Time Period: PM Peak
Intersection: Cliff Ave & I-229 SB On-Ramp
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS
East/West Street: I-229 SB On-Ramp
North/South Street: Cliff Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	164	658			1305	382
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Hourly Flow Rate, HFR	176	707			1403	410
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume				0		0
Peak Hour Factor, PHF				0.93		0.93
Hourly Flow Rate, HFR				0		0
Percent Heavy Vehicles				3		3
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0	0	
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	176						0	
C(m) (vph)	333							
v/c	0.53							
95% queue length	2.93							
Control Delay	27.3							
LOS	D							
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/15/2013
Analysis Time Period: PM Peak
Intersection: Cliff Ave & I-229 SB On-Ramp
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS
East/West Street: I-229 SB On-Ramp
North/South Street: Cliff Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	164	658			1305	382
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Peak-15 Minute Volume	44	177			351	103
Hourly Flow Rate, HFR	176	707			1403	410
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				0		0
Peak Hour Factor, PHF				0.93		0.93
Peak-15 Minute Volume				0		0
Hourly Flow Rate, HFR				0		0
Percent Heavy Vehicles				3		3
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	100	30	600
	Through	1056	1800	4	54	100	30	600
S5	Left-Turn	0	1800	3	0	100	30	200
	Through	664	1800	4	54	100	30	200

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					3		3
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.9		6.3
	2-stage	4.2					5.9		6.3

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					3		3
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	1056	0	664	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	54	0	54	0
Cycle Length, C (sec)	100	100	100	100
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.720	0.000	0.720	0.000
g(q1)	8.2	0.0	5.2	0.0
g(q2)	5.3	0.0	1.7	0.0
g(q)	13.5	0.0	6.8	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	13.605		4.535	
Smoothing Factor, F	0.221		0.460	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3476	0	3547	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	15.3	0.0	6.9	0.0
Proportion time blocked, p	0.153		0.069	

Computation 3-Platoon Event Periods	Result
p(2)	0.153
p(5)	0.069
p(dom)	0.153
p(subo)	0.069
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.931		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.813	0.931	0.847
p(11)			
p(12)	0.931		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1813					2313		906
s	3000					3000		3000
Px	0.931					0.813		0.931
V c,u,x	1724					2155		750
C r,x	358					40		407
C plat,x	333					33		379

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					1608	705		
s					3000	3000		
P(x)					0.931	0.847		
V(c,u,x)					1504	292		
C(r,x)					169	729		
C(plat,x)					157	618		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		906
Potential Capacity		379
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		379
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		1813
Potential Capacity		333
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		333
Probability of Queue free St.	1.00	0.47
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.47	0.47
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		2313
Potential Capacity		33
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.47	
Maj. L, Min T Adj. Imp Factor.	0.58	
Cap. Adj. factor due to Impeding mvmnt	0.58	0.47
Movement Capacity		16

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	373	173
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.47	1.00
Movement Capacity	176	173
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	135	373
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.47
Movement Capacity	135	176

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.47	0.47
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		1608
Potential Capacity	385	157
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.47	1.00
Movement Capacity	182	157

Part 2 - Second Stage		
Conflicting Flows		705
Potential Capacity	522	618
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.47
Movement Capacity	522	291

Part 3 - Single Stage		
Conflicting Flows		2313
Potential Capacity		33
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.47	
Maj. L, Min T Adj. Imp Factor.	0.58	
Cap. Adj. factor due to Impeding mvmnt	0.58	0.47
Movement Capacity		16

Results for Two-stage process:		
a	0.91	0.91
y		0.51
C t		100

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				0		0
Movement Capacity (vph)				100		379
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				100		379
Volume				0		0
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

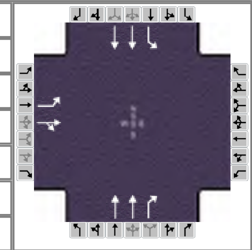
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	176						0	
C(m) (vph)	333							
v/c	0.53							
95% queue length	2.93							
Control Delay	27.3							
LOS	D							
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.47	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	27.3	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

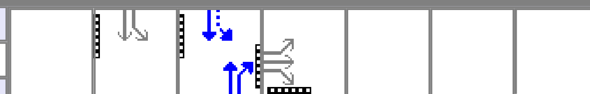
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Cliff_AM.xus				
Project Description	Existing AM				

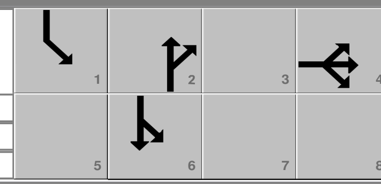


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	371	0	131					1320	346	95	446	

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.2	52.1	27.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		33.0				57.2	9.8	67.0
Change Period, (*Y+Rc*), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.1				0.0	4.2	0.0
Queue Clearance Time (*gs*), s		29.2					5.3	
Green Extension Time (*ge*), s		0.0				0.0	0.0	0.0
Phase Call Probability		1.00					0.96	
Max Out Probability		1.00					1.00	

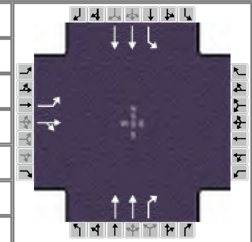
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	464	164						1650	433	119	558	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1692	1512						1735	1470	1588	1612	
Queue Service Time (*gs*), s	27.2	8.8						43.4	20.0	3.3	5.0	
Cycle Queue Clearance Time (*gc*), s	27.2	8.8						43.4	20.0	3.3	5.0	
Green Ratio (*g/C*)	0.28	0.28						0.52	0.52	0.59	0.62	
Capacity (*c*), veh/h	472	422						1810	766	170	1995	
Volume-to-Capacity Ratio (*X*)	0.982	0.388						0.912	0.564	0.697	0.279	
Available Capacity (*ca*), veh/h	472	422						1810	766	190	1995	
Back of Queue (*Q*), veh/ln (95th percentile)	21.9	5.6						20.7	8.8	3.3	2.7	
Queue Storage Ratio (*RQ*) (95th percentile)	3.74	0.14						0.22	0.90	0.84	0.09	
Uniform Delay (*d1*), s/veh	35.8	29.1						21.8	16.2	22.4	4.9	
Incremental Delay (*d2*), s/veh	36.7	0.6						2.8	0.9	8.8	0.3	
Initial Queue Delay (*d3*), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	72.5	29.7						24.6	17.1	31.2	5.2	
Level of Service (LOS)	E	C						C	B	C	A	
Approach Delay, s/veh / LOS	61.3	E		0.0			23.0	C		9.8	A	
Intersection Delay, s/veh / LOS	27.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS	1.5	A			2.2	B	1.0	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:02:04 PM

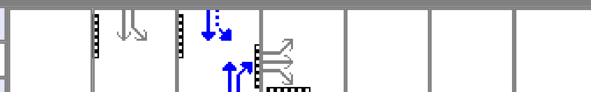
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Cliff_PM.xus				
Project Description	Existing PM				

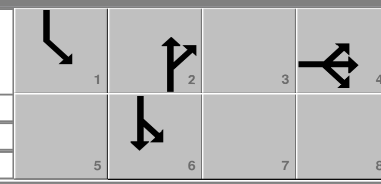


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	158	0	321					664	147	114	1191	

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	48	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.1	54.3	25.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		31.0				59.4	9.7	69.0
Change Period, ($Y+R_c$), s		5.1				5.1	4.6	5.1
Max Allow Headway (MAH), s		4.2				0.0	4.2	0.0
Queue Clearance Time (g_s), s		25.5					5.2	
Green Extension Time (g_e), s		0.3				0.0	0.1	0.0
Phase Call Probability		1.00					0.97	
Max Out Probability		1.00					1.00	

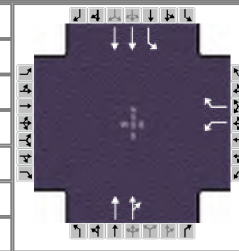
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	170	345						714	158	123	1281	
Adjusted Saturation Flow Rate (s), veh/h/ln	1603	1432						1628	1418	1589	1692	
Queue Service Time (g_s), s	8.8	23.5						12.8	5.7	3.2	21.3	
Cycle Queue Clearance Time (g_c), s	8.8	23.5						12.8	5.7	3.2	21.3	
Green Ratio (g/C)	0.26	0.26						0.54	0.54	0.61	0.64	
Capacity (c), veh/h	415	370						1767	769	400	2163	
Volume-to-Capacity Ratio (X)	0.410	0.932						0.404	0.205	0.306	0.592	
Available Capacity (c_a), veh/h	431	385						1767	769	438	2163	
Back of Queue (Q), veh/ln (95th percentile)	6.0	16.2						7.9	3.3	2.0	10.9	
Queue Storage Ratio (RQ) (95th percentile)	1.03	0.41						0.08	0.34	0.51	0.35	
Uniform Delay (d_1), s/veh	30.7	36.2						13.4	11.8	9.8	9.9	
Incremental Delay (d_2), s/veh	0.6	28.7						0.6	0.5	0.3	0.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	31.4	64.9						14.0	12.3	10.1	10.7	
Level of Service (LOS)	C	E						B	B	B	B	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	53.8	D	0.0		13.7	B	10.7	B
Intersection Delay, s/veh / LOS	19.6				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.3	A			1.2	A	1.6	A

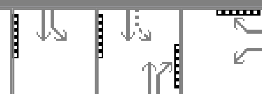
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Cliff Ave & 49th St	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Cliff_AM.xus				
Project Description	Existing AM				

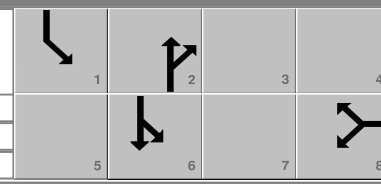


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				38		546		1037	19	164	390	

Signal Information			
Cycle, s	94.1	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.4	37.9	34.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				39.1		43.0	12.0	55.0
Change Period, ($Y+R_c$), s				5.1		5.1	4.6	5.1
Max Allow Headway (MAH), s				4.4		4.1	4.2	4.1
Queue Clearance Time (g_s), s				32.4		39.9	9.2	9.6
Green Extension Time (g_e), s				1.6		0.0	0.0	10.2
Phase Call Probability				1.00		1.00	1.00	1.00
Max Out Probability				0.39		1.00	1.00	0.06

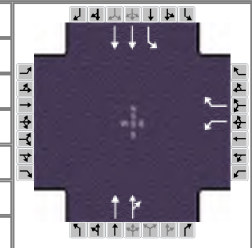
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h				48		503		662	658	205	488	
Adjusted Saturation Flow Rate (s), veh/h/ln				1681		1496		1748	1736	1664	1664	
Queue Service Time (g_s), s				1.7		30.4		37.9	34.3	7.2	7.6	
Cycle Queue Clearance Time (g_c), s				1.7		30.4		37.9	34.3	7.2	7.6	
Green Ratio (g/C)				0.36		0.36		0.40	0.40	0.50	0.53	
Capacity (c), veh/h				607		540		704	699	208	1765	
Volume-to-Capacity Ratio (X)				0.078		0.930		0.940	0.941	0.988	0.276	
Available Capacity (c_a), veh/h				713		634		704	699	208	1765	
Back of Queue (Q), veh/ln (95th percentile)				1.2		19.2		24.8	24.7	9.9	5.0	
Queue Storage Ratio (RQ) (95th percentile)				0.42		0.49		0.63	0.63	1.02	0.05	
Uniform Delay (d_1), s/veh				19.8		28.9		27.0	27.0	24.4	12.2	
Incremental Delay (d_2), s/veh				0.1		18.8		22.1	22.3	57.6	0.4	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (d), s/veh				19.8		47.7		49.1	49.3	82.1	12.5	
Level of Service (LOS)				B		D		D	D	F	B	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		45.3	D	49.2	D	33.1	C
Intersection Delay, s/veh / LOS	44.0				D			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.6	A	1.1	A

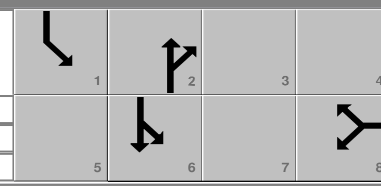
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Cliff_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				55		272		490	59	441	947	

Signal Information										
Cycle, s	40.4	Reference Phase	6							
Offset, s	0	Reference Point	Begin	Green	9.2	13.1	3.3	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				8.4		18.2	13.8	32.0
Change Period, ($Y+R_c$), s				5.1		5.1	4.6	5.1
Max Allow Headway (MAH), s				4.3		4.1	4.2	4.1
Queue Clearance Time (g_s), s				4.0		9.1	8.7	4.3
Green Extension Time (g_e), s				0.2		1.3	0.6	7.6
Phase Call Probability				0.78		1.00	1.00	1.00
Max Out Probability				0.64		1.00	1.00	0.14

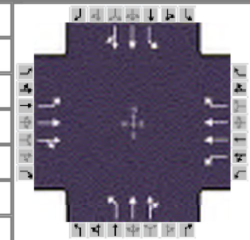
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h				59		76		294	286	474	1018	
Adjusted Saturation Flow Rate (s), veh/h/ln				1681		1496		1748	1691	1664	1664	
Queue Service Time (g_s), s				1.4		2.0		7.1	5.5	6.7	2.3	
Cycle Queue Clearance Time (g_c), s				1.4		2.0		7.1	5.5	6.7	2.3	
Green Ratio (g/C)				0.08		0.08		0.33	0.33	0.60	0.67	
Capacity (c), veh/h				135		121		568	550	680	2218	
Volume-to-Capacity Ratio (X)				0.437		0.634		0.517	0.520	0.698	0.459	
Available Capacity (c_a), veh/h				371		330		568	550	771	2218	
Back of Queue (Q), veh/ln (95th percentile)				1.0		1.4		3.9	3.9	2.1	0.6	
Queue Storage Ratio (RQ) (95th percentile)				0.33		0.04		0.10	0.10	0.22	0.01	
Uniform Delay (d_1), s/veh				17.7		18.0		11.0	11.1	5.8	0.9	
Incremental Delay (d_2), s/veh				2.2		5.4		3.3	3.5	1.7	0.5	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (d), s/veh				19.9		23.4		14.4	14.5	7.5	1.4	
Level of Service (LOS)				B		C		B	B	A	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		21.9	C	14.5	B	3.3	A
Intersection Delay, s/veh / LOS	7.4				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.8	C	2.5	B	0.6	A
Bicycle LOS Score / LOS				F	1.0	A	1.7	A

HCS 2010 Signalized Intersection Results Summary

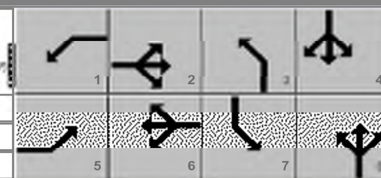
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	26th St & Southeastern Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_26th_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	57	718	132	57	1240	220	546	446	89	57	69	44

Signal Information			
Cycle, s	134.0	Reference Phase	6
Offset, s	130	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.1	0.9	56.3	6.8	31.4	8.5
Yellow	3.9	0.0	3.9	3.9	3.9	3.9
Red	1.0	0.0	1.8	1.0	1.0	1.8



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.0	62.0	9.9	62.8	48.0	50.5	11.7	14.2
Change Period, ($Y+R_c$), s	4.9	5.7	4.9	5.7	4.9	5.7	4.9	5.7
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0	4.2	4.1	4.2	4.1
Queue Clearance Time (g_s), s	4.6		5.3		45.1	23.8	7.3	6.5
Green Extension Time (g_e), s	0.1	0.0	0.1	0.0	0.0	3.0	0.0	2.0
Phase Call Probability	0.88		0.93		1.00	1.00	0.93	1.00
Max Out Probability	0.08		0.21		1.00	0.00	1.00	0.39

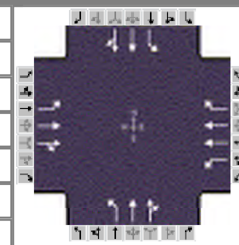
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	57	714	0	71	1550	169	683	341	324	71	57	56
Adjusted Saturation Flow Rate (s), veh/h/ln	1664	1748	0	1664	1664	1481	1664	1748	1649	1664	1748	1611
Queue Service Time (g_s), s	2.6	16.6	0.0	3.3	57.1	7.8	43.1	21.6	21.8	5.3	4.2	4.5
Cycle Queue Clearance Time (g_c), s	2.6	16.6	0.0	3.3	57.1	7.8	43.1	21.6	21.8	5.3	4.2	4.5
Green Ratio (g/C)	0.45	0.42		0.46	0.43	0.43	0.40	0.33	0.33	0.11	0.06	0.06
Capacity (c), veh/h	105	1468		330	1419	631	627	584	551	187	111	102
Volume-to-Capacity Ratio (X)	0.543	0.487	0.000	0.216	1.093	0.267	1.089	0.584	0.588	0.382	0.513	0.546
Available Capacity (c_a), veh/h	189	1468		404	1419	631	627	660	623	215	186	172
Back of Queue (Q), veh/ln (95th percentile)	1.5	7.4		2.3	42.3	4.9	41.8	14.5	13.9	4.1	3.6	3.6
Queue Storage Ratio (RQ) (95th percentile)	0.78	0.15	0.00	0.60	1.60	0.51	3.56	0.37	0.36	1.06	0.09	0.09
Uniform Delay (d_1), s/veh	32.4	20.8		21.5	28.9	18.3	39.5	36.9	37.0	54.9	60.8	60.9
Incremental Delay (d_2), s/veh	0.4	0.1	0.0	0.3	53.4	1.0	62.6	1.0	1.1	1.3	3.6	4.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	32.8	20.9		21.8	82.3	19.3	102.1	38.0	38.1	56.2	64.4	65.4
Level of Service (LOS)	C	C		C	F	B	F	D	D	E	E	E
Approach Delay, s/veh / LOS	21.7	C		73.9	E		70.5	E		61.5	E	
Intersection Delay, s/veh / LOS	62.4						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.3	A	2.0	A	1.6	A	0.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 10:54:57 AM

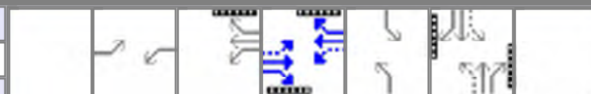
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	26th St & Southeastern Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_26th_PM.xus				
Project Description	Existing PM				

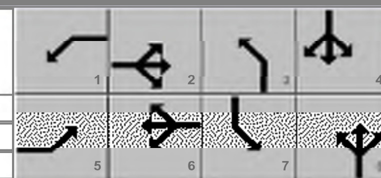


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	59	1192	453	71	785	87	206	120	65	201	343	66

Signal Information				
Cycle, s	146.0	Reference Phase	6
Offset, s	3	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.9	0.6	85.3	14.1	20.8	0.0
Yellow	3.9	0.0	3.9	3.9	3.9	0.0
Red	1.0	0.0	1.8	1.0	1.8	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	8.8	91.0	9.5	91.6	19.0	26.5	19.0	26.5
Change Period, (Y+R_c), s	4.9	5.7	4.9	5.7	4.9	5.7	4.9	5.7
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0	4.2	4.1	4.2	4.1
Queue Clearance Time (g_s), s	4.2		4.7		16.1	9.5	16.1	19.4
Green Extension Time (g_e), s	0.1	0.0	0.1	0.0	0.0	2.0	0.0	1.5
Phase Call Probability	0.92		0.95		1.00	1.00	1.00	1.00
Max Out Probability	0.03		0.06		1.00	0.01	1.00	0.28

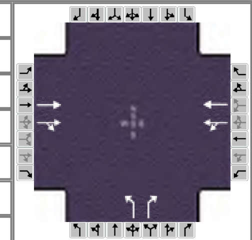
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	62	1258	0	76	844	58	222	92	89	216	210	205
Adjusted Saturation Flow Rate (s), veh/h/ln	1664	1748	0	1664	1664	1481	1664	1748	1580	1664	1748	1679
Queue Service Time (g_s), s	2.2	22.4	0.0	2.7	12.1	1.3	14.1	7.0	7.5	14.1	17.1	17.4
Cycle Queue Clearance Time (g_c), s	2.2	22.4	0.0	2.7	12.1	1.3	14.1	7.0	7.5	14.1	17.1	17.4
Green Ratio (g/C)	0.61	0.58		0.62	0.59	0.59	0.24	0.14	0.14	0.24	0.14	0.14
Capacity (c), veh/h	394	2042		289	1958	872	220	249	225	302	249	240
Volume-to-Capacity Ratio (X)	0.158	0.616	0.000	0.264	0.431	0.067	1.009	0.371	0.396	0.715	0.843	0.854
Available Capacity (c_a), veh/h	481	2042		369	1958	872	220	327	295	302	327	314
Back of Queue (Q), veh/ln (95th percentile)	1.5	10.1		1.9	6.7	0.8	9.5	5.7	5.6	3.2	13.4	13.3
Queue Storage Ratio (RQ) (95th percentile)	0.77	0.21	0.00	0.48	0.25	0.09	0.81	0.15	0.14	0.83	0.34	0.34
Uniform Delay (d_1), s/veh	12.0	9.2		13.2	7.8	6.6	52.6	56.6	56.9	50.3	61.0	61.1
Incremental Delay (d_2), s/veh	0.1	1.1	0.0	0.5	0.7	0.1	62.9	0.9	1.1	7.8	14.3	16.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	12.2	10.3		13.7	8.5	6.8	115.5	57.6	58.0	58.1	75.2	77.2
Level of Service (LOS)	B	B		B	A	A	F	E	E	E	E	E
Approach Delay, s/veh / LOS	10.4	B		8.8	A		89.5	F		70.0	E	
Intersection Delay, s/veh / LOS	30.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	3.0	C	3.5	D
Bicycle LOS Score / LOS	1.6	A	1.3	A	0.8	A	1.0	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 10:56:48 AM

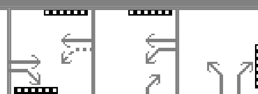
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	26th St & NB I-229 ramps	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_26th_AM.xus				
Project Description	Existing AM				

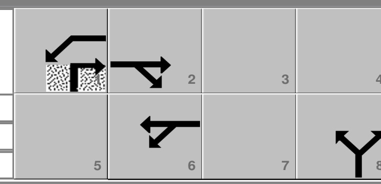


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		529	100	352	1478		87		378			

Signal Information			
Cycle, s	134.0	Reference Phase	2
Offset, s	41	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	21.5	85.5	11.1	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.9	1.9	1.3	0.0	0.0	0.0



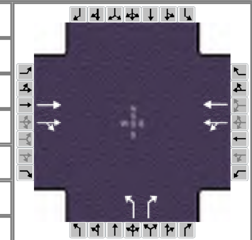
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		8.3	0.0	14.0		9.0		
Phase Duration, s		27.0	91.0	118.0		16.0		
Change Period, (Y+R_c), s		5.5	5.5	5.5		4.9		
Max Allow Headway (MAH), s		3.1	0.0	3.6		4.2		
Queue Clearance Time (g_s), s		36.9		114.5		10.6		
Green Extension Time (g_e), s		0.0	0.0	0.0		0.5		
Phase Call Probability		1.00		1.00		1.00		
Max Out Probability		1.00		1.00		0.28		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		400	379	926	1174		109		171			
Adjusted Saturation Flow Rate (s), veh/h/ln		1748	1655	1300	1710		1664		1481			
Queue Service Time (g_s), s		34.9	21.5	4.0	0.0		8.6		4.9			
Cycle Queue Clearance Time (g_c), s		34.9	21.5	112.5	0.0		8.6		4.9			
Green Ratio (g/C)		0.16	0.16	0.84	0.84		0.08		0.72			
Capacity (c), veh/h		280	266	1130	1435		138		1068			
Volume-to-Capacity Ratio (X)		1.425	1.428	0.820	0.818		0.787		0.160			
Available Capacity (c_a), veh/h		280	266	1130	1435		212		1134			
Back of Queue (Q), veh/ln (95th percentile)		39.3	37.7	13.6	0.4		7.1		2.5			
Queue Storage Ratio (RQ) (95th percentile)		0.94	0.90	0.28	0.01		1.05		0.06			
Uniform Delay (d_1), s/veh		56.3	56.3	7.3	0.0		60.3		5.9			
Incremental Delay (d_2), s/veh		209.6	211.8	0.6	0.5		10.2		0.1			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		265.9	268.1	7.9	0.5		70.5		6.0			
Level of Service (LOS)		F	F	A	A		E		A			
Approach Delay, s/veh / LOS	267.0	F		3.8	A		31.0	C		0.0		
Intersection Delay, s/veh / LOS	71.1						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	0.6	A	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.1	A	2.4	B		F		

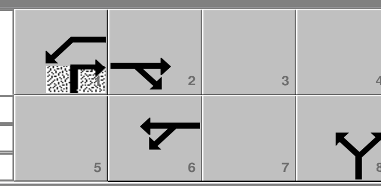
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	26th St & NB I-229 ramps	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_26th_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1084	81	88	969		43		620			

Signal Information										
Cycle, s	146.0	Reference Phase	2							
Offset, s	79	Reference Point	Begin	Green	72.5	38.5	19.1	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.9	1.9	1.3	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		8.3	0.0	14.0		9.0		
Phase Duration, s		78.0	44.0	122.0		24.0		
Change Period, ($Y+R_c$), s		5.5	5.5	5.5		4.9		
Max Allow Headway (*MAH*), s		3.1	0.0	3.5		4.3		
Queue Clearance Time (g_s), s		43.3		118.5		21.1		
Green Extension Time (g_e), s		2.7	0.0	0.0		0.0		
Phase Call Probability		1.00		1.00		1.00		
Max Out Probability		0.00		1.00		1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		616	603	408	726		46		526			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1748	1708	912	1642		1664		1481			
Queue Service Time (g_s), s		41.3	32.9	4.0	0.0		3.6		19.1			
Cycle Queue Clearance Time (g_c), s		41.3	32.9	116.5	0.0		3.6		19.1			
Green Ratio (*g/C*)		0.50	0.50	0.80	0.80		0.13		0.39			
Capacity (*c*), veh/h		868	848	758	1310		218		584			
Volume-to-Capacity Ratio (*X*)		0.710	0.711	0.539	0.554		0.212		0.900			
Available Capacity (c_a), veh/h		868	848	758	1310		218		584			
Back of Queue (*Q*), veh/ln (95th percentile)		16.9	16.6	13.8	0.9		2.8		27.4			
Queue Storage Ratio (*RQ*) (95th percentile)		0.40	0.40	0.28	0.02		0.41		0.70			
Uniform Delay (d_1), s/veh		18.0	18.0	15.3	0.0		56.7		41.5			
Incremental Delay (d_2), s/veh		3.3	3.3	2.2	1.4		0.5		17.0			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		21.2	21.3	17.5	1.4		57.2		58.5			
Level of Service (LOS)		C	C	B	A		E		E			
Approach Delay, s/veh / LOS	21.3	C		7.2	A		58.4	E		0.0		
Intersection Delay, s/veh / LOS	23.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	0.6	A	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.5	A	1.4	A		F		

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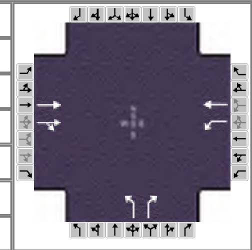
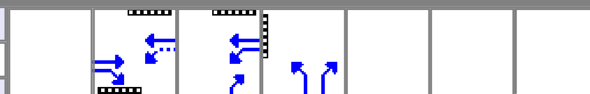
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	26th St & Yeager Road	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_26th_AM.xus				
Project Description	Existing AM				

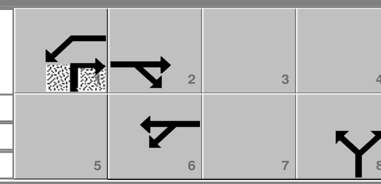


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		428	63	817	748		95		201			

Signal Information			
Cycle, s	146.4	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	72.0	41.5	17.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.9	1.9	1.3	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		8.3	1.0	4.0		9.0		
Phase Duration, s		77.5	47.0	124.5		21.9		
Change Period, ($Y+R_c$), s		5.5	5.5	5.5		4.9		
Max Allow Headway (MAH), s		4.1	4.1	4.1		4.3		
Queue Clearance Time (g_s), s		18.4	43.5	28.7		19.0		
Green Extension Time (g_e), s		2.4	0.0	13.3		0.0		
Phase Call Probability		1.00	1.00	1.00		1.00		
Max Out Probability		0.00	1.00	0.01		1.00		

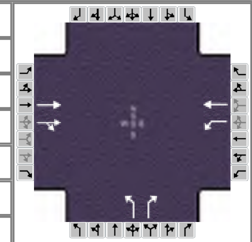
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		313	301	942	863		119		251			
Adjusted Saturation Flow Rate (s), veh/h/ln		1748	1669	1664	1748		1664		1481			
Queue Service Time (g_s), s		16.2	16.4	41.5	26.7		9.9		17.0			
Cycle Queue Clearance Time (g_c), s		16.2	16.4	41.5	26.7		9.9		17.0			
Green Ratio (g/C)		0.49	0.49	0.76	0.81		0.12		0.40			
Capacity (c), veh/h		859	821	813	1420		193		592			
Volume-to-Capacity Ratio (X)		0.364	0.366	1.159	0.607		0.614		0.425			
Available Capacity (c_a), veh/h		859	821	813	1420		193		592			
Back of Queue (Q), veh/ln (95th percentile)		11.2	10.8	59.3	11.6		8.6		11.1			
Queue Storage Ratio (RQ) (95th percentile)		0.19	0.19	1.41	0.28		0.22		2.84			
Uniform Delay (d_1), s/veh		23.0	23.1	34.1	5.1		61.6		31.8			
Incremental Delay (d_2), s/veh		1.1	1.1	78.2	0.9		13.8		2.2			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		24.1	24.2	112.3	6.0		75.3		34.0			
Level of Service (LOS)		C	C	F	A		E		C			

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	24.2	C	61.5	E	47.3	D	0.0	
Intersection Delay, s/veh / LOS	51.4				D			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	0.6	A	2.8	C	2.3	B
Bicycle LOS Score / LOS	1.0	A	3.7	D		F		

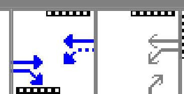
HCS 2010 Signalized Intersection Results Summary

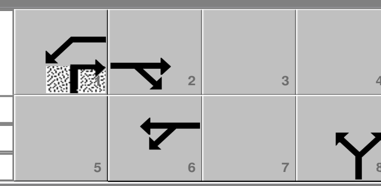
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	26th St & Yeager Road	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_26th_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		626	87	566	446		77		539			

Signal Information										
Cycle, s	146.0	Reference Phase	2							
Offset, s	111	Reference Point	Begin	Green	71.3	30.8	27.9	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.9	1.9	1.3	0.0	0.0	0.0





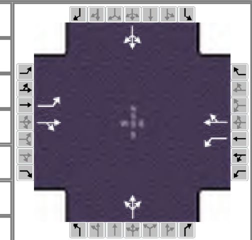
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		8.3	1.0	4.0		9.0		
Phase Duration, s		76.8	36.3	113.2		32.8		
Change Period, ($Y+R_c$), s		5.5	5.5	5.5		4.9		
Max Allow Headway (MAH), s		0.0	4.2	0.0		3.4		
Queue Clearance Time (g_s), s			28.5			30.1		
Green Extension Time (g_e), s		0.0	2.3	0.0		0.0		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.24			1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		376	361	608	479		83		580			
Adjusted Saturation Flow Rate (s), veh/h/ln		1748	1673	1664	1748		1664		1481			
Queue Service Time (g_s), s		21.4	15.5	26.5	1.2		6.2		28.1			
Cycle Queue Clearance Time (g_c), s		21.4	15.5	26.5	1.2		6.2		28.1			
Green Ratio (g/C)		0.49	0.49	0.68	0.74		0.19		0.40			
Capacity (c), veh/h		851	815	633	1286		321		598			
Volume-to-Capacity Ratio (X)		0.442	0.443	0.960	0.372		0.258		0.968			
Available Capacity (c_a), veh/h		851	815	754	1286		321		598			
Back of Queue (Q), veh/ln (95th percentile)		9.4	9.1	29.5	0.9		4.7		17.8			
Queue Storage Ratio (RQ) (95th percentile)		0.16	0.16	0.70	0.02		0.12		4.56			
Uniform Delay (d_1), s/veh		15.8	15.9	35.6	0.4		50.1		42.6			
Incremental Delay (d_2), s/veh		1.4	1.5	19.0	0.7		0.2		28.7			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		17.2	17.3	54.7	1.1		50.2		71.3			
Level of Service (LOS)		B	B	D	A		D		E			
Approach Delay, s/veh / LOS	17.3		B	31.1		C	68.7		E	0.0		
Intersection Delay, s/veh / LOS	37.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	0.7	A	2.8	C	2.3	B
Bicycle LOS Score / LOS	1.1	A	2.3	B		F		

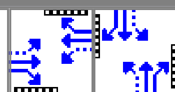
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	26th St & Van Eps Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_26th_AM.xus				
Project Description	Existing AM				

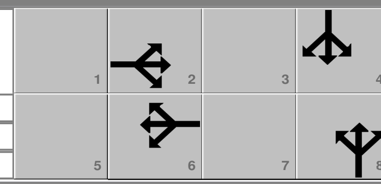


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	6	453	6	19	811	13	13	13	13	25	13	19

Signal Information			
Cycle, s	67.0	Reference Phase	2
Offset, s	18	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	50.0	7.9	0.0	0.0	0.0	0.0
Yellow	3.6	3.2	0.0	0.0	0.0	0.0
Red	1.0	1.3	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		54.6		54.6		12.4		12.4
Change Period, (*Y+Rc*), s		4.6		4.6		4.5		4.5
Max Allow Headway (*MAH*), s		4.1		4.1		4.2		4.2
Queue Clearance Time (*gs*), s		23.2		22.8		3.8		4.7
Green Extension Time (*ge*), s		8.6		8.6		0.1		0.1
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.15		0.14		1.00		1.00

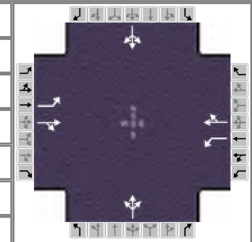
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	8	574		22	959			49			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	577	1743		827	1743			1580			1539	
Queue Service Time (*gs*), s	0.0	0.2		0.5	20.8			0.0			0.4	
Cycle Queue Clearance Time (*gc*), s	21.2	0.2		0.7	20.8			1.8			2.7	
Green Ratio (*g/C*)	0.75	0.75		0.75	0.75			0.12			0.12	
Capacity (*c*), veh/h	359	1301		722	1300			258			259	
Volume-to-Capacity Ratio (*X*)	0.021	0.441		0.031	0.738			0.189			0.275	
Available Capacity (*ca*), veh/h	359	1301		722	1300			258			259	
Back of Queue (*Q*), veh/ln (95th percentile)	0.1	0.4		0.1	8.1			1.4			2.2	
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.02		0.03	0.14			0.06			0.09	
Uniform Delay (*d1*), s/veh	4.5	0.0		2.3	4.8			26.9			27.2	
Incremental Delay (*d2*), s/veh	0.1	0.6		0.1	2.9			1.6			2.6	
Initial Queue Delay (*d3*), s/veh	0.0	0.0		0.0	0.0			0.0			0.0	
Control Delay (*d*), s/veh	4.6	0.6		2.3	7.7			28.5			29.9	
Level of Service (LOS)	A	A		A	A			C			C	
Approach Delay, s/veh / LOS	0.7	A		7.6	A		28.5	C		29.9	C	
Intersection Delay, s/veh / LOS	6.7						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.4	A	2.2	B	0.6	A	0.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:06:54 PM

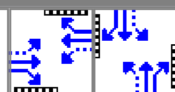
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	26th St & Van Eps Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_26th_PM.xus				
Project Description	Existing PM				

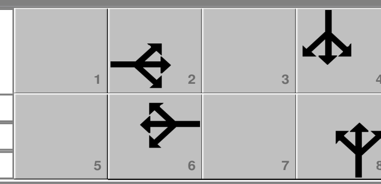


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	12	696	4	4	506	13	4	4	5	12	4	12

Signal Information			
Cycle, s	73.0	Reference Phase	2
Offset, s	40	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	57.0	6.9	0.0	0.0	0.0	0.0
Yellow	3.6	3.2	0.0	0.0	0.0	0.0
Red	1.0	1.3	0.0	0.0	0.0	0.0



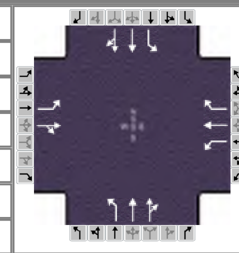
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		61.6		61.6		11.4		11.4
Change Period, ($Y+R_c$), s		4.6		4.6		4.5		4.5
Max Allow Headway (*MAH*), s		4.1		4.1		4.2		4.2
Queue Clearance Time (g_s), s		2.0		2.0		2.6		3.2
Green Extension Time (g_e), s		6.6		6.6		0.0		0.0
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		0.00		0.90		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	722		4	557			14			30	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	840	1746		721	1740			1587			1535	
Queue Service Time (g_s), s	0.0	0.0		0.0	0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s	0.0	0.0		0.0	0.0			0.6			1.2	
Green Ratio (*g/C*)	0.78	0.78		0.78	0.78			0.09			0.09	
Capacity (*c*), veh/h	755	1363		661	1358			215			216	
Volume-to-Capacity Ratio (*X*)	0.016	0.530		0.006	0.410			0.065			0.140	
Available Capacity (c_a), veh/h	755	1363		661	1358			215			216	
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	0.5		0.0	0.6			0.5			1.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.00	0.02		0.00	0.01			0.02			0.04	
Uniform Delay (d_1), s/veh	0.0	0.0		0.0	0.0			30.2			30.5	
Incremental Delay (d_2), s/veh	0.0	0.7		0.0	0.9			0.6			1.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0			0.0			0.0	
Control Delay (*d*), s/veh	0.0	0.7		0.0	0.9			30.8			31.8	
Level of Service (LOS)	A	A		A	A			C			C	
Approach Delay, s/veh / LOS	0.7	A		0.9	A		30.8	C		31.8	C	
Intersection Delay, s/veh / LOS	1.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.8	A	1.4	A	0.5	A	0.5	A

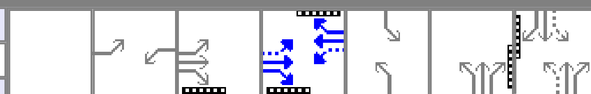
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	26th St & Cliff Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_26th_AM.xus				
Project Description	Existing AM				

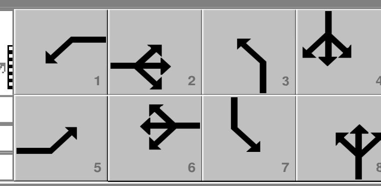


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	94	339	89	63	529	251	138	692	25	101	333	82

Signal Information			
Cycle, s	134.0	Reference Phase	2
Offset, s	100	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.3	0.1	50.0	7.4	3.3	48.7
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.4	1.0	0.0	1.4



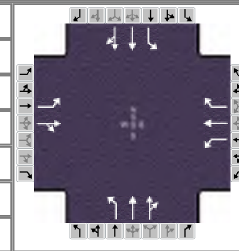
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	55.1	9.9	55.0	15.3	57.0	12.0	53.7
Change Period, ($Y+R_c$), s	4.6	5.0	4.6	5.0	4.6	5.0	4.6	5.0
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0	4.2	4.1	4.2	4.1
Queue Clearance Time (g_s), s	7.4		5.6		10.5	30.5	8.4	17.6
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.2	5.8	0.0	6.3
Phase Call Probability	0.99		0.94		1.00	1.00	0.99	1.00
Max Out Probability	1.00		1.00		0.61	0.12	1.00	0.04

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	118	535		74	618	293	173	451	445	126	267	252
Adjusted Saturation Flow Rate (s), veh/h/ln	1664	1685		1664	1748	1481	1664	1748	1726	1664	1748	1628
Queue Service Time (g_s), s	5.4	39.0		3.6	45.0	18.1	8.5	28.5	28.5	6.4	15.4	15.6
Cycle Queue Clearance Time (g_c), s	5.4	39.0		3.6	45.0	18.1	8.5	28.5	28.5	6.4	15.4	15.6
Green Ratio (g/C)	0.41	0.37		0.41	0.37	0.37	0.45	0.39	0.39	0.42	0.36	0.36
Capacity (c), veh/h	143	630		177	652	553	402	678	670	244	635	591
Volume-to-Capacity Ratio (X)	0.820	0.849		0.415	0.947	0.530	0.429	0.665	0.665	0.518	0.420	0.426
Available Capacity (c_a), veh/h	143	630		179	652	553	459	678	670	244	635	591
Back of Queue (Q), veh/ln (95th percentile)	6.4	25.4		2.7	26.4	9.5	6.2	19.0	18.8	4.8	11.2	10.8
Queue Storage Ratio (RQ) (95th percentile)	1.32	0.65		0.68	1.04	2.43	0.91	0.49	0.48	1.24	0.29	0.28
Uniform Delay (d_1), s/veh	36.4	38.5		30.6	32.4	25.7	24.0	33.8	33.8	28.0	32.1	32.2
Incremental Delay (d_2), s/veh	30.0	13.4		1.0	17.7	2.3	0.7	5.1	5.2	1.9	2.0	2.2
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	66.4	51.9		31.6	50.1	27.9	24.7	38.9	39.0	29.9	34.1	34.4
Level of Service (LOS)	E	D		C	D	C	C	D	D	C	C	C
Approach Delay, s/veh / LOS	54.5	D		42.1	D		36.6	D		33.4	C	
Intersection Delay, s/veh / LOS	41.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.4	B	2.3	B
Bicycle LOS Score / LOS	1.6	A	2.2	B	1.4	A	1.0	A

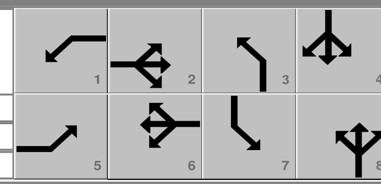
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	26th St & Cliff Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_26th_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	59	402	43	59	386	77	93	360	43	267	810	104

Signal Information										
Cycle, s	146.0	Reference Phase	2							
Offset, s	55	Reference Point	Begin	Green	5.6	37.8	5.4	5.7	67.7	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.4	1.0	1.0	1.4	0.0



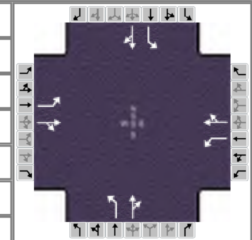
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.2	42.8	10.2	42.8	10.0	72.7	20.3	83.0
Change Period, ($Y+R_c$), s	4.6	5.0	4.6	5.0	4.6	5.0	4.6	5.0
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0	4.2	4.1	4.2	4.1
Queue Clearance Time (g_s), s	6.1		6.1		6.7	13.4	14.6	29.4
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	6.6	1.1	6.6
Phase Call Probability	0.92		0.92		0.98	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	0.00	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	63	478		63	415	83	100	220	214	287	501	481
Adjusted Saturation Flow Rate (s), veh/h/ln	1664	1718		1664	1748	1481	1664	1748	1682	1664	1748	1677
Queue Service Time (g_s), s	4.1	37.8		4.1	33.2	5.8	4.7	11.3	11.4	12.6	27.4	27.4
Cycle Queue Clearance Time (g_c), s	4.1	37.8		4.1	33.2	5.8	4.7	11.3	11.4	12.6	27.4	27.4
Green Ratio (g/C)	0.30	0.26		0.30	0.26	0.26	0.50	0.46	0.46	0.58	0.53	0.53
Capacity (c), veh/h	141	444		113	452	383	299	810	780	591	934	896
Volume-to-Capacity Ratio (X)	0.449	1.076		0.559	0.917	0.216	0.334	0.271	0.274	0.485	0.537	0.537
Available Capacity (c_a), veh/h	173	444		145	452	383	299	810	780	941	934	896
Back of Queue (Q), veh/ln (95th percentile)	3.2	33.9		3.2	23.3	4.0	3.4	8.6	8.4	8.6	17.5	16.9
Queue Storage Ratio (RQ) (95th percentile)	0.65	0.87		0.82	0.92	1.02	0.50	0.22	0.22	2.19	0.45	0.43
Uniform Delay (d_1), s/veh	41.5	54.1		41.8	46.3	37.3	20.9	24.0	24.1	16.1	22.2	22.2
Incremental Delay (d_2), s/veh	2.2	64.7		3.9	24.4	1.2	0.7	0.8	0.9	0.6	2.2	2.3
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	43.8	118.8		45.7	70.7	38.5	21.5	24.9	24.9	16.7	24.4	24.5
Level of Service (LOS)	D	F		D	E	D	C	C	C	B	C	C
Approach Delay, s/veh / LOS	110.0	F		63.2	E		24.3	C		22.7	C	
Intersection Delay, s/veh / LOS	47.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.4	B	2.3	B
Bicycle LOS Score / LOS	1.4	A	1.4	A	0.9	A	1.5	A

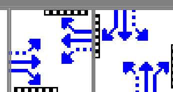
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	18th St & Cleveland Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_18th_St_AM.xus				
Project Description	Existing AM				

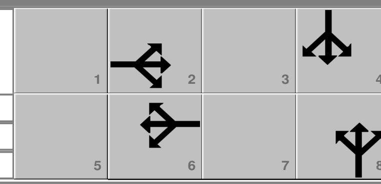


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	31	63	25	19	227	69	50	150	13	25	113	76

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	30.0	20.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		35.0		35.0		25.0		25.0
Change Period, (Y+R_c), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		4.3		4.3		4.3		4.3
Queue Clearance Time (g_s), s		12.0		10.5		11.4		8.7
Green Extension Time (g_e), s		2.0		2.1		1.4		1.6
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.01		0.01		0.22		0.08

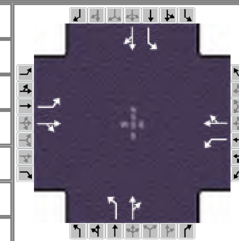
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	39	110		24	370		63	204		31	236	
Adjusted Saturation Flow Rate (s), veh/h/ln	998	1663		1266	1677		1139	1740		1174	1646	
Queue Service Time (g_s), s	1.6	2.1		0.6	8.5		2.7	5.3		1.2	6.7	
Cycle Queue Clearance Time (g_c), s	10.0	2.1		2.7	8.5		9.4	5.3		6.5	6.7	
Green Ratio (g/C)	0.50	0.50		0.50	0.50		0.33	0.33		0.33	0.33	
Capacity (c), veh/h	478	831		708	839		372	580		407	549	
Volume-to-Capacity Ratio (X)	0.081	0.132		0.034	0.441		0.168	0.351		0.077	0.431	
Available Capacity (c_a), veh/h	478	831		708	839		372	580		407	549	
Back of Queue (Q), veh/ln (95th percentile)	0.6	1.3		0.3	5.3		1.4	3.9		0.6	4.7	
Queue Storage Ratio (RQ) (95th percentile)	0.33	0.02		0.10	0.14		0.28	0.10		0.13	0.12	
Uniform Delay (d_1), s/veh	12.8	8.0		8.8	9.6		19.2	15.1		17.6	15.6	
Incremental Delay (d_2), s/veh	0.3	0.3		0.1	1.7		1.0	1.7		0.4	2.5	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	13.2	8.3		8.9	11.3		20.2	16.8		17.9	18.0	
Level of Service (LOS)	B	A		A	B		C	B		B	B	
Approach Delay, s/veh / LOS	9.6	A		11.2	B		17.6	B		18.0	B	
Intersection Delay, s/veh / LOS	14.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.7	A	1.1	A	0.9	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:12:33 PM

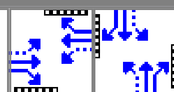
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	18th St & Cleveland Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_18th_St_PM.xus				
Project Description	Existing PM				

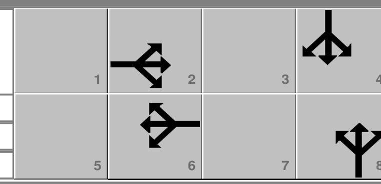


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	97	256	43	16	110	43	38	174	22	87	213	59

Signal Information			
Cycle, s	65.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	30.0	25.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		35.0		35.0		30.0		30.0
Change Period, ($Y+R_c$), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		4.3		4.3		4.3		4.3
Queue Clearance Time (g_s), s		10.1		10.9		12.2		11.5
Green Extension Time (g_e), s		2.3		2.3		2.1		2.2
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.01		0.01		0.08		0.06

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	104	322		17	165		41	211		94	292	
Adjusted Saturation Flow Rate (s), veh/h/ln	1204	1703		1044	1663		1082	1730		1166	1698	
Queue Service Time (g_s), s	3.7	8.1		0.7	3.8		1.9	5.5		4.0	8.3	
Cycle Queue Clearance Time (g_c), s	7.5	8.1		8.9	3.8		10.2	5.5		9.5	8.3	
Green Ratio (g/C)	0.46	0.46		0.46	0.46		0.38	0.38		0.38	0.38	
Capacity (c), veh/h	595	786		462	768		388	665		460	653	
Volume-to-Capacity Ratio (X)	0.175	0.409		0.037	0.214		0.105	0.317		0.203	0.448	
Available Capacity (c_a), veh/h	595	786		462	768		388	665		460	653	
Back of Queue (Q), veh/ln (95th percentile)	1.8	5.4		0.3	2.5		0.9	4.0		2.0	5.9	
Queue Storage Ratio (RQ) (95th percentile)	0.91	0.07		0.11	0.06		0.19	0.10		0.41	0.15	
Uniform Delay (d_1), s/veh	12.7	11.6		14.6	10.5		18.7	14.0		17.4	14.9	
Incremental Delay (d_2), s/veh	0.5	1.3		0.2	0.6		0.5	1.2		1.0	2.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	13.2	12.9		14.7	11.1		19.2	15.3		18.3	17.1	
Level of Service (LOS)	B	B		B	B		B	B		B	B	
Approach Delay, s/veh / LOS	13.0	B		11.4	B		15.9	B		17.4	B	
Intersection Delay, s/veh / LOS	14.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.2	A	0.8	A	0.9	A	1.1	A

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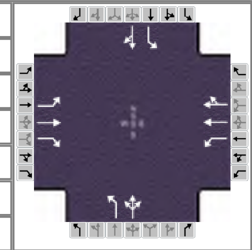
HCS 2010 Signalized Intersection Results Summary

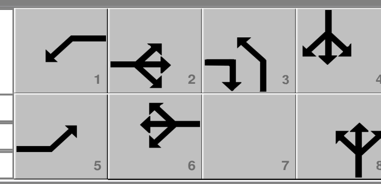
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	18th St & Southeastern Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_18th_St_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	6	82	94	38	302	13	597	95	31	6	38	25

Signal Information			
Cycle, s	58.8	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.5	1.7	8.8	20.5	3.7	0.0
Yellow	3.6	0.0	3.6	3.6	3.6	0.0
Red	2.3	0.0	2.3	2.3	2.3	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		10.0		10.0
Phase Duration, s	6.4	14.7	8.1	16.4		26.4		9.6
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9		5.9		5.9
Max Allow Headway (*MAH*), s	4.1	4.1	4.2	4.1		4.2		4.2
Queue Clearance Time (g_s), s	2.2	5.1	3.4	8.2		16.4		4.8
Green Extension Time (g_e), s	0.0	2.3	0.0	2.3		4.0		0.1
Phase Call Probability	0.12	1.00	0.54	1.00		1.00		0.76
Max Out Probability	1.00	0.00	1.00	0.00		0.00		0.90

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	8	103	118	48	198	196	448	448		8	79	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664	1748	1481	1664	1748	1722	1664	1664		1681	1647	
Queue Service Time (g_s), s	0.2	3.1	2.5	1.4	6.2	6.2	14.1	14.1		0.2	2.8	
Cycle Queue Clearance Time (g_c), s	0.2	3.1	2.5	1.4	6.2	6.2	14.1	14.1		0.2	2.8	
Green Ratio (*g/C*)	0.16	0.15	0.50	0.19	0.18	0.18	0.35	0.35		0.06	0.06	
Capacity (*c*), veh/h	175	263	740	309	314	309	581	581		106	104	
Volume-to-Capacity Ratio (*X*)	0.043	0.390	0.159	0.154	0.631	0.634	0.771	0.771		0.071	0.761	
Available Capacity (c_a), veh/h	334	1504	1792	420	1504	1482	1811	1811		260	255	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	2.2	1.2	0.9	4.5	4.5	8.8	8.8		0.2	2.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.06	0.03	0.32	0.06	0.06	0.23	0.23		0.05	0.06	
Uniform Delay (d_1), s/veh	21.3	22.6	8.0	20.1	22.4	22.4	17.1	17.1		26.0	27.2	
Incremental Delay (d_2), s/veh	0.1	0.9	0.1	0.2	1.9	2.0	2.2	2.2		0.3	10.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	21.4	23.5	8.1	20.3	24.3	24.4	19.3	19.3		26.3	38.0	
Level of Service (LOS)	C	C	A	C	C	C	B	B		C	D	
Approach Delay, s/veh / LOS	15.5	B		23.9	C		19.4	B		37.0	D	
Intersection Delay, s/veh / LOS	21.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.5	B	2.8	C
Bicycle LOS Score / LOS	0.9	A	0.9	A	2.0	A	0.6	A

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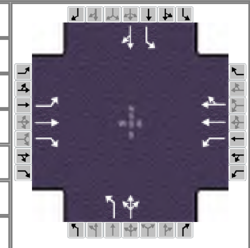
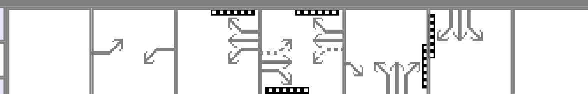
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	18th St & Southeastern Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_18th_St_PM.xus				
Project Description	Existing PM				

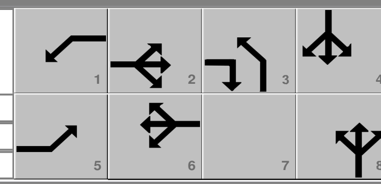


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	26	354	490	33	158	16	151	77	38	4	87	12

Signal Information			
Cycle, s	65.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.6	0.3	24.2	9.9	5.4	0.0
Yellow	3.6	0.0	3.6	3.6	3.6	0.0
Red	2.3	0.0	2.3	2.3	2.3	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	3.0	1.1	4.0		10.0		10.0
Phase Duration, s	7.5	30.1	7.8	30.4		15.8		11.3
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9		5.9		5.9
Max Allow Headway (*MAH*), s	4.1	4.2	4.2	4.2		4.2		4.1
Queue Clearance Time (g_s), s	2.7	19.1	2.8	4.4		9.1		5.9
Green Extension Time (g_e), s	0.0	5.1	0.0	5.1		0.9		0.3
Phase Call Probability	0.40	1.00	0.47	1.00		0.99		0.86
Max Out Probability	1.00	0.00	1.00	0.00		0.00		0.00

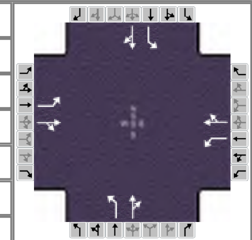
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	28	381	527	35	94	93	97	97		4	106	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664	1748	1481	1664	1748	1691	1664	1664		1681	1727	
Queue Service Time (g_s), s	0.7	11.4	17.1	0.8	2.3	2.4	3.4	3.4		0.2	3.9	
Cycle Queue Clearance Time (g_c), s	0.7	11.4	17.1	0.8	2.3	2.4	3.4	3.4		0.2	3.9	
Green Ratio (g/C)	0.40	0.37	0.53	0.40	0.38	0.38	0.15	0.15		0.08	0.08	
Capacity (*c*), veh/h	519	650	778	355	658	637	255	255		140	143	
Volume-to-Capacity Ratio (*X*)	0.054	0.586	0.678	0.100	0.143	0.146	0.383	0.383		0.031	0.742	
Available Capacity (c_a), veh/h	634	1722	1686	462	1722	1666	617	617		623	640	
Back of Queue (*Q*), veh/ln (95th percentile)	0.4	7.5	8.3	0.5	1.5	1.5	2.4	2.4		0.1	3.3	
Queue Storage Ratio (*RQ*) (95th percentile)	0.10	0.19	0.21	0.18	0.02	0.02	0.06	0.06		0.03	0.08	
Uniform Delay (d_1), s/veh	12.2	16.4	11.4	12.9	13.4	13.4	24.8	24.8		27.4	29.2	
Incremental Delay (d_2), s/veh	0.0	0.8	1.0	0.1	0.1	0.1	0.9	0.9		0.1	7.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	12.2	17.2	12.4	13.1	13.5	13.5	25.7	25.7		27.5	36.5	
Level of Service (LOS)	B	B	B	B	B	B	C	C		C	D	
Approach Delay, s/veh / LOS	14.4		B	13.4		B	29.0		C	36.2		D
Intersection Delay, s/veh / LOS	18.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.5	B	2.8	C
Bicycle LOS Score / LOS	2.0	B	0.7	A	1.0	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:08:03 PM

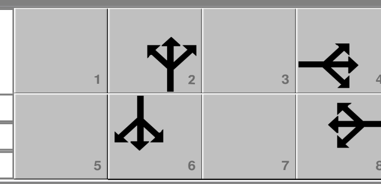
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	12th St & Cleveland	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_12th_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	19	82	25	31	232	57	82	296	31	25	132	32

Signal Information									
Cycle, s	65.0	Reference Phase	2						
Offset, s	0	Reference Point	Begin	Green	37.9	17.1	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.4	1.4	0.0	0.0	0.0	0.0



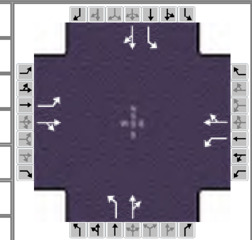
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		22.1		22.1		42.9		42.9
Change Period, (*Y+Rc*), s		5.0		5.0		5.0		5.0
Max Allow Headway (*MAH*), s		4.2		4.2		0.0		0.0
Queue Clearance Time (*gs*), s		16.3		14.9				
Green Extension Time (*ge*), s		0.8		1.1		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		1.00		0.73				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	24	134		39	361		103	409		31	205	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1016	1693		1251	1704		1172	1735		973	1705	
Queue Service Time (*gs*), s	1.5	4.1		1.7	12.9		3.0	8.4		1.2	3.7	
Cycle Queue Clearance Time (*gc*), s	14.3	4.1		5.7	12.9		6.7	8.4		9.6	3.7	
Green Ratio (*g/C*)	0.26	0.26		0.26	0.26		0.58	0.58		0.58	0.58	
Capacity (*c*), veh/h	178	447		362	449		726	1011		552	993	
Volume-to-Capacity Ratio (*X*)	0.133	0.299		0.107	0.804		0.141	0.404		0.057	0.206	
Available Capacity (*ca*), veh/h	223	521		417	524		726	1011		552	993	
Back of Queue (*Q*), veh/ln (95th percentile)	0.6	2.8		0.9	9.7		1.3	5.1		0.5	2.2	
Queue Storage Ratio (*RQ*) (95th percentile)	0.22	0.07		0.29	0.25		0.33	0.13		0.12	0.06	
Uniform Delay (*d1*), s/veh	29.0	19.1		21.4	22.4		8.0	7.4		10.0	6.4	
Incremental Delay (*d2*), s/veh	0.3	0.4		0.1	7.7		0.4	1.2		0.2	0.5	
Initial Queue Delay (*d3*), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	29.4	19.5		21.5	30.1		8.4	8.6		10.2	6.9	
Level of Service (LOS)	C	B		C	C		A	A		B	A	
Approach Delay, s/veh / LOS	21.0	C		29.3	C		8.6	A		7.4	A	
Intersection Delay, s/veh / LOS	16.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.2	B	2.2	B
Bicycle LOS Score / LOS	0.7	A	1.1	A	1.3	A	0.9	A

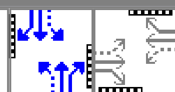
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	12th St & Cleveland Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_12th_PM.xus				
Project Description	Existing PM				

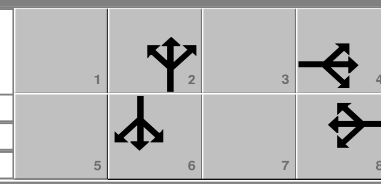


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	59	214	87	33	138	55	43	217	33	65	283	33

Signal Information			
Cycle, s	70.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	41.2	18.8	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		23.8		23.8		46.2		46.2
Change Period, ($Y+R_c$), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		4.3		4.3		0.0		0.0
Queue Clearance Time (g_s), s		14.2		16.3				
Green Extension Time (g_e), s		2.5		2.4		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		0.01		0.01				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	63	324		35	208		46	269		70	340	
Adjusted Saturation Flow Rate (s), veh/h/ln	1170	1677		1052	1679		1036	1724		1106	1732	
Queue Service Time (g_s), s	3.3	12.2		2.2	7.2		1.7	5.3		2.3	7.0	
Cycle Queue Clearance Time (g_c), s	10.5	12.2		14.3	7.2		8.8	5.3		7.7	7.0	
Green Ratio (g/C)	0.27	0.27		0.27	0.27		0.59	0.59		0.59	0.59	
Capacity (c), veh/h	298	451		204	452		607	1014		668	1019	
Volume-to-Capacity Ratio (X)	0.213	0.717		0.174	0.460		0.076	0.265		0.105	0.334	
Available Capacity (c_a), veh/h	569	839		447	839		607	1014		668	1019	
Back of Queue (Q), veh/ln (95th percentile)	1.7	8.4		1.0	5.0		0.7	3.3		1.0	4.4	
Queue Storage Ratio (RQ) (95th percentile)	0.56	0.21		0.34	0.13		0.18	0.08		0.25	0.12	
Uniform Delay (d_1), s/veh	25.7	23.2		29.6	21.3		9.7	7.0		8.9	7.4	
Incremental Delay (d_2), s/veh	0.4	2.1		0.4	0.7		0.2	0.6		0.3	0.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	26.0	25.3		30.0	22.1		9.9	7.7		9.3	8.3	
Level of Service (LOS)	C	C		C	C		A	A		A	A	
Approach Delay, s/veh / LOS	25.4	C		23.2	C		8.0	A		8.4	A	
Intersection Delay, s/veh / LOS	15.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.2	B	2.2	B
Bicycle LOS Score / LOS	1.1	A	0.9	A	1.0	A	1.2	A

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E 12th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E 12th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	13	113	6	6	327	13
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	16	141	7	7	408	16
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	6	25	7	6	19	13
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	7	31	8	7	23	16
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	16	7		46			46	
C(m) (vph)	1135	1434		434			452	
v/c	0.01	0.00		0.11			0.10	
95% queue length	0.04	0.01		0.35			0.34	
Control Delay	8.2	7.5		14.3			13.9	
LOS	A	A		B			B	
Approach Delay				14.3			13.9	
Approach LOS				B			B	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E 12th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E 12th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	13	113	6	6	327	13
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	4	35	2	2	102	4
Hourly Flow Rate, HFR	16	141	7	7	408	16
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	6	25	7	6	19	13
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	2	8	2	2	6	4
Hourly Flow Rate, HFR	7	31	8	7	23	16
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	65	30	1325
	Through	232	1800	3	17	65	30	1325

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	141	408
Shared ln volume, major rt vehicles:	7	16
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2	2	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog			232	0

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	17	0
Cycle Length, C (sec)	65	65
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.262	0.000
g(q1)	6.2	0.0
g(q2)	0.9	0.0
g(q)	7.1	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.550	
beta			0.645	
Travel time, t(a) (sec)			30.045	
Smoothing Factor, F			0.086	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			848	0
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			0.0	0.0
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)	1.000		
p(7)	1.000		
p(8)	1.000		
p(9)	1.000		
p(10)	1.000		
p(11)	1.000		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	424	148	626	614	144	626	610	416
s	1500	1500	1500	1500	1500	1500	1500	1500
Px	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
V c,u,x	424	148	626	614	144	626	610	416
C r,x	1135	1434	397	407	903	397	409	637
C plat,x	1135	1434	397	407	903	397	409	637

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500	1500	1500	1500	1500	1500	1500	1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	144	416
Potential Capacity	903	637
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	903	637
Probability of Queue free St.	0.99	0.97

Step 2: LT from Major St.	4	1
Conflicting Flows	148	424
Potential Capacity	1434	1135
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1434	1135
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.	0.99	0.98

Step 3: TH from Minor St.	8	11
Conflicting Flows	614	610
Potential Capacity	407	409
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	398	400
Probability of Queue free St.	0.92	0.94

Step 4: LT from Minor St.	7	10
Conflicting Flows	626	626
Potential Capacity	397	397
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	0.90
Maj. L, Min T Adj. Imp Factor.	0.94	0.93
Cap. Adj. factor due to Impeding mvmnt	0.92	0.92
Movement Capacity	364	364

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	614	610
Potential Capacity	407	409
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	398	400

Result for 2 stage process:		
a		
y		
C t	398	400
Probability of Queue free St.	0.92	0.94

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	626	626
Potential Capacity	397	397
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	0.90
Maj. L, Min T Adj. Imp Factor.	0.94	0.93
Cap. Adj. factor due to Impeding mvmnt	0.92	0.92
Movement Capacity	364	364

Results for Two-stage process:		
a		
y		
C t	364	364

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	7	31	8	7	23	16
Movement Capacity (vph)	364	398	903	364	400	637
Shared Lane Capacity (vph)		434			452	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	364	398	903	364	400	637
Volume	7	31	8	7	23	16
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		434			452	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	16	7		46			46	
C(m) (vph)	1135	1434		434			452	
v/c	0.01	0.00		0.11			0.10	
95% queue length	0.04	0.01		0.35			0.34	
Control Delay	8.2	7.5		14.3			13.9	
LOS	A	A		B			B	
Approach Delay				14.3			13.9	
Approach LOS				B			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5	141	408
v(i2), Volume for stream 3 or 6	7	16
s(il), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.98	0.99
d(M,LT), Delay for stream 1 or 4	8.2	7.5
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.1	0.0

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E 12th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E 12th St
North/South Street: Lowell Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	12	294	4	12	186	16
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	12	316	4	12	199	17
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	4	16	11	55	26	12
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	4	17	11	59	27	12
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	12	12		32			98	
C(m) (vph)	1354	1240		481			429	
v/c	0.01	0.01		0.07			0.23	
95% queue length	0.03	0.03		0.21			0.87	
Control Delay	7.7	7.9		13.0			15.9	
LOS	A	A		B			C	
Approach Delay				13.0			15.9	
Approach LOS				B			C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E 12th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E 12th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	12	294	4	12	186	16
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	3	79	1	3	50	4
Hourly Flow Rate, HFR	12	316	4	12	199	17
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	4	16	11	55	26	12
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	1	4	3	15	7	3
Hourly Flow Rate, HFR	4	17	11	59	27	12
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	65	30	1325
	Through	138	1800	3	19	65	30	1325

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	316	199
Shared ln volume, major rt vehicles:	4	17
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2	2	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog			138	0

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	19	0
Cycle Length, C (sec)	65	65
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.292	0.000
g(q1)	3.5	0.0
g(q2)	0.3	0.0
g(q)	3.8	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha			0.550	
beta			0.645	
Travel time, t(a) (sec)			30.045	
Smoothing Factor, F			0.086	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			522	0
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			0.0	0.0
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)	1.000		
p(7)	1.000		
p(8)	1.000		
p(9)	1.000		
p(10)	1.000		
p(11)	1.000		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	216	320	593	582	318	588	576	208
s	1500	1500	1500	1500	1500	1500	1500	1500
Px	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
V c,u,x	216	320	593	582	318	588	576	208
C r,x	1354	1240	417	425	723	421	428	832
C plat,x	1354	1240	417	425	723	421	428	832

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500	1500	1500	1500	1500	1500	1500	1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	318	208
Potential Capacity	723	832
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	723	832
Probability of Queue free St.	0.98	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows	320	216
Potential Capacity	1240	1354
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1240	1354
Probability of Queue free St.	0.99	0.99
Maj L-Shared Prob Q free St.	0.99	0.99

Step 3: TH from Minor St.	8	11
Conflicting Flows	582	576
Potential Capacity	425	428
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	416	419
Probability of Queue free St.	0.96	0.94

Step 4: LT from Minor St.	7	10
Conflicting Flows	593	588
Potential Capacity	417	421
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	0.94
Maj. L, Min T Adj. Imp Factor.	0.94	0.95
Cap. Adj. factor due to Impeding mvmnt	0.92	0.94
Movement Capacity	384	395

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	582	576
Potential Capacity	425	428
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity	416	419

Result for 2 stage process:		
a		
y		
C t	416	419
Probability of Queue free St.	0.96	0.94

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	593	588
Potential Capacity	417	421
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.92	0.94
Maj. L, Min T Adj. Imp Factor.	0.94	0.95
Cap. Adj. factor due to Impeding mvmnt	0.92	0.94
Movement Capacity	384	395
Results for Two-stage process:		
a		
y		
C t	384	395

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	4	17	11	59	27	12
Movement Capacity (vph)	384	416	723	395	419	832
Shared Lane Capacity (vph)		481			429	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	384	416	723	395	419	832
Volume	4	17	11	59	27	12
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		481			429	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

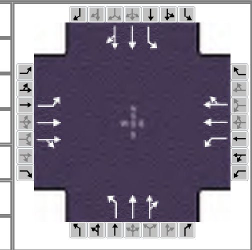
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	12	12		32			98	
C(m) (vph)	1354	1240		481			429	
v/c	0.01	0.01		0.07			0.23	
95% queue length	0.03	0.03		0.21			0.87	
Control Delay	7.7	7.9		13.0			15.9	
LOS	A	A		B			C	
Approach Delay				13.0			15.9	
Approach LOS				B			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.99
v(il), Volume for stream 2 or 5	316	199
v(i2), Volume for stream 3 or 6	4	17
s(il), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.99	0.99
d(M,LT), Delay for stream 1 or 4	7.7	7.9
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.1	0.1

HCS 2010 Signalized Intersection Results Summary

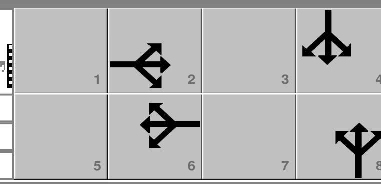
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Sycamore Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	207	359	120	75	666	38	270	465	63	38	264	258

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	106	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.4	3.0	54.5	3.8	8.0	15.8
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	0.0	0.0	2.0	0.0	0.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	15.5	66.7	9.0	60.1	19.0	33.0	7.4	21.4
Change Period, (*Y+R*c), s	3.6	5.6	3.6	5.6	3.6	5.6	3.6	5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.2	4.1	4.2	4.1
Queue Clearance Time (g_s), s	11.1		5.5		17.4	22.4	4.8	12.1
Green Extension Time (g_e), s	0.9	0.0	0.2	0.0	0.0	3.7	0.0	3.6
Phase Call Probability	1.00		0.95		1.00	1.00	0.78	1.00
Max Out Probability	0.00		0.00		1.00	0.08	1.00	0.10

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	259	311	288	94	444	436	338	336	324	48	330	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1553	1617	1698	1665	1681	1765	1691	1681	1765	0
Queue Service Time (g_s), s	9.1	13.8	13.8	3.5	17.4	17.4	15.4	20.3	20.4	2.8	10.1	0.0
Cycle Queue Clearance Time (g_c), s	9.1	13.8	13.8	3.5	17.4	17.4	15.4	20.3	20.4	2.8	10.1	0.0
Green Ratio (*g/C*)	0.59	0.53	0.53	0.52	0.47	0.47	0.29	0.24	0.24	0.17	0.14	
Capacity (*c*), veh/h	422	894	817	443	798	783	336	417	399	150	479	
Volume-to-Capacity Ratio (*X*)	0.614	0.348	0.352	0.212	0.557	0.557	1.005	0.807	0.811	0.317	0.688	0.000
Available Capacity (c_a), veh/h	730	894	817	647	798	783	336	594	569	188	834	
Back of Queue (*Q*), veh/ln (95th percentile)	5.8	9.7	8.9	2.2	10.0	9.9	11.9	13.7	13.4	2.2	7.8	
Queue Storage Ratio (*RQ*) (95th percentile)	1.23	0.08	0.08	0.47	0.26	0.26	3.02	0.35	0.34	0.55	0.20	0.00
Uniform Delay (d_1), s/veh	14.4	18.9	18.4	14.6	14.7	14.7	39.0	37.3	37.4	41.3	45.2	
Incremental Delay (d_2), s/veh	1.4	1.0	1.1	0.2	2.8	2.8	50.4	5.5	5.9	1.2	1.8	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	15.8	19.9	19.6	14.8	17.5	17.6	89.4	42.8	43.2	42.6	47.0	
Level of Service (LOS)	B	B	B	B	B	B	F	D	D	D	D	
Approach Delay, s/veh / LOS	18.5	B		17.3	B		58.7	E		46.4	D	
Intersection Delay, s/veh / LOS	33.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	3.2	C	2.8	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	1.3	A	1.3	A	0.8	A

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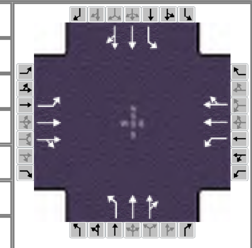
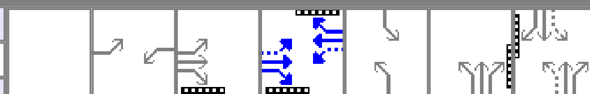
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Sycamore Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

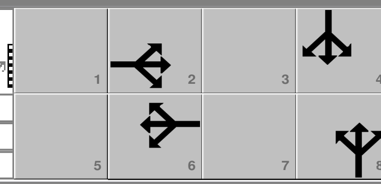


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	299	838	332	135	534	59	213	315	152	97	392	212

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	97	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.9	2.9	51.5	7.8	2.0	18.4
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	0.0	0.0	2.0	0.0	0.0	2.0



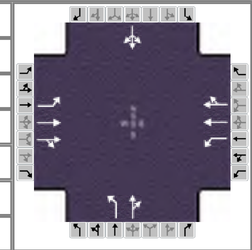
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	18.0	63.5	11.5	57.1	17.0	29.6	11.4	24.0
Change Period, (*Y+Rc*), s	3.6	5.6	3.6	5.6	3.6	5.6	3.6	5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (*gs*), s	13.3		7.6		15.1	18.1	7.9	15.0
Green Extension Time (*ge*), s	1.1	0.0	0.4	0.0	0.0	3.6	0.2	3.4
Phase Call Probability	1.00		0.99		1.00	1.00	0.97	1.00
Max Out Probability	0.00		0.00		1.00	0.06	0.05	0.10

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	306	628	570	145	324	314	229	262	240	104	422	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1534	1617	1698	1638	1681	1765	1572	1681	1765	0
Queue Service Time (*gs*), s	11.3	36.5	36.9	5.6	12.1	12.2	13.1	15.6	16.1	5.9	13.0	0.0
Cycle Queue Clearance Time (*gc*), s	11.3	36.5	36.9	5.6	12.1	12.2	13.1	15.6	16.1	5.9	13.0	0.0
Green Ratio (*g/C*)	0.58	0.50	0.50	0.51	0.44	0.44	0.29	0.21	0.21	0.23	0.16	
Capacity (*c*), veh/h	519	848	766	245	753	727	301	365	325	220	559	
Volume-to-Capacity Ratio (*X*)	0.590	0.741	0.745	0.592	0.430	0.432	0.762	0.720	0.739	0.474	0.754	0.000
Available Capacity (*ca*), veh/h	868	848	766	434	753	727	301	532	474	330	895	
Back of Queue (*Q*), veh/ln (95th percentile)	6.9	21.8	20.4	3.8	7.9	7.8	9.9	10.9	10.3	4.5	9.4	
Queue Storage Ratio (*RQ*) (95th percentile)	1.44	0.18	0.17	0.79	0.21	0.20	2.52	0.28	0.26	1.14	0.24	0.00
Uniform Delay (*d1*), s/veh	13.7	28.1	28.6	21.4	15.7	15.7	33.5	39.0	39.2	36.9	43.6	
Incremental Delay (*d2*), s/veh	0.8	4.6	5.2	2.3	1.8	1.9	10.9	2.7	3.4	1.6	2.1	0.0
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	14.6	32.7	33.8	23.6	17.4	17.5	44.4	41.7	42.6	38.5	45.7	
Level of Service (LOS)	B	C	C	C	B	B	D	D	D	D	D	
Approach Delay, s/veh / LOS	29.4	C		18.6	B		42.8	D		44.3	D	
Intersection Delay, s/veh / LOS	32.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	3.1	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	1.1	A	1.1	A	0.9	A

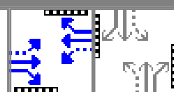
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Bahnson Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				

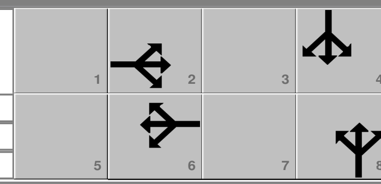


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	6	655	44	6	1182	6	57	6	25	6	0	6

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	46	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	93.3	11.5	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		8.0
Phase Duration, s		98.9		98.9		17.1		17.1
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.2		4.2
Queue Clearance Time (g_s), s						11.5		5.2
Green Extension Time (g_e), s		0.0		0.0		0.4		0.5
Phase Call Probability						0.98		0.98
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	8	442	432	7	742	741	71	39			15	
Adjusted Saturation Flow Rate (s), veh/h/ln	341	1698	1660	608	1698	1695	1402	1541			1301	
Queue Service Time (g_s), s	1.1	10.5	10.6	0.1	14.0	13.9	5.8	2.7			0.0	
Cycle Queue Clearance Time (g_c), s	14.1	10.5	10.6	10.0	14.0	13.9	9.5	2.7			3.2	
Green Ratio (g/C)	0.80	0.80	0.80	0.80	0.80	0.80	0.10	0.10			0.10	
Capacity (c), veh/h	298	1368	1338	500	1368	1366	154	151			174	
Volume-to-Capacity Ratio (X)	0.025	0.323	0.323	0.015	0.542	0.543	0.462	0.257			0.086	
Available Capacity (c_a), veh/h	298	1368	1338	500	1368	1366	626	670			654	
Back of Queue (Q), veh/ln (95th percentile)	0.1	5.8	5.7	0.0	5.4	5.4	3.8	1.9			0.7	
Queue Storage Ratio (RQ) (95th percentile)	0.04	0.11	0.11	0.01	0.05	0.05	0.98	0.10			0.04	
Uniform Delay (d_1), s/veh	7.4	4.4	4.4	1.4	2.7	2.7	53.3	48.4			47.7	
Incremental Delay (d_2), s/veh	0.1	0.6	0.6	0.0	1.0	1.0	2.1	0.9			0.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	
Control Delay (d), s/veh	7.6	5.0	5.0	1.4	3.7	3.7	55.5	49.3			47.9	
Level of Service (LOS)	A	A	A	A	A	A	E	D			D	
Approach Delay, s/veh / LOS	5.0	A		3.7	A		53.3	D		47.9	D	
Intersection Delay, s/veh / LOS	6.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	1.7	A	0.7	A	0.5	A

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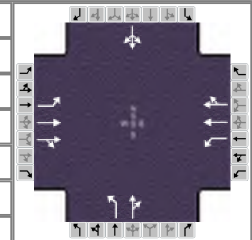
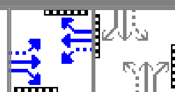
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Bahnson Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

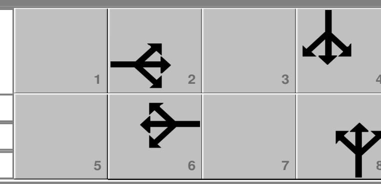


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	5	1421	109	16	943	0	76	0	43	5	4	4

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	9	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	91.4	13.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		8.0
Phase Duration, s		97.0		97.0		19.0		19.0
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						13.3		5.9
Green Extension Time (g_e), s		0.0		0.0		0.5		0.5
Phase Call Probability						0.99		0.99
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	5	789	776	17	1014	0	82	46			14	
Adjusted Saturation Flow Rate (s), veh/h/ln	533	1698	1655	315	1698	0	1401	1496			1445	
Queue Service Time (g_s), s	0.3	18.0	18.4	1.6	12.0	0.0	6.7	3.3			0.0	
Cycle Queue Clearance Time (g_c), s	11.0	18.0	18.4	19.4	12.0	0.0	11.3	3.3			3.9	
Green Ratio (g/C)	0.79	0.79	0.79	0.79	0.79		0.12	0.12			0.12	
Capacity (c), veh/h	434	1341	1307	264	2682		166	170			207	
Volume-to-Capacity Ratio (X)	0.012	0.588	0.594	0.065	0.378	0.000	0.494	0.272			0.067	
Available Capacity (c_a), veh/h	434	1341	1307	264	2682		530	560			599	
Back of Queue (Q), veh/ln (95th percentile)	0.1	7.4	7.4	0.3	6.3		4.4	2.3			0.7	
Queue Storage Ratio (RQ) (95th percentile)	0.02	0.15	0.15	0.07	0.05	0.00	1.12	0.12			0.03	
Uniform Delay (d_1), s/veh	4.7	3.6	3.7	5.9	4.5		52.8	47.0			46.0	
Incremental Delay (d_2), s/veh	0.0	1.5	1.6	0.4	0.3	0.0	2.3	0.9			0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	
Control Delay (d), s/veh	4.7	5.1	5.2	6.3	4.9		55.1	47.9			46.1	
Level of Service (LOS)	A	A	A	A	A		E	D			D	

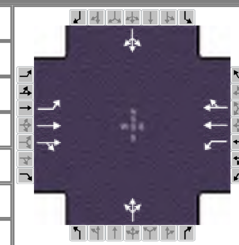
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	5.2	A	4.9	A	52.5	D	46.1	D
Intersection Delay, s/veh / LOS	7.5				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	1.3	A	0.7	A	0.5	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:21:35 PM

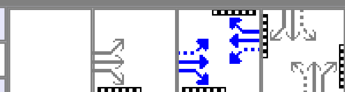
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				

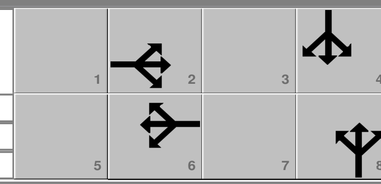


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	38	674	25	13	1175	57	13	6	6	25	6	13

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	93	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.1	92.9	5.7	0.0	0.0	0.0
Yellow	3.0	3.6	3.6	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



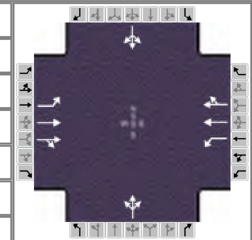
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		6.3		8.0		8.0
Phase Duration, s	6.1	104.7		98.5		11.3		11.3
Change Period, ($Y+R_c$), s	3.0	5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s	4.1	0.0		0.0		4.2		4.2
Queue Clearance Time (g_s), s	2.5					4.1		5.9
Green Extension Time (g_e), s	0.1	0.0		0.0		0.2		0.2
Phase Call Probability	0.78					0.94		0.94
Max Out Probability	0.00					0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	48	440	434	16	773	765		31			55	
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1676	608	1698	1670		1589			1568	
Queue Service Time (g_s), s	0.5	5.0	5.0	0.7	19.5	19.8		0.0			1.8	
Cycle Queue Clearance Time (g_c), s	0.5	5.0	5.0	0.7	19.5	19.8		2.1			3.9	
Green Ratio (g/C)	0.85	0.85	0.85	0.80	0.80	0.80		0.05			0.05	
Capacity (c), veh/h	309	1450	1432	549	1361	1338		126			126	
Volume-to-Capacity Ratio (X)	0.154	0.303	0.303	0.030	0.568	0.572		0.249			0.436	
Available Capacity (c_a), veh/h	637	1450	1432	549	1361	1338		365			362	
Back of Queue (Q), veh/ln (95th percentile)	0.3	1.7	1.7	0.1	8.8	8.8		1.7			3.0	
Queue Storage Ratio (RQ) (95th percentile)	0.09	0.04	0.04	0.03	0.17	0.17		0.08			0.15	
Uniform Delay (d_1), s/veh	4.0	1.4	1.4	2.5	4.3	4.3		53.4			54.2	
Incremental Delay (d_2), s/veh	0.2	0.5	0.5	0.1	1.4	1.5		1.0			2.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	4.2	1.8	1.8	2.6	5.7	5.8		54.4			56.5	
Level of Service (LOS)	A	A	A	A	A	A		D			E	
Approach Delay, s/veh / LOS	2.0	A		5.7	A		54.4	D		56.5	E	
Intersection Delay, s/veh / LOS	6.1						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	1.8	A	0.5	A	0.6	A

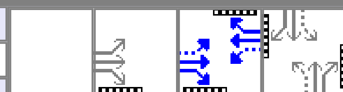
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

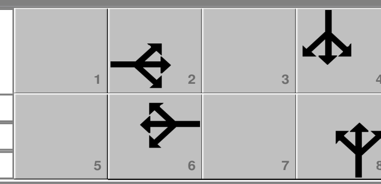


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	109	1404	70	12	925	86	38	4	22	109	4	55

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	98	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.3	80.4	17.2	0.0	0.0	0.0
Yellow	3.0	3.6	3.6	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



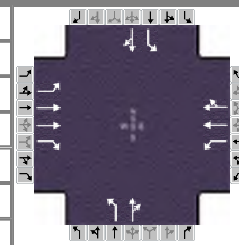
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		6.3		8.0		8.0
Phase Duration, s	7.3	93.2		86.0		22.8		22.8
Change Period, ($Y+R_c$), s	3.0	5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.1	0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s	4.1					7.0		16.6
Green Extension Time (g_e), s	0.3	0.0		0.0		0.8		0.6
Phase Call Probability	0.97					1.00		1.00
Max Out Probability	0.00					0.00		0.07

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	111	755	746	13	552	535		69			181	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1669	335	1698	1647		1373			1406	
Queue Service Time (g_s), s	2.1	12.4	12.0	1.5	14.9	15.1		0.0			9.6	
Cycle Queue Clearance Time (g_c), s	2.1	12.4	12.0	6.6	14.9	15.1		5.0			14.6	
Green Ratio (*g/C*)	0.75	0.76	0.76	0.69	0.69	0.69		0.15			0.15	
Capacity (*c*), veh/h	402	1283	1261	280	1177	1141		253			259	
Volume-to-Capacity Ratio (*X*)	0.276	0.588	0.591	0.046	0.469	0.469		0.272			0.697	
Available Capacity (c_a), veh/h	639	1283	1261	280	1177	1141		353			360	
Back of Queue (*Q*), veh/ln (95th percentile)	1.2	4.5	4.3	0.2	8.2	8.1		3.3			9.1	
Queue Storage Ratio (*RQ*) (95th percentile)	0.30	0.11	0.11	0.06	0.16	0.16		0.17			0.46	
Uniform Delay (d_1), s/veh	5.8	2.3	2.2	6.7	6.5	6.6		44.1			48.4	
Incremental Delay (d_2), s/veh	0.2	1.1	1.2	0.3	1.2	1.3		0.6			3.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	6.0	3.5	3.4	7.0	7.8	7.9		44.7			51.8	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	3.6	A		7.8	A		44.7	D		51.8	D	
Intersection Delay, s/veh / LOS	9.1						A					

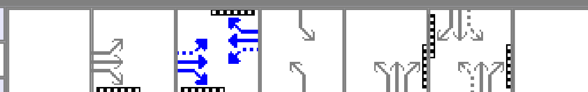
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.9	A	1.4	A	0.6	A	0.8	A

HCS 2010 Signalized Intersection Results Summary

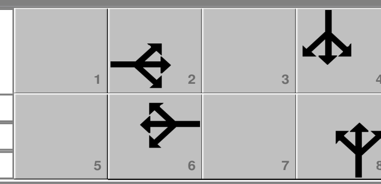
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Cleveland Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	164	666	75	13	1138	50	225	201	14	57	113	215



Signal Information											
Cycle, s	116.0	Reference Phase	2								
Offset, s	103	Reference Point	Begin	Green	11.1	48.4	5.3	5.7	25.3	0.0	
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	3.6	3.0	3.0	3.6	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	2.0	0.0	0.0	2.0	0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	1.0	3.0		6.3	1.1	4.0	1.1	4.0
Phase Duration, s	14.1	68.1		54.0	17.0	39.6	8.3	30.9
Change Period, ($Y+R_c$), s	3.0	5.6		5.6	3.0	5.6	3.0	5.6
Max Allow Headway (MAH), s	4.2	0.0		0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	12.3				16.0	16.5	5.8	24.9
Green Extension Time (g_e), s	0.0	0.0		0.0	0.0	2.2	0.1	0.4
Phase Call Probability	1.00				1.00	1.00	0.90	1.00
Max Out Probability	1.00				1.00	0.01	0.01	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	205	833	71	16	745	737	281	263		71	323	
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1617	1439	632	1698	1673	1681	1751		1681	1603	
Queue Service Time (g_s), s	10.3	15.3	1.2	1.6	48.4	48.4	14.0	14.5		3.8	22.9	
Cycle Queue Clearance Time (g_c), s	10.3	15.3	1.2	2.9	48.4	48.4	14.0	14.5		3.8	22.9	
Green Ratio (g/C)	0.53	0.54	0.54	0.42	0.42	0.42	0.36	0.29		0.26	0.22	
Capacity (c), veh/h	217	1743	776	319	709	698	287	513		307	349	
Volume-to-Capacity Ratio (X)	0.944	0.478	0.092	0.051	1.052	1.056	0.980	0.511		0.232	0.923	
Available Capacity (c_a), veh/h	217	1743	776	319	709	698	287	530		433	365	
Back of Queue (Q), veh/ln (95th percentile)	13.4	8.3	0.7	0.5	35.8	35.8	14.9	10.4		2.8	17.3	
Queue Storage Ratio (RQ) (95th percentile)	2.81	0.31	0.15	0.12	0.89	0.89	3.80	0.29		1.45	0.44	
Uniform Delay (d_1), s/veh	39.5	12.2	5.4	18.9	30.5	30.5	33.2	34.1		33.1	44.4	
Incremental Delay (d_2), s/veh	39.8	0.8	0.2	0.2	44.7	46.3	47.5	0.8		0.4	28.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	79.3	13.0	5.6	19.1	75.2	76.8	80.7	34.9		33.5	72.5	
Level of Service (LOS)	E	B	A	B	F	F	F	C		C	E	
Approach Delay, s/veh / LOS	24.8	C		75.4	E		58.6	E		65.4	E	
Intersection Delay, s/veh / LOS	55.9						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.4	B	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.4	A	1.7	A	1.4	A	1.1	A

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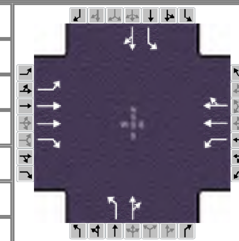
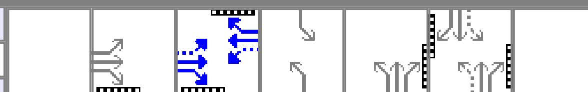
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cleveland Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

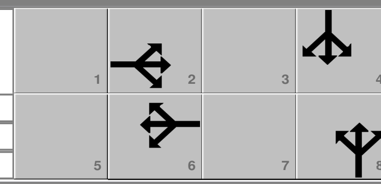


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	232	1405	201	33	915	70	152	186	43	135	179	169

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	95	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	10.8	50.9	9.6	1.0	26.6	0.0
Yellow	3.0	3.6	3.0	0.0	3.6	0.0
Red	0.0	2.0	0.0	0.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	1.0	3.0		6.3	1.1	4.0	1.1	4.0
Phase Duration, s	13.8	70.3		56.5	13.5	33.2	12.6	32.2
Change Period, (Y+R_c), s	3.0	5.6		5.6	3.0	5.6	3.0	5.6
Max Allow Headway (MAH), s	4.2	0.0		0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	10.4				10.5	16.2	9.5	25.8
Green Extension Time (g_e), s	0.5	0.0		0.0	0.1	1.9	0.1	0.8
Phase Call Probability	1.00				0.99	1.00	0.99	1.00
Max Out Probability	0.18				1.00	0.04	1.00	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	234	1420	179	35	533	521	163	238		145	344	
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1617	1439	362	1698	1658	1681	1716		1681	1635	
Queue Service Time (g_s), s	8.4	37.5	3.6	7.1	25.4	25.4	8.5	14.2		7.5	23.8	
Cycle Queue Clearance Time (g_c), s	8.4	37.5	3.6	32.6	25.4	25.4	8.5	14.2		7.5	23.8	
Green Ratio (g/C)	0.55	0.56	0.56	0.44	0.44	0.44	0.32	0.24		0.31	0.23	
Capacity (c), veh/h	325	1803	803	147	745	727	239	408		312	375	
Volume-to-Capacity Ratio (X)	0.721	0.787	0.223	0.241	0.716	0.716	0.684	0.583		0.466	0.918	
Available Capacity (c_a), veh/h	416	1803	803	147	745	727	260	441		347	407	
Back of Queue (Q), veh/ln (95th percentile)	4.5	14.1	1.5	1.5	13.6	13.4	7.0	10.2		5.7	17.8	
Queue Storage Ratio (RQ) (95th percentile)	0.95	0.53	0.31	0.40	0.34	0.33	1.77	0.29		2.88	0.45	
Uniform Delay (d_1), s/veh	22.3	16.5	5.7	28.5	18.0	17.9	32.6	39.1		31.2	43.6	
Incremental Delay (d_2), s/veh	0.4	0.3	0.1	3.4	5.1	5.2	6.5	1.7		1.1	24.5	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	22.7	16.9	5.8	31.8	23.1	23.1	39.0	40.8		32.3	68.1	
Level of Service (LOS)	C	B	A	C	C	C	D	D		C	E	
Approach Delay, s/veh / LOS	16.5	B		23.4	C		40.1	D		57.5	E	
Intersection Delay, s/veh / LOS	26.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	2.1	B	1.4	A	1.1	A	1.3	A

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TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: 10th St & Blaine Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Blaine Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		899	25		1578	
Peak-Hour Factor, PHF		0.80	0.80		0.80	
Hourly Flow Rate, HFR		1123	31		1972	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			6			
Peak Hour Factor, PHF			0.80			
Hourly Flow Rate, HFR			7			
Percent Heavy Vehicles			2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					7			
C(m) (vph)					626			
v/c					0.01			
95% queue length					0.03			
Control Delay					10.8			
LOS					B			
Approach Delay				10.8				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: 10th St & Blaine Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Blaine Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		899	25		1578	
Peak-Hour Factor, PHF		0.80	0.80		0.80	
Peak-15 Minute Volume		281	8		493	
Hourly Flow Rate, HFR		1123	31		1972	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			6			
Peak Hour Factor, PHF			0.80			
Peak-15 Minute Volume			2			
Hourly Flow Rate, HFR			7			
Percent Heavy Vehicles			2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?			No			
Lanes			1			
Configuration			R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	375
	Through	428	1800	4	35	116	30	375
S5	Left-Turn	0	1800	3	0	116	30	325
	Through	1138	1800	4	48	116	30	325

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)						6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)						2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)						0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage					6.2			
	2-stage					6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					2			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	428	0	1138	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	35	0	48	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.402	0.000	0.552	0.000
g(q1)	8.2	0.0	16.4	0.0
g(q2)	1.6	0.0	12.0	0.0
g(q)	9.8	0.0	28.4	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.400		0.400	
beta	0.714		0.714	
Travel time, t(a) (sec)	8.503		7.370	
Smoothing Factor, F	0.292		0.322	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3477	0	3600	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	9.5	0.0	30.1	0.0
Proportion time blocked, p	0.082		0.259	

Computation 3-Platoon Event Periods	Result
p(2)	0.082
p(5)	0.259
p(dom)	0.259
p(subo)	0.082
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	0.918		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					577			
s					3000			
Px					0.918			
V c,u,x					361			
C r,x					682			
C plat,x					626			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	577	
Potential Capacity	626	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	626	
Probability of Queue free St.	0.99	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	306	122
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	306	122
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	122	300
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	122	300

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	305	113
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	305	113

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	553	639
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity	553	632

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			7			
Movement Capacity (vph)			626			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			626			
Volume			7			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					7			
C(m) (vph)					626			
v/c					0.01			
95% queue length					0.03			
Control Delay					10.8			
LOS					B			
Approach Delay				10.8				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

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_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/13/2013
Analysis Time Period: PM Peak
Intersection:         10th St & Blaine Ave
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2013
Project ID:  I-229 MIS - 10th St Corridor
East/West Street:     10th St
North/South Street:   Blaine Ave
Intersection Orientation: EW                 Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach       Eastbound              Westbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                             1834   50             1236
Peak-Hour Factor, PHF              0.93   0.93           0.93
Hourly Flow Rate, HFR              1972   53             1329
Percent Heavy Vehicles             --     --             --     --
Median Type/Storage         Raised curb         / 1
RT Channelized?
Lanes                              2    0                2
Configuration                      T   TR                T
Upstream Signal?                   Yes                   Yes
______________________________________________________________________________
Minor Street:  Approach       Northbound             Southbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                    4
Peak Hour Factor, PHF                     0.93
Hourly Flow Rate, HFR                     4
Percent Heavy Vehicles                    2
Percent Grade (%)                  0                     0
Flared Approach:  Exists?/Storage                /                      /
Lanes                                   1
Configuration                          R
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach            EB     WB         Northbound             Southbound
Movement            1      4   |  7      8      9    |  10     11     12
Lane Config                    |                R    |
______________________________________________________________________________
v (vph)                                         4
C(m) (vph)                                      561
v/c                                             0.01
95% queue length                                0.02
Control Delay                                   11.5
LOS                                              B
Approach Delay                           11.5
Approach LOS                              B
______________________________________________________________________________
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Phone:                                       Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_______________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/13/2013
Analysis Time Period: PM Peak
Intersection:         10th St & Blaine Ave
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2013
Project ID:  I-229 MIS - 10th St Corridor
East/West Street:     10th St
North/South Street:   Blaine Ave
Intersection Orientation: EW                Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments__________________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R
________________________________________________________________________________
Volume                            1834   50            1236
Peak-Hour Factor, PHF             0.93   0.93          0.93
Peak-15 Minute Volume             493    13            332
Hourly Flow Rate, HFR             1972   53            1329
Percent Heavy Vehicles            --     --            --     --
Median Type/Storage        Raised curb          / 1
RT Channelized?
Lanes                             2    0               2
Configuration                     T   TR               T
Upstream Signal?                  Yes                  Yes
________________________________________________________________________________
Minor Street Movements      7      8      9      10     11     12
                            L      T      R      L      T      R
________________________________________________________________________________
Volume                                   4
Peak Hour Factor, PHF                    0.93
Peak-15 Minute Volume                    1
Hourly Flow Rate, HFR                    4
Percent Heavy Vehicles                   2
Percent Grade (%)                 0                    0
Flared Approach:  Exists?/Storage               /                      /
RT Channelized?                          No
Lanes                                 1
Configuration                        R
________________________________________________________________________________

______________________Pedestrian Volumes and Adjustments_________________________
Movements                    13     14     15     16
________________________________________________________________________________
Flow (ped/hr)                0      0      0      0
```

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	375
	Through	991	1800	4	34	116	30	375
S5	Left-Turn	0	1800	3	0	116	30	325
	Through	915	1800	4	49	116	30	325

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)						6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)						2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)						0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage					6.2			
	2-stage					6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					2			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	991	0	915	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	34	0	49	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.391	0.000	0.563	0.000
g(q1)	19.5	0.0	12.9	0.0
g(q2)	11.3	0.0	6.6	0.0
g(q)	30.7	0.0	19.5	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.400		0.400	
beta	0.714		0.714	
Travel time, t(a) (sec)	8.503		7.370	
Smoothing Factor, F	0.292		0.322	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3600	0	3598	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	31.6	0.0	20.3	0.0
Proportion time blocked, p	0.273		0.175	

Computation 3-Platoon Event Periods	Result
p(2)	0.273
p(5)	0.175
p(dom)	0.273
p(subo)	0.175
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	0.727		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					1012			
s					3000			
Px					0.727			
V c,u,x					266			
C r,x					771			
C plat,x					561			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	1012	
Potential Capacity	561	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	561	
Probability of Queue free St.	0.99	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	119	274
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	119	274
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	274	113
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	274	113

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	109	273
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	109	273

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	701	576
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity	701	572

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			4			
Movement Capacity (vph)			561			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			561			
Volume			4			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

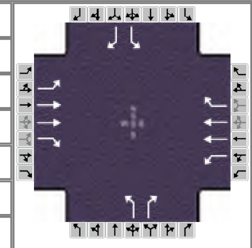
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					4			
C(m) (vph)					561			
v/c					0.01			
95% queue length					0.02			
Control Delay					11.5			
LOS					B			
Approach Delay				11.5				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

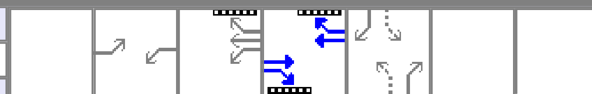
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & I-229 SPUI	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				

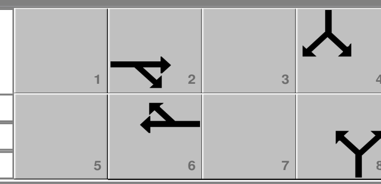


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	119	428	252	377	755	446	245		321	175		290

Signal Information				
Cycle, s	116.0	Reference Phase	6
Offset, s	104	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.8	13.6	33.6	24.4	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	4.5	4.5	4.5	3.7	0.0	0.0



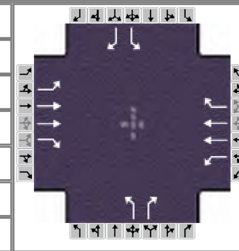
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	20.9	41.7	42.6	63.4		31.7		31.7
Change Period, ($Y+R_c$), s	8.1	8.1	8.1	8.1		7.3		7.3
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.0		4.0
Queue Clearance Time (g_s), s	12.5		33.8			23.4		16.3
Green Extension Time (g_e), s	0.4	0.0	0.6	0.0		1.0		1.5
Phase Call Probability	0.99		1.00			1.00		1.00
Max Out Probability	0.00		1.00			0.39		0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	149	535	0	447	895	0	306		0	219		0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service Time (g_s), s	10.5	14.1	0.0	31.8	27.3	0.0	21.4		0.0	14.3		0.0
Cycle Queue Clearance Time (g_c), s	10.5	14.1	0.0	31.8	27.3	0.0	21.4		0.0	14.3		0.0
Green Ratio (g/C)	0.11	0.29	0.29	0.30	0.48	0.48	0.21		0.21	0.21		0.21
Capacity (*c*), veh/h	178	937	417	480	1541	686	403		303	403		303
Volume-to-Capacity Ratio (*X*)	0.836	0.571	0.000	0.930	0.580	0.000	0.760		0.000	0.543		0.000
Available Capacity (c_a), veh/h	365	937	417	518	1541	686	476		368	476		368
Back of Queue (*Q*), veh/ln (95th percentile)	8.3	8.5	0.0	16.2	13.0	0.0	13.9		0.0	9.6		0.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.67	0.36	0.00	1.31	0.49	0.00	0.36		0.00	0.25		0.00
Uniform Delay (d_1), s/veh	51.8	26.1	0.0	51.9	31.0	0.0	44.6		0.0	41.8		0.0
Incremental Delay (d_2), s/veh	9.3	2.4	0.0	3.2	0.1	0.0	5.9		0.0	1.1		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0
Control Delay (*d*), s/veh	61.2	28.5	0.0	55.1	31.2	0.0	50.5		0.0	42.9		0.0
Level of Service (LOS)	E	C		E	C		D			D		
Approach Delay, s/veh / LOS	35.6	D		39.1	D		50.5	D		42.9	D	
Intersection Delay, s/veh / LOS	39.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.7	B	3.6	D	3.3	C
Bicycle LOS Score / LOS	1.1	A	1.7	A		F		F

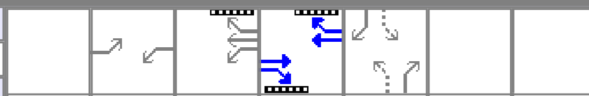
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 SPUI	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

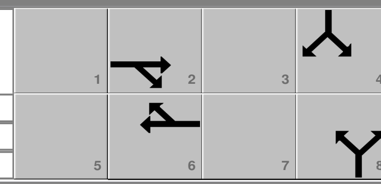


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	224	991	288	365	658	213	164		490	403		169

Signal Information			
Cycle, s	116.0	Reference Phase	6
Offset, s	100	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	19.6	6.2	33.9	32.8	0.0	0.0
Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Red	4.5	0.0	4.5	3.7	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	27.7	42.0	33.9	48.2		40.1		40.1
Change Period, (Y+R_c), s	8.1	8.1	8.1	8.1		7.3		7.3
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0		4.0		4.0
Queue Clearance Time (g_s), s	19.2		27.8			12.2		32.5
Green Extension Time (g_e), s	0.4	0.0	0.0	0.0		2.1		0.3
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.42		1.00			0.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (v), veh/h	241	1066	0	392	708	0	176		0	433		0
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service Time (g_s), s	17.2	33.9	0.0	25.8	22.3	0.0	10.2		0.0	30.5		0.0
Cycle Queue Clearance Time (g_c), s	17.2	33.9	0.0	25.8	22.3	0.0	10.2		0.0	30.5		0.0
Green Ratio (g/C)	0.17	0.29	0.29	0.22	0.35	0.35	0.28		0.28	0.28		0.28
Capacity (c), veh/h	273	945	421	360	1118	498	519		407	519		407
Volume-to-Capacity Ratio (X)	0.882	1.128	0.000	1.091	0.633	0.000	0.340		0.000	0.834		0.000
Available Capacity (c_a), veh/h	346	945	421	360	1118	498	532		418	532		418
Back of Queue (Q), veh/ln (95th percentile)	13.0	30.5	0.0	24.2	13.2	0.0	7.1		0.0	19.2		0.0
Queue Storage Ratio (RQ) (95th percentile)	1.05	1.28	0.00	1.95	0.49	0.00	0.19		0.00	0.50		0.00
Uniform Delay (d_1), s/veh	54.8	37.6	0.0	54.2	35.7	0.0	33.5		0.0	40.8		0.0
Incremental Delay (d_2), s/veh	15.4	68.4	0.0	64.0	1.7	0.0	0.4		0.0	10.8		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0
Control Delay (d), s/veh	70.2	105.9	0.0	118.2	37.3	0.0	33.9		0.0	51.6		0.0
Level of Service (LOS)	E	F		F	D		C			D		
Approach Delay, s/veh / LOS	99.4	F		66.2	E		33.9	C		51.6	D	
Intersection Delay, s/veh / LOS	76.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.5	B	3.3	C	3.4	C
Bicycle LOS Score / LOS	1.6	A	1.4	A		F		F

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:21:35 PM

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: 10th St & Conklin Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Conklin Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		429	6		1284	6
Peak-Hour Factor, PHF		0.80	0.80		0.80	0.80
Hourly Flow Rate, HFR		536	7		1604	7
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0		2	0
Configuration		T	TR		T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume			75			6
Peak Hour Factor, PHF			0.80			0.80
Hourly Flow Rate, HFR			93			7
Percent Heavy Vehicles			2			2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes			1			1
Configuration			R			R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					93			7
C(m) (vph)					765			480
v/c					0.12			0.01
95% queue length					0.41			0.04
Control Delay					10.4			12.6
LOS					B			B
Approach Delay				10.4			12.6	
Approach LOS				B			B	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: 10th St & Conklin Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Conklin Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		429	6		1284	6
Peak-Hour Factor, PHF		0.80	0.80		0.80	0.80
Peak-15 Minute Volume		134	2		401	2
Hourly Flow Rate, HFR		536	7		1604	7
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0		2	0
Configuration		T	TR		T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12	
	L	T	R	L	T	R	
Volume			75			6	
Peak Hour Factor, PHF			0.80			0.80	
Peak-15 Minute Volume			23			2	
Hourly Flow Rate, HFR			93			7	
Percent Heavy Vehicles			2			2	
Percent Grade (%)		0			0		
Flared Approach: Exists?/Storage				/			/
RT Channelized?			No			No	
Lanes			1			1	
Configuration			R			R	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	325
	Through	380	1800	4	85	116	30	325
S5	Left-Turn	0	1800	3	0	116	30	300
	Through	755	1800	4	56	116	30	300

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)						6.2			6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)						2			2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)						0.00			0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage					6.2			6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					2			2
t(f)					3.3			3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	380	0	755	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	85	0	56	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.977	0.000	0.644	0.000
g(q1)	0.3	0.0	8.7	0.0
g(q2)	0.0	0.0	3.4	0.0
g(q)	0.3	0.0	12.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	7.370		6.803	
Smoothing Factor, F	0.289		0.306	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	381	0	3556	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	12.4	0.0
Proportion time blocked, p	0.000		0.107	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.107
p(dom)	0.107
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	1.000		
p(10)			
p(11)			
p(12)	0.893		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					272			806
s					3000			3000
Px					1.000			0.893
V c,u,x					272			544
C r,x					765			537
C plat,x					765			480

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	272	806
Potential Capacity	765	480
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	765	480
Probability of Queue free St.	0.88	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	1.00
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.88
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	1.00
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.88
Movement Capacity		
Results for Two-stage process:		
a		
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			93			7
Movement Capacity (vph)			765			480
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep			765			480
Volume			93			7
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					93			7
C(m) (vph)					765			480
v/c					0.12			0.01
95% queue length					0.41			0.04
Control Delay					10.4			12.6
LOS					B			B
Approach Delay				10.4			12.6	
Approach LOS				B			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

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                 HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/13/2013
Analysis Time Period: PM Peak
Intersection:         10th St & Conklin Ave
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2013
Project ID:  I-229 MIS - 10th St Corridor
East/West Street:     10th St
North/South Street:   Conklin Ave
Intersection Orientation: EW                Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach        Eastbound              Westbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                             756    21                 979    12
Peak-Hour Factor, PHF              0.93   0.93               0.93   0.93
Hourly Flow Rate, HFR              812    22                 1052   12
Percent Heavy Vehicles             --     --                 --     --
Median Type/Storage         Raised curb          / 1
RT Channelized?
Lanes                              2    0                    2    0
Configuration                      T   TR                    T   TR
Upstream Signal?                   Yes                       Yes
______________________________________________________________________________
Minor Street:  Approach        Northbound             Southbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                    55                        11
Peak Hour Factor, PHF                     0.93                      0.93
Hourly Flow Rate, HFR                     59                        11
Percent Heavy Vehicles                    2                         2
Percent Grade (%)                  0                         0
Flared Approach:  Exists?/Storage              /                      /
Lanes                                   1                      1
Configuration                          R                      R
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach             EB     WB         Northbound           Southbound
Movement             1      4    |  7      8      9    |  10     11     12
Lane Config                      |                R    |                R
______________________________________________________________________________
v (vph)                                           59                    11
C(m) (vph)                                        634                   757
v/c                                               0.09                  0.01
95% queue length                                  0.31                  0.04
Control Delay                                     11.3                  9.8
LOS                                                B                     A
Approach Delay                             11.3                9.8
Approach LOS                                B                   A
______________________________________________________________________________
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HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: 10th St & Conklin Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2013
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Conklin Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		756	21		979	12
Peak-Hour Factor, PHF		0.93	0.93		0.93	0.93
Peak-15 Minute Volume		203	6		263	3
Hourly Flow Rate, HFR		812	22		1052	12
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						
Lanes		2	0		2	0
Configuration		T	TR		T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			55			11
Peak Hour Factor, PHF			0.93			0.93
Peak-15 Minute Volume			15			3
Hourly Flow Rate, HFR			59			11
Percent Heavy Vehicles			2			2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			No
Lanes			1			1
Configuration			R			R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	325
	Through	702	1800	4	83	116	30	325
S5	Left-Turn	0	1800	3	0	116	30	300
	Through	658	1800	4	42	116	30	300

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)						6.2			6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)						2			2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)						0.00			0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage					6.2			6.2
	2-stage					6.2			6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					2			2
t(f)					3.3			3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	702	0	658	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	83	0	42	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.954	0.000	0.483	0.000
g(q1)	1.0	0.0	11.0	0.0
g(q2)	0.4	0.0	3.5	0.0
g(q)	1.4	0.0	14.5	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.400		0.400	
beta	0.714		0.714	
Travel time, t(a) (sec)	7.370		6.803	
Smoothing Factor, F	0.322		0.340	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	1515	0	3591	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	14.7	0.0
Proportion time blocked, p	0.000		0.126	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.126
p(dom)	0.126
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	1.000		
p(10)			
p(11)			
p(12)	0.874		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					417			532
s					3000			3000
Px					1.000			0.874
V c,u,x					417			175
C r,x					634			867
C plat,x					634			757

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	417	532
Potential Capacity	634	757
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	634	757
Probability of Queue free St.	0.91	0.99

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	1.00
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.91
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	391	358
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	391	358
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	356	386
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	356	386

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	338	314
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	338	314

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	719	598
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.91
Movement Capacity	709	542

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	1.00
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.91
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			59			11
Movement Capacity (vph)			634			757
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			634			757
Volume			59			11
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

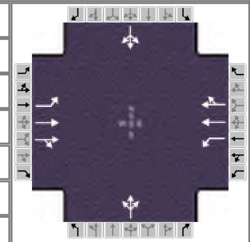
Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					59			11
C(m) (vph)					634			757
v/c					0.09			0.01
95% queue length					0.31			0.04
Control Delay					11.3			9.8
LOS					B			A
Approach Delay				11.3			9.8	
Approach LOS				B			A	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

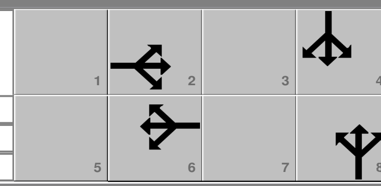
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Lowell Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	6	642	8	38	1208	44	6	19	25	63	19	31

Signal Information										
Cycle, s	116.0	Reference Phase	6	Green	3.1	85.1	13.7	0.0	0.0	0.0
Offset, s	102	Reference Point	Begin	Yellow	3.0	3.6	3.5	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Red	0.0	2.0	2.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On							



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		90.7	6.1	96.8		19.2		19.2
Change Period, ($Y+R_c$), s		5.6	3.0	5.6		5.5		5.5
Max Allow Headway (MAH), s		0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s			2.8			6.1		13.2
Green Extension Time (g_e), s		0.0	0.1	0.0		0.6		0.5
Phase Call Probability			0.77			1.00		1.00
Max Out Probability			0.00			0.00		0.01

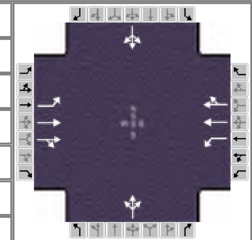
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	8	407	405	46	762	755		63			141	
Adjusted Saturation Flow Rate (s), veh/h/ln	330	1698	1691	1617	1698	1677		1627			1438	
Queue Service Time (g_s), s	1.0	10.7	10.7	0.8	14.1	13.8		0.0			7.0	
Cycle Queue Clearance Time (g_c), s	9.0	10.7	10.7	0.8	14.1	13.8		4.1			11.2	
Green Ratio (g/C)	0.73	0.73	0.73	0.78	0.79	0.79		0.12			0.12	
Capacity (c), veh/h	281	1246	1241	518	1336	1319		226			218	
Volume-to-Capacity Ratio (X)	0.027	0.327	0.327	0.089	0.571	0.573		0.276			0.649	
Available Capacity (c_a), veh/h	281	1246	1241	738	1336	1319		372			352	
Back of Queue (Q), veh/ln (95th percentile)	0.2	6.7	6.7	0.4	5.8	5.6		3.1			7.5	
Queue Storage Ratio (RQ) (95th percentile)	0.03	0.11	0.11	0.20	0.24	0.23		0.08			0.19	
Uniform Delay (d_1), s/veh	7.7	6.1	6.2	3.8	2.7	2.6		47.0			50.0	
Incremental Delay (d_2), s/veh	0.2	0.7	0.7	0.1	1.3	1.3		0.7			3.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	7.9	6.8	6.8	3.9	4.0	3.9		47.6			53.3	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	6.8		A	3.9		A	47.6		D	53.3		D
Intersection Delay, s/veh / LOS	8.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	1.8	A	0.6	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:16:38 PM

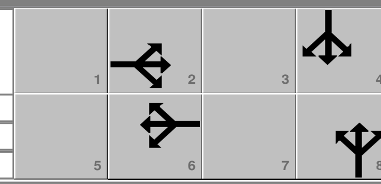
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Lowell Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	33	1344	21	104	843	43	12	16	28	97	26	12

Signal Information										
Cycle, s	116.0	Reference Phase	6							
Offset, s	72	Reference Point	Begin	Green	4.1	83.3	14.5	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	3.6	3.5	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		88.9	7.1	96.0		20.0		20.0
Change Period, ($Y+R_c$), s		5.6	3.0	5.6		5.5		5.5
Max Allow Headway (MAH), s		0.0	4.2	0.0		4.2		4.2
Queue Clearance Time (g_s), s			3.9			5.9		14.0
Green Extension Time (g_e), s		0.0	0.3	0.0		0.6		0.5
Phase Call Probability			0.97			1.00		1.00
Max Out Probability			0.00			0.00		0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	35	735	732	112	481	472		60			145	
Adjusted Saturation Flow Rate (s), veh/h/ln	564	1698	1689	1617	1698	1669		1612			1379	
Queue Service Time (g_s), s	1.8	21.2	21.2	1.9	9.2	8.8		0.0			8.1	
Cycle Queue Clearance Time (g_c), s	4.0	21.2	21.2	1.9	9.2	8.8		3.9			12.0	
Green Ratio (g/C)	0.72	0.72	0.72	0.77	0.78	0.78		0.13			0.13	
Capacity (c), veh/h	457	1219	1213	304	1323	1300		239			226	
Volume-to-Capacity Ratio (X)	0.078	0.603	0.604	0.368	0.363	0.363		0.251			0.642	
Available Capacity (c_a), veh/h	457	1219	1213	553	1323	1300		371			349	
Back of Queue (Q), veh/ln (95th percentile)	0.4	10.1	10.1	1.2	4.8	4.5		2.9			7.7	
Queue Storage Ratio (RQ) (95th percentile)	0.09	0.16	0.16	0.63	0.20	0.19		0.07			0.20	
Uniform Delay (d_1), s/veh	4.2	6.0	6.0	7.0	3.5	3.3		46.1			49.8	
Incremental Delay (d_2), s/veh	0.3	1.9	1.9	0.6	0.6	0.6		0.5			3.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	4.4	7.9	7.9	7.6	4.1	3.9		46.6			52.8	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	7.8		A	4.4		A	46.6		D	52.8		D
Intersection Delay, s/veh / LOS	9.7						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.7	A	1.4	A	0.6	A	0.7	A

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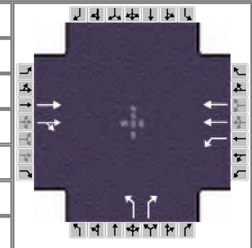
HCS 2010 Signalized Intersection Results Summary

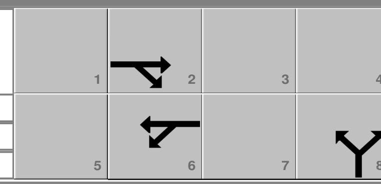
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Jessica Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		618	24	13	1232		63		38			

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	46	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	97.2	7.6	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		6.0		9.0		
Phase Duration, s		102.8		102.8		13.2		
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		
Queue Clearance Time (g_s), s						7.3		
Green Extension Time (g_e), s		0.0		0.0		0.5		
Phase Call Probability						0.98		
Max Out Probability						0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		404	399	16	1495		79		48			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1675	650	1617		1681		1496			
Queue Service Time (g_s), s		17.3	4.7	0.3	5.4		5.3		3.6			
Cycle Queue Clearance Time (g_c), s		17.3	4.7	18.0	5.4		5.3		3.6			
Green Ratio (*g/C*)		0.84	0.84	0.84	0.84		0.07		0.07			
Capacity (*c*), veh/h		1422	1403	509	2708		111		99			
Volume-to-Capacity Ratio (*X*)		0.284	0.284	0.031	0.552		0.711		0.482			
Available Capacity (c_a), veh/h		1422	1403	509	2708		643		572			
Back of Queue (*Q*), veh/ln (95th percentile)		2.0	2.0	0.1	1.5		4.5		2.6			
Queue Storage Ratio (*RQ*) (95th percentile)		0.05	0.05	0.03	0.02		1.14		0.13			
Uniform Delay (d_1), s/veh		1.5	1.5	2.8	0.6		53.1		52.3			
Incremental Delay (d_2), s/veh		0.5	0.5	0.1	0.6		8.1		3.6			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		2.0	2.0	2.9	1.2		61.2		55.9			
Level of Service (LOS)		A	A	A	A		E		E			
Approach Delay, s/veh / LOS	2.0	A		1.2	A		59.2	E		0.0		
Intersection Delay, s/veh / LOS	4.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	2.9	C	2.7	B
Bicycle LOS Score / LOS	1.1	A	1.8	A		F		

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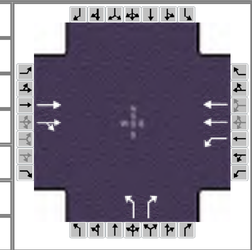
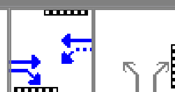
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Jessica Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

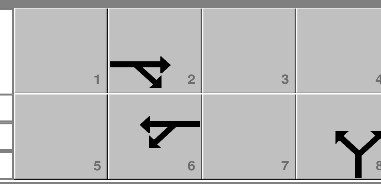


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1360	76	50	817		38		38			

Signal Information				
Cycle, s	116.0	Reference Phase	2	
Offset, s	37	Reference Point	Begin	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	



Green	99.8	5.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		6.0		9.0		
Phase Duration, s		105.4		105.4		10.6		
Change Period, (*Y+R*c), s		5.6		5.6		5.6		
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		
Queue Clearance Time (g_s), s						5.1		
Green Extension Time (g_e), s		0.0		0.0		0.2		
Phase Call Probability						0.93		
Max Out Probability						0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		777	767	54	878		41		41			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1666	321	1617		1681		1496			
Queue Service Time (g_s), s		31.9	14.3	10.8	6.7		2.8		3.1			
Cycle Queue Clearance Time (g_c), s		31.9	14.3	41.8	6.7		2.8		3.1			
Green Ratio (*g/C*)		0.86	0.86	0.86	0.86		0.04		0.04			
Capacity (*c*), veh/h		1462	1434	250	2783		72		64			
Volume-to-Capacity Ratio (*X*)		0.532	0.535	0.215	0.316		0.569		0.639			
Available Capacity (c_a), veh/h		1462	1434	250	2783		382		340			
Back of Queue (*Q*), veh/ln (95th percentile)		5.3	5.3	1.5	2.2		2.4		2.4			
Queue Storage Ratio (*RQ*) (95th percentile)		0.14	0.14	0.39	0.04		0.60		0.12			
Uniform Delay (d_1), s/veh		2.2	2.2	12.6	1.8		54.5		54.6			
Incremental Delay (d_2), s/veh		1.2	1.2	1.8	0.3		6.9		10.1			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		3.3	3.4	14.5	2.1		61.4		64.8			
Level of Service (LOS)		A	A	B	A		E		E			

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	3.4	A	2.8	A	63.1	E	0.0	
Intersection Delay, s/veh / LOS	5.1				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	2.9	C	2.7	B
Bicycle LOS Score / LOS	1.8	A	1.3	A		F		

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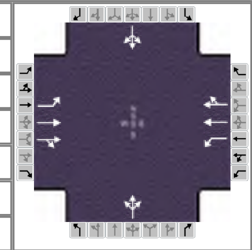
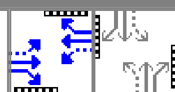
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Blauvelt Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				

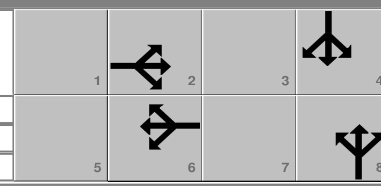


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	7	610	6	19	1257	19	6	6	13	19	6	13

Signal Information				
Cycle, s	116.0	Reference Phase	2	
Offset, s	47	Reference Point	Begin	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	



Green	99.7	5.1	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



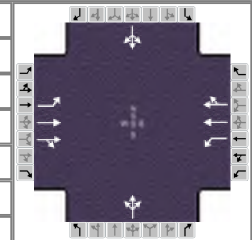
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		105.3		105.3		10.7		10.7
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						4.1		5.3
Green Extension Time (g_e), s		0.0		0.0		0.2		0.2
Phase Call Probability						0.92		0.92
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	9	386	384	23	776	774		31			48	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	320	1698	1692	670	1698	1689		1633			1584	
Queue Service Time (g_s), s	1.9	10.6	10.6	0.2	6.7	6.7		0.0			1.2	
Cycle Queue Clearance Time (g_c), s	8.2	10.6	10.6	11.2	6.7	6.7		2.1			3.3	
Green Ratio (g/C)	0.86	0.86	0.86	0.86	0.86	0.86		0.04			0.04	
Capacity (*c*), veh/h	318	1460	1455	577	1460	1452		110			116	
Volume-to-Capacity Ratio (*X*)	0.028	0.264	0.264	0.040	0.532	0.533		0.285			0.410	
Available Capacity (c_a), veh/h	318	1460	1455	577	1460	1452		363			361	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	7.5	7.5	0.1	2.1	2.1		1.7			2.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.05	0.15	0.15	0.02	0.06	0.06		0.09			0.13	
Uniform Delay (d_1), s/veh	6.5	4.4	4.5	1.1	0.7	0.7		54.1			54.6	
Incremental Delay (d_2), s/veh	0.1	0.4	0.4	0.1	1.1	1.1		1.4			2.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	6.7	4.8	4.9	1.2	1.9	1.9		55.5			56.9	
Level of Service (LOS)	A	A	A	A	A	A		E			E	
Approach Delay, s/veh / LOS	4.9	A		1.8	A		55.5	E		56.9	E	
Intersection Delay, s/veh / LOS	4.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.0	A	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	1.8	A	0.5	A	0.6	A

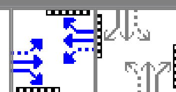
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Blauvelt Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

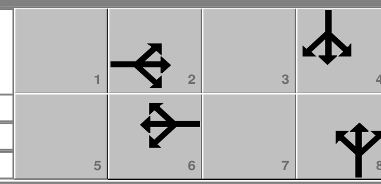


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	33	1376	27	22	806	27	12	4	27	33	12	21

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	28	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	97.5	7.3	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		103.1		103.1		12.9		12.9
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						5.2		7.1
Green Extension Time (g_e), s		0.0		0.0		0.3		0.3
Phase Call Probability						0.98		0.98
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	35	756	752	24	450	445		46			71	
Adjusted Saturation Flow Rate (s), veh/h/ln	596	1698	1686	333	1698	1678		1584			1547	
Queue Service Time (g_s), s	0.1	1.6	1.7	1.6	6.5	6.5		0.0			1.9	
Cycle Queue Clearance Time (g_c), s	7.1	1.6	1.7	3.2	6.5	6.5		3.2			5.1	
Green Ratio (g/C)	0.84	0.84	0.84	0.84	0.84	0.84		0.06			0.06	
Capacity (c), veh/h	529	1428	1418	337	1428	1411		139			143	
Volume-to-Capacity Ratio (X)	0.067	0.529	0.531	0.070	0.315	0.315		0.333			0.495	
Available Capacity (c_a), veh/h	529	1428	1418	337	1428	1411		357			360	
Back of Queue (Q), veh/ln (95th percentile)	0.1	1.0	1.0	0.2	2.8	2.8		2.4			3.8	
Queue Storage Ratio (RQ) (95th percentile)	0.01	0.02	0.02	0.05	0.07	0.07		0.12			0.20	
Uniform Delay (d_1), s/veh	0.5	0.2	0.2	1.9	1.9	1.9		52.5			53.3	
Incremental Delay (d_2), s/veh	0.2	0.9	1.0	0.4	0.6	0.6		1.4			2.6	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	0.6	1.1	1.1	2.3	2.5	2.5		53.9			55.9	
Level of Service (LOS)	A	A	A	A	A	A		D			E	
Approach Delay, s/veh / LOS	1.1		A	2.5		A	53.9		D	55.9		E
Intersection Delay, s/veh / LOS	4.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	1.2	A	0.6	A	0.6	A

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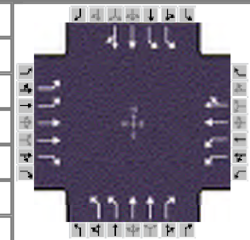
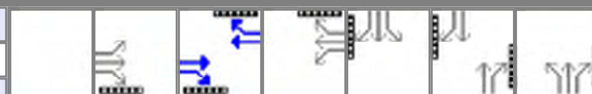
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Cliff Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				

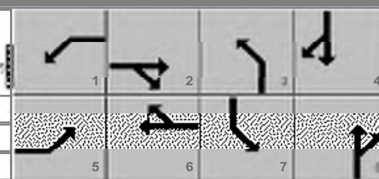


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	76	390	69	182	974	120	94	289	120	113	258	101

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	115	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.5	45.8	12.3	6.9	4.0	7.7
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	2.0	2.1	2.0	2.0	2.1	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	11.1	62.6	17.9	69.4	13.3	23.0	12.5	22.2
Change Period, ($Y+R_c$), s	5.6	5.7	5.7	5.7	5.7	5.7	5.6	5.7
Max Allow Headway (MAH), s	4.3	0.0	4.3	0.0	4.1	4.1	4.2	4.2
Queue Clearance Time (g_s), s	5.5		10.0		6.0	13.8	7.0	15.3
Green Extension Time (g_e), s	0.3	0.0	2.2	0.0	1.7	1.8	0.1	1.2
Phase Call Probability	0.95		1.00		0.98	1.00	0.99	1.00
Max Out Probability	0.00		1.00		0.01	0.01	1.00	0.01

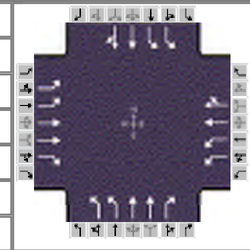
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	95	488	0	221	663	643	118	361	0	141	203	194
Adjusted Saturation Flow Rate (s), veh/h/ln	1570	1617	1439	1570	1698	1642	1616	1664	1481	1616	1748	1634
Queue Service Time (g_s), s	3.5	6.9	0.0	8.0	35.5	35.7	4.0	11.8	0.0	5.0	12.9	13.3
Cycle Queue Clearance Time (g_c), s	3.5	6.9	0.0	8.0	35.5	35.7	4.0	11.8	0.0	5.0	12.9	13.3
Green Ratio (g/C)	0.05	0.49	0.49	0.11	0.55	0.55	0.07	0.15	0.15	0.06	0.14	0.14
Capacity (c), veh/h	149	1586	706	330	932	902	212	495	220	194	249	233
Volume-to-Capacity Ratio (X)	0.638	0.307	0.000	0.670	0.711	0.714	0.555	0.730	0.000	0.730	0.817	0.836
Available Capacity (c_a), veh/h	542	1586	706	360	932	902	563	856	381	237	443	414
Back of Queue (Q), veh/ln (95th percentile)	2.8	4.3	0.0	6.3	21.4	21.0	3.0	8.4	0.0	4.0	9.7	9.5
Queue Storage Ratio (RQ) (95th percentile)	0.42	0.15	0.00	0.94	0.42	0.42	0.44	0.25	0.00	1.36	0.43	0.42
Uniform Delay (d_1), s/veh	57.0	10.2	0.0	52.7	22.5	22.5	51.3	44.3	0.0	52.5	45.5	45.7
Incremental Delay (d_2), s/veh	4.3	0.5	0.0	3.5	3.8	4.0	2.3	2.1	0.0	8.6	6.5	7.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	61.3	10.7	0.0	56.2	26.3	26.6	53.6	46.4	0.0	61.0	52.0	53.4
Level of Service (LOS)	E	B		E	C	C	D	D		E	D	D
Approach Delay, s/veh / LOS	18.9	B		30.7	C		48.2	D		54.9	D	
Intersection Delay, s/veh / LOS	35.4						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.0	A	1.8	A	0.9	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 10:59:40 AM

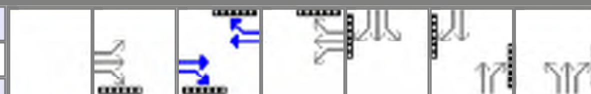
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency	HDR			Duration, h	0.25	
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other	
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93	
Intersection	10th St & Cliff Ave	Analysis Year	2013	Analysis Period	1> 4:30	
File Name	Existing_10th_St_PM_New.xus					
Project Description	Existing PM					

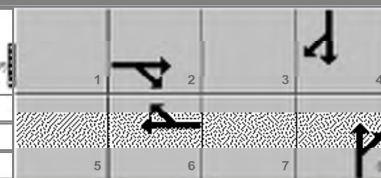


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	135	903	99	120	599	120	120	375	245	288	469	109

Signal Information				
Cycle, s	116.0	Reference Phase	2	
Offset, s	114	Reference Point	Begin	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	



Green	7.8	40.8	6.9	13.5	4.7	8.5
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	2.0	2.1	2.0	2.0	2.1	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	13.4	59.9	12.5	59.0	14.1	24.5	19.1	29.5
Change Period, (Y+R_c), s	5.6	5.7	5.7	5.7	5.7	5.7	5.6	5.7
Max Allow Headway (MAH), s	4.3	0.0	4.3	0.0	4.1	4.1	4.2	4.1
Queue Clearance Time (g_s), s	7.4		6.6		6.4	15.1	12.8	21.6
Green Extension Time (g_e), s	0.5	0.0	0.3	0.0	2.1	2.1	0.7	2.2
Phase Call Probability	0.99		0.98		0.98	1.00	1.00	1.00
Max Out Probability	0.00		1.00		0.00	0.00	0.18	0.01

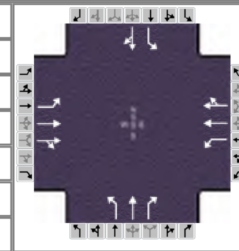
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	145	971	0	129	396	375	129	403	0	310	308	293
Adjusted Saturation Flow Rate (s), veh/h/ln	1570	1617	1439	1570	1698	1601	1616	1664	1481	1616	1748	1650
Queue Service Time (g_s), s	5.4	25.5	0.0	4.6	19.6	19.6	4.4	13.1	0.0	10.8	19.4	19.6
Cycle Queue Clearance Time (g_c), s	5.4	25.5	0.0	4.6	19.6	19.6	4.4	13.1	0.0	10.8	19.4	19.6
Green Ratio (g/C)	0.07	0.47	0.47	0.06	0.46	0.46	0.07	0.16	0.16	0.12	0.21	0.21
Capacity (c), veh/h	211	1511	673	184	781	736	234	538	240	376	358	338
Volume-to-Capacity Ratio (X)	0.689	0.643	0.000	0.699	0.508	0.509	0.552	0.749	0.000	0.823	0.859	0.866
Available Capacity (c_a), veh/h	658	1511	673	198	781	736	677	995	443	554	614	580
Back of Queue (Q), veh/ln (95th percentile)	4.2	14.8	0.0	3.6	13.2	12.7	3.3	9.1	0.0	8.0	13.3	12.9
Queue Storage Ratio (RQ) (95th percentile)	0.64	0.53	0.00	0.53	0.26	0.25	0.48	0.27	0.00	2.72	0.59	0.57
Uniform Delay (d_1), s/veh	56.7	21.6	0.0	50.0	23.1	23.2	50.6	43.3	0.0	47.8	40.5	40.6
Incremental Delay (d_2), s/veh	3.5	1.9	0.0	9.3	2.2	2.4	2.0	2.1	0.0	6.3	6.1	6.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	60.2	23.4	0.0	59.3	25.3	25.5	52.6	45.4	0.0	54.2	46.6	47.6
Level of Service (LOS)	E	C		E	C	C	D	D		D	D	D
Approach Delay, s/veh / LOS	28.2		C	30.3		C	47.2		D	49.5		D
Intersection Delay, s/veh / LOS	37.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.0	C	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.4	A	1.2	A	0.9	A	1.2	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:00:39 AM

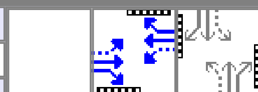
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Fairfax Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				

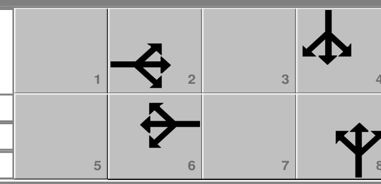


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	26	516	50	50	1100	19	156	38	6	13	25	25

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	105	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	81.7	23.1	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		5.0		6.0
Phase Duration, s		87.3		87.3		28.7		28.7
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						22.2		5.7
Green Extension Time (g_e), s		0.0		0.0		1.0		1.2
Phase Call Probability						1.00		1.00
Max Out Probability						0.02		0.00

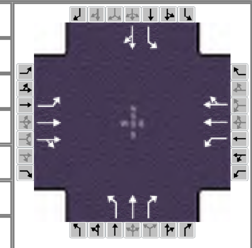
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	33	359	349	61	685	681	195	48	8	16	63	
Adjusted Saturation Flow Rate (s), veh/h/ln	381	1698	1645	710	1698	1688	1334	1765	1496	1352	1619	
Queue Service Time (g_s), s	5.0	9.8	9.9	2.4	15.3	15.3	16.5	2.6	0.5	1.2	3.7	
Cycle Queue Clearance Time (g_c), s	20.2	9.8	9.9	12.9	15.3	15.3	20.2	2.6	0.5	3.7	3.7	
Green Ratio (g/C)	0.70	0.70	0.70	0.70	0.70	0.70	0.20	0.20	0.20	0.20	0.20	
Capacity (c), veh/h	280	1195	1158	501	1195	1188	286	352	299	303	323	
Volume-to-Capacity Ratio (X)	0.116	0.300	0.301	0.122	0.573	0.574	0.681	0.135	0.025	0.054	0.193	
Available Capacity (c_a), veh/h	280	1195	1158	501	1195	1188	416	523	443	434	480	
Back of Queue (Q), veh/ln (95th percentile)	0.9	6.8	6.6	0.8	6.8	6.7	9.6	2.0	0.3	0.7	2.7	
Queue Storage Ratio (RQ) (95th percentile)	0.23	0.24	0.23	0.21	0.24	0.24	1.62	0.10	0.11	0.36	0.14	
Uniform Delay (d_1), s/veh	12.6	7.0	7.1	5.5	4.3	4.2	47.0	38.2	37.3	39.7	38.6	
Incremental Delay (d_2), s/veh	0.8	0.6	0.6	0.3	1.3	1.3	2.8	0.2	0.0	0.1	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	13.4	7.7	7.7	5.8	5.5	5.5	49.8	38.3	37.4	39.7	38.9	
Level of Service (LOS)	B	A	A	A	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	7.9		A	5.6		A	47.3		D	39.1		D
Intersection Delay, s/veh / LOS	11.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	1.7	A	0.9	A	0.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:16:38 PM

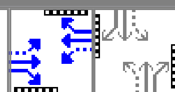
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Fairfax Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

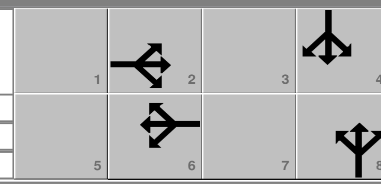


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	12	1082	109	38	777	13	55	22	33	22	81	16

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	105	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	90.4	14.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		5.0		6.0
Phase Duration, s		96.0		96.0		20.0		20.0
Change Period, (*Y+Rc*), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		4.2
Queue Clearance Time (g_s), s						13.7		8.6
Green Extension Time (g_e), s		0.0		0.0		0.7		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

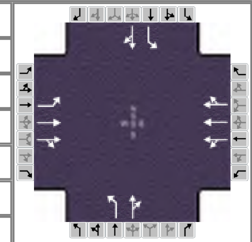
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	13	650	631	41	426	423	59	24	35	24	104	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	622	1698	1643	414	1698	1688	1285	1765	1496	1382	1714	
Queue Service Time (g_s), s	0.3	9.4	9.1	1.2	4.6	4.5	5.2	1.4	2.5	1.8	6.6	
Cycle Queue Clearance Time (g_c), s	5.0	9.4	9.1	11.7	4.6	4.5	11.7	1.4	2.5	3.1	6.6	
Green Ratio (*g/C*)	0.78	0.78	0.78	0.78	0.78	0.78	0.12	0.12	0.12	0.12	0.12	
Capacity (*c*), veh/h	521	1322	1279	350	1322	1314	151	220	187	219	214	
Volume-to-Capacity Ratio (*X*)	0.025	0.492	0.493	0.117	0.322	0.322	0.392	0.107	0.190	0.108	0.487	
Available Capacity (c_a), veh/h	521	1322	1279	350	1322	1314	294	417	353	373	405	
Back of Queue (*Q*), veh/ln (95th percentile)	0.1	4.5	4.2	0.3	2.4	2.4	3.1	1.1	1.7	1.1	5.2	
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.16	0.15	0.08	0.09	0.08	0.53	0.06	0.58	0.58	0.27	
Uniform Delay (d_1), s/veh	1.7	2.1	2.0	2.1	1.7	1.6	52.7	45.0	45.5	46.3	47.3	
Incremental Delay (d_2), s/veh	0.1	1.2	1.2	0.6	0.5	0.5	1.7	0.2	0.5	0.2	1.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	1.7	3.3	3.2	2.7	2.2	2.2	54.4	45.2	46.0	46.6	49.0	
Level of Service (LOS)	A	A	A	A	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	3.2	A		2.2	A		50.0	D		48.6	D	
Intersection Delay, s/veh / LOS	7.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.6	A	1.2	A	0.7	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:21:35 PM

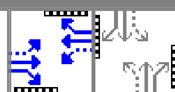
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	10th St & Franklin Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_10th_St_AM_New.xus				
Project Description	Existing AM				

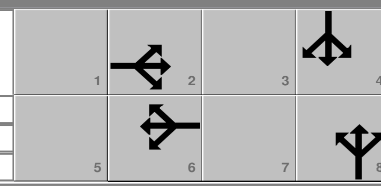


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	573	38	6	1231	44	13	6	6	13	6	63

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	106	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	94.7	10.1	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



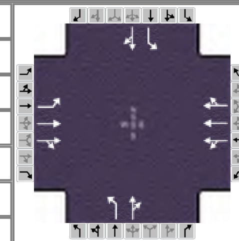
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		8.0		6.0		6.0
Phase Duration, s		100.3		100.3		15.7		15.7
Change Period, (*Y+R*c), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.4		4.4
Queue Clearance Time (*g*s), s						9.8		8.4
Green Extension Time (*g*e), s		0.0		0.0		0.4		0.4
Phase Call Probability						0.99		0.99
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	63	386	378	558	510	501	16	15		16	86	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	316	1698	1661	1688	1545	1516	1306	1619		1393	1516	
Queue Service Time (*g*s), s	0.0	0.0	0.0	0.0	7.3	7.2	1.4	1.0		1.3	6.4	
Cycle Queue Clearance Time (*g*c), s	9.6	0.0	0.0	7.2	7.3	7.2	7.8	1.0		2.2	6.4	
Green Ratio (*g/C*)	0.82	0.82	0.82	0.82	0.82	0.82	0.09	0.09		0.09	0.09	
Capacity (*c*), veh/h	300	1386	1356	1410	1261	1237	104	141		172	132	
Volume-to-Capacity Ratio (*X*)	0.208	0.278	0.279	0.396	0.405	0.405	0.156	0.106		0.095	0.653	
Available Capacity (*c*a), veh/h	300	1386	1356	1410	1261	1237	265	341		343	319	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	0.3	0.3	3.5	3.2	3.1	0.9	0.7		0.8	4.7	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.01	0.01	0.12	0.11	0.11	0.30	0.04		0.28	0.24	
Uniform Delay (*d*1), s/veh	0.4	0.0	0.0	1.7	1.8	1.7	55.0	48.8		49.8	51.3	
Incremental Delay (*d*2), s/veh	1.6	0.5	0.5	0.7	0.8	0.8	0.7	0.3		0.2	5.4	
Initial Queue Delay (*d*3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	1.9	0.5	0.5	2.4	2.5	2.5	55.7	49.1		50.1	56.6	
Level of Service (LOS)	A	A	A	A	A	A	E	D		D	E	
Approach Delay, s/veh / LOS	0.6		A	2.5		A	52.5		D	55.6		E
Intersection Delay, s/veh / LOS	4.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.9	C	3.2	C
Bicycle LOS Score / LOS	1.2	A	1.4	A	0.5	A	0.7	A

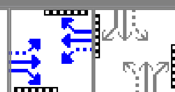
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Franklin Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
Project Description	Existing PM				

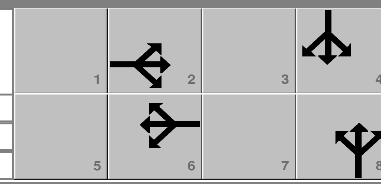


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	71	1148	12	4	806	38	38	4	17	38	4	50

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	89	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	94.7	10.1	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		8.0		6.0		6.0
Phase Duration, s		100.3		100.3		15.7		15.7
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						9.6		6.8
Green Extension Time (g_e), s		0.0		0.0		0.4		0.5
Phase Call Probability						0.99		0.99
Max Out Probability						0.00		0.00

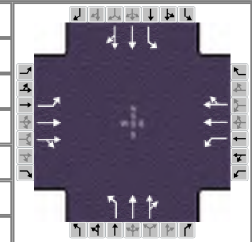
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	76	625	623	324	297	291	41	23		41	58	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	589	1698	1692	1681	1545	1507	1340	1540		1383	1513	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	5.4	5.5	3.5	1.6		3.3	4.2	
Cycle Queue Clearance Time (g_c), s	6.6	0.0	0.0	5.4	5.4	5.5	7.6	1.6		4.8	4.2	
Green Ratio (*g/C*)	0.82	0.82	0.82	0.82	0.82	0.82	0.09	0.09		0.09	0.09	
Capacity (*c*), veh/h	515	1386	1381	1403	1261	1230	131	135		165	132	
Volume-to-Capacity Ratio (*X*)	0.148	0.451	0.451	0.231	0.236	0.236	0.312	0.168		0.248	0.439	
Available Capacity (c_a), veh/h	515	1386	1381	1403	1261	1230	296	324		335	318	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	0.7	0.7	3.0	2.8	2.8	2.2	1.1		2.1	3.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.00	0.02	0.02	0.10	0.10	0.10	0.74	0.06		0.71	0.15	
Uniform Delay (d_1), s/veh	0.2	0.0	0.0	2.6	2.6	2.7	53.8	49.0		51.2	50.2	
Incremental Delay (d_2), s/veh	0.6	1.1	1.1	0.4	0.4	0.4	1.3	0.6		0.8	2.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	0.8	1.1	1.1	3.0	3.0	3.1	55.2	49.6		52.0	52.5	
Level of Service (LOS)	A	A	A	A	A	A	E	D		D	D	
Approach Delay, s/veh / LOS	1.0	A		3.0	A		53.2	D		52.3	D	
Intersection Delay, s/veh / LOS	5.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.9	C	3.2	C
Bicycle LOS Score / LOS	1.6	A	1.0	A	0.6	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 1:02:59 PM

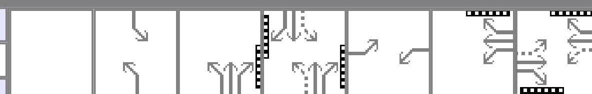
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	E 6th St & Cleveland Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_E 6th St_AM.xus				
Project Description	Existing AM				

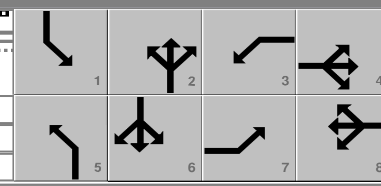


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	44	188	89	175	427	146	94	132	94	75	138	82

Signal Information			
Cycle, s	46.6	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.9	0.7	8.5	2.0	3.9	10.4
Yellow	4.0	0.0	3.6	4.0	0.0	3.6
Red	0.0	0.0	1.5	0.0	0.0	1.5



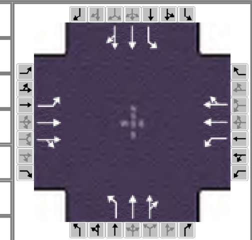
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	6.0	15.5	9.9	19.4	7.6	14.3	6.9	13.6
Change Period, ($Y+R_c$), s	4.0	5.1	4.0	5.1	4.0	5.1	4.0	5.1
Max Allow Headway (*MAH*), s	4.2	4.1	4.1	4.1	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	3.2	6.3	6.3	10.7	4.6	6.8	4.1	6.7
Green Extension Time (g_e), s	0.1	4.1	0.0	3.0	0.0	1.8	0.0	1.8
Phase Call Probability	0.51	1.00	0.94	1.00	0.78	1.00	0.70	1.00
Max Out Probability	0.00	0.04	1.00	0.40	1.00	0.05	1.00	0.04

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	55	179	167	219	373	343	118	105	178	94	102	173
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1576	1681	1765	1610	1681	979	1577	1681	982	1595
Queue Service Time (g_s), s	1.2	4.1	4.3	4.3	8.7	8.7	2.6	4.5	4.8	2.1	4.4	4.7
Cycle Queue Clearance Time (g_c), s	1.2	4.1	4.3	4.3	8.7	8.7	2.6	4.5	4.8	2.1	4.4	4.7
Green Ratio (g/C)	0.27	0.22	0.22	0.39	0.31	0.31	0.26	0.20	0.20	0.24	0.18	0.18
Capacity (*c*), veh/h	284	395	353	503	541	494	375	193	311	316	178	289
Volume-to-Capacity Ratio (*X*)	0.194	0.453	0.474	0.435	0.690	0.694	0.313	0.542	0.573	0.297	0.570	0.600
Available Capacity (c_a), veh/h	715	1056	943	507	753	687	460	418	673	428	419	681
Back of Queue (*Q*), veh/ln (95th percentile)	0.7	2.7	2.6	2.3	5.4	5.0	1.6	1.8	3.0	1.3	1.8	3.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.12	0.07	0.07	0.21	0.14	0.13	0.23	0.05	0.08	0.22	0.05	0.08
Uniform Delay (d_1), s/veh	13.5	15.6	15.7	10.5	14.2	14.2	14.0	16.8	17.0	14.6	17.4	17.5
Incremental Delay (d_2), s/veh	0.3	0.8	1.0	0.6	1.6	1.8	0.5	2.4	1.7	0.5	2.9	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	13.8	16.4	16.7	11.1	15.8	16.0	14.5	19.2	18.6	15.1	20.3	19.5
Level of Service (LOS)	B	B	B	B	B	B	B	B	B	B	C	B
Approach Delay, s/veh / LOS	16.2	B		14.8	B		17.6	B		18.6	B	
Intersection Delay, s/veh / LOS	16.2						B					

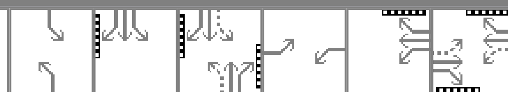
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.8	C	2.8	C
Bicycle LOS Score / LOS	0.8	A	1.3	A	0.8	A	0.8	A

HCS 2010 Signalized Intersection Results Summary

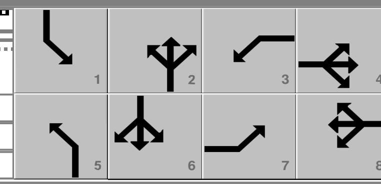
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	E 6th St & Cleveland Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_E_6th_St_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	93	484	179	135	273	104	131	186	213	224	267	76



Signal Information											
Cycle, s	60.9	Reference Phase	2								
Offset, s	0	Reference Point	End	Green	5.3	0.7	14.0	3.8	1.3	17.6	
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	0.0	3.6	4.0	0.0	3.6	
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	1.5	0.0	0.0	1.5	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	7.8	22.7	9.1	24.0	9.3	19.1	10.0	19.8
Change Period, ($Y+R_c$), s	4.0	5.1	4.0	5.1	4.0	5.1	4.0	5.1
Max Allow Headway (*MAH*), s	4.2	4.2	4.1	4.2	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	4.5	13.7	5.6	7.9	5.8	11.9	8.0	9.6
Green Extension Time (g_e), s	0.2	3.9	0.0	3.6	0.0	2.1	0.0	2.4
Phase Call Probability	0.82	1.00	0.91	1.00	0.91	1.00	0.98	1.00
Max Out Probability	0.01	0.18	1.00	0.26	1.00	0.39	1.00	0.22

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	100	373	340	145	209	196	141	164	265	241	135	234
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1602	1681	1765	1600	1681	983	1527	1681	982	1660
Queue Service Time (g_s), s	2.5	11.6	11.7	3.6	5.7	5.9	3.8	9.4	9.9	6.0	7.4	7.6
Cycle Queue Clearance Time (g_c), s	2.5	11.6	11.7	3.6	5.7	5.9	3.8	9.4	9.9	6.0	7.4	7.6
Green Ratio (*g/C*)	0.35	0.29	0.29	0.37	0.31	0.31	0.32	0.23	0.23	0.33	0.24	0.24
Capacity (*c*), veh/h	401	510	463	331	549	498	349	226	351	348	237	400
Volume-to-Capacity Ratio (*X*)	0.249	0.731	0.735	0.438	0.382	0.394	0.404	0.725	0.757	0.692	0.571	0.584
Available Capacity (c_a), veh/h	682	808	733	355	576	523	368	321	499	348	321	542
Back of Queue (*Q*), veh/ln (95th percentile)	1.6	8.1	7.6	2.3	3.8	3.6	2.5	4.1	6.6	5.3	3.1	5.1
Queue Storage Ratio (*RQ*) (95th percentile)	0.27	0.21	0.19	0.21	0.10	0.09	0.37	0.10	0.17	0.90	0.08	0.13
Uniform Delay (d_1), s/veh	14.0	19.5	19.6	14.5	16.4	16.5	16.3	21.7	21.9	18.3	20.3	20.4
Incremental Delay (d_2), s/veh	0.3	2.0	2.3	0.9	0.4	0.5	0.8	4.7	4.1	5.8	2.2	1.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	14.3	21.6	21.9	15.4	16.9	17.0	17.1	26.4	26.0	24.0	22.5	21.8
Level of Service (LOS)	B	C	C	B	B	B	B	C	C	C	C	C
Approach Delay, s/veh / LOS	20.8	C		16.5	B		23.9	C		22.8	C	
Intersection Delay, s/veh / LOS	21.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.2	A	0.9	A	1.0	A	1.0	A

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/12/2013
Analysis Time Period: AM Peak
Intersection: E 6th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E 6th St
North/South Street: Lowell Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	13	296	25	32	565	6
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	16	369	31	39	706	7
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L	TR		L	TR	
Upstream Signal?		No			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	19	13	19	6	19	25
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	23	16	23	7	23	31
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	16	39		62			61	
C(m) (vph)	869	1159		192			230	
v/c	0.02	0.03		0.32			0.27	
95% queue length	0.06	0.10		1.32			1.03	
Control Delay	9.2	8.2		32.4			26.2	
LOS	A	A		D			D	
Approach Delay				32.4			26.2	
Approach LOS				D			D	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/12/2013
Analysis Time Period: AM Peak
Intersection: E 6th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E 6th St
North/South Street: Lowell Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	13	296	25	32	565	6
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	4	92	8	10	177	2
Hourly Flow Rate, HFR	16	369	31	39	706	7
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L	TR		L	TR	
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	19	13	19	6	19	25
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	6	4	6	2	6	8
Hourly Flow Rate, HFR	23	16	23	7	23	31
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	47	30	1300
	Through	427	1800	3	14	47	30	1300

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2	2	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog			427	0

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	14	0
Cycle Length, C (sec)	47	47
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.298	0.000
g(q1)	7.8	0.0
g(q2)	2.4	0.0
g(q)	10.3	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.550	
beta			0.645	
Travel time, t(a) (sec)			29.478	
Smoothing Factor, F			0.087	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			1095	0
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			3.1	0.0
Proportion time blocked, p	0.000		0.065	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.065
p(dom)	0.065
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)	0.935		
p(4)	1.000		
p(7)	0.935		
p(8)	0.935		
p(9)	1.000		
p(10)	0.935		
p(11)	0.935		
p(12)	0.935		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	713	400	1230	1207	384	1224	1220	710
s	1500	1500	1500	1500	1500	1500	1500	1500
Px	0.935	1.000	0.935	0.935	1.000	0.935	0.935	0.935
V c,u,x	658	400	1211	1187	384	1205	1200	655
C r,x	930	1159	159	188	664	161	185	466
C plat,x	869	1159	149	176	664	151	173	436

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500	1500	1500	1500	1500	1500	1500	1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	384	710
Potential Capacity	664	436
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	664	436
Probability of Queue free St.	0.97	0.93

Step 2: LT from Major St.	4	1
Conflicting Flows	400	713
Potential Capacity	1159	869
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1159	869
Probability of Queue free St.	0.97	0.98
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1207	1220
Potential Capacity	176	173
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	167	164
Probability of Queue free St.	0.90	0.86

Step 4: LT from Minor St.	7	10
Conflicting Flows	1230	1224
Potential Capacity	149	151
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.82	0.86
Maj. L, Min T Adj. Imp Factor.	0.86	0.89
Cap. Adj. factor due to Impeding mvmnt	0.80	0.86
Movement Capacity	119	130

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1207	1220
Potential Capacity	176	173
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	167	164

Result for 2 stage process:		
a		
y		
C t	167	164
Probability of Queue free St.	0.90	0.86

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1230	1224
Potential Capacity	149	151
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.82	0.86
Maj. L, Min T Adj. Imp Factor.	0.86	0.89
Cap. Adj. factor due to Impeding mvmnt	0.80	0.86
Movement Capacity	119	130

Results for Two-stage process:		
a		
y		
C t	119	130

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	23	16	23	7	23	31
Movement Capacity (vph)	119	167	664	130	164	436
Shared Lane Capacity (vph)		192			230	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	119	167	664	130	164	436
Volume	23	16	23	7	23	31
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		192			230	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	16	39		62			61	
C(m) (vph)	869	1159		192			230	
v/c	0.02	0.03		0.32			0.27	
95% queue length	0.06	0.10		1.32			1.03	
Control Delay	9.2	8.2		32.4			26.2	
LOS	A	A		D			D	
Approach Delay				32.4			26.2	
Approach LOS				D			D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.97
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.2	8.2
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/12/2013
Analysis Time Period: PM Peak
Intersection: E 6th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E 6th St
North/South Street: Lowell Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	26	714	33	38	430	12
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	27	767	35	40	462	12
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L	TR		L	TR	
Upstream Signal?		No			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	22	16	38	4	16	16
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	23	17	40	4	17	17
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	27	40		80			38	
C(m) (vph)	1088	822		171			186	
v/c	0.02	0.05		0.47			0.20	
95% queue length	0.08	0.15		2.21			0.74	
Control Delay	8.4	9.6		43.3			29.3	
LOS	A	A		E			D	
Approach Delay				43.3			29.3	
Approach LOS				E			D	

HCS+: Unsignalized Intersections Release 5.6

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/12/2013
Analysis Time Period: PM Peak
Intersection: E 6th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E 6th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	26	714	33	38	430	12
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	7	192	9	10	116	3
Hourly Flow Rate, HFR	27	767	35	40	462	12
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L		TR	L		TR
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	22	16	38	4	16	16
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	6	4	10	1	4	4
Hourly Flow Rate, HFR	23	17	40	4	17	17
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	61	30	1300
	Through	273	1800	3	19	61	30	1300

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2	2	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog			273	0

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	19	0
Cycle Length, C (sec)	61	61
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.311	0.000
g(q1)	6.4	0.0
g(q2)	1.1	0.0
g(q)	7.5	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				0.550
beta				0.645
Travel time, t(a) (sec)				29.478
Smoothing Factor, F				0.087
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			893	0
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			0.0	0.0
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)	1.000		
p(7)	1.000		
p(8)	1.000		
p(9)	1.000		
p(10)	1.000		
p(11)	1.000		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	474	802	1403	1392	784	1415	1404	468
s	1500	1500	1500	1500	1500	1500	1500	1500
Px	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
V c,u,x	474	802	1403	1392	784	1415	1404	468
C r,x	1088	822	117	142	393	115	140	595
C plat,x	1088	822	117	142	393	115	140	595

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500	1500	1500	1500	1500	1500	1500	1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	784	468
Potential Capacity	393	595
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	393	595
Probability of Queue free St.	0.90	0.97

Step 2: LT from Major St.	4	1
Conflicting Flows	802	474
Potential Capacity	822	1088
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	822	1088
Probability of Queue free St.	0.95	0.98
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1392	1404
Potential Capacity	142	140
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity	132	130
Probability of Queue free St.	0.87	0.87

Step 4: LT from Minor St.	7	10
Conflicting Flows	1403	1415
Potential Capacity	117	115
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.81	0.81
Maj. L, Min T Adj. Imp Factor.	0.85	0.85
Cap. Adj. factor due to Impeding mvmnt	0.83	0.77
Movement Capacity	97	88

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1392	1404
Potential Capacity	142	140
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity	132	130

Result for 2 stage process:		
a		
y		
C t	132	130
Probability of Queue free St.	0.87	0.87

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1403	1415
Potential Capacity	117	115
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.81	0.81
Maj. L, Min T Adj. Imp Factor.	0.85	0.85
Cap. Adj. factor due to Impeding mvmnt	0.83	0.77
Movement Capacity	97	88

Results for Two-stage process:		
a		
y		
C t	97	88

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	23	17	40	4	17	17
Movement Capacity (vph)	97	132	393	88	130	595
Shared Lane Capacity (vph)		171			186	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	97	132	393	88	130	595
Volume	23	17	40	4	17	17
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		171			186	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	27	40		80			38	
C(m) (vph)	1088	822		171			186	
v/c	0.02	0.05		0.47			0.20	
95% queue length	0.08	0.15		2.21			0.74	
Control Delay	8.4	9.6		43.3			29.3	
LOS	A	A		E			D	
Approach Delay				43.3			29.3	
Approach LOS				E			D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.95
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.4	9.6
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E Rice St & Bahnson Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Rice St
North/South Street: Bahnson Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	31	188	19	6	678	6
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	38	234	23	7	847	7
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	1	1	1	1	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	25	6	6	6	6	31
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	31	7	7	7	7	38
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	38	7		45			52	
C(m) (vph)	769	1285		163			273	
v/c	0.05	0.01		0.28			0.19	
95% queue length	0.16	0.02		1.07			0.69	
Control Delay	9.9	7.8		35.3			21.3	
LOS	A	A		E			C	
Approach Delay				35.3			21.3	
Approach LOS				E			C	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E Rice St & Bahnson Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Rice St
North/South Street: Bahnson Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	31	188	19	6	678	6
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	10	59	6	2	212	2
Hourly Flow Rate, HFR	38	234	23	7	847	7
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	1	1	1	1	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	25	6	6	6	6	31
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	8	2	2	2	2	10
Hourly Flow Rate, HFR	31	7	7	7	7	38
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6	6	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	6	6	2	2	2	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				

```
Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)
_______________________________________________________________________________
Computation 2-Proportion of TWSC Intersection Time  blocked
                                              Movement 2        Movement 5
                                           V(t)   V(l,prot)  V(t)   V(l,prot)
_______________________________________________________________________________
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c,max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
Proportion time blocked, p                         0.000             0.000
_______________________________________________________________________________
Computation 3-Platoon Event Periods       Result
_______________________________________________________________________________
p(2)                                      0.000
p(5)                                      0.000
p(dom)
p(subo)
Constrained or unconstrained?
_______________________________________________________________________________
Proportion
unblocked                   (1)              (2)              (3)
for minor               Single-stage         Two-Stage Process
movements, p(x)           Process         Stage I          Stage II
_______________________________________________________________________________
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
_______________________________________________________________________________
Computation 4 and 5
Single-Stage Process
Movement                 1      4      7      8      9     10     11     12
                         L      L      L      T      R      L      T      R
_______________________________________________________________________________
V c,x                   854    257    1197   1178   234    1189   1194   847
s
Px
V c,u,x
_______________________________________________________________________________
C r,x
C plat,x
_______________________________________________________________________________
Two-Stage Process
                      7                8               10               11
```

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	234	847
Potential Capacity	805	362
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	805	362
Probability of Queue free St.	0.99	0.90

Step 2: LT from Major St.	4	1
Conflicting Flows	257	854
Potential Capacity	1285	769
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1285	769
Probability of Queue free St.	0.99	0.95
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1178	1194
Potential Capacity	191	187
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	181	177
Probability of Queue free St.	0.96	0.96

Step 4: LT from Minor St.	7	10
Conflicting Flows	1197	1189
Potential Capacity	163	165
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.91	0.91
Maj. L, Min T Adj. Imp Factor.	0.93	0.93
Cap. Adj. factor due to Impeding mvmnt	0.83	0.92
Movement Capacity	136	152

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1178	1194
Potential Capacity	191	187
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	181	177

Result for 2 stage process:		
a		
y		
C t	181	177
Probability of Queue free St.	0.96	0.96

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1197	1189
Potential Capacity	163	165
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.91	0.91
Maj. L, Min T Adj. Imp Factor.	0.93	0.93
Cap. Adj. factor due to Impeding mvmnt	0.83	0.92
Movement Capacity	136	152

Results for Two-stage process:		
a		
y		
C t	136	152

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	31	7	7	7	7	38
Movement Capacity (vph)	136	181	805	152	177	362
Shared Lane Capacity (vph)		163			273	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	136	181	805	152	177	362
Volume	31	7	7	7	7	38
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		163			273	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	38	7		45			52	
C(m) (vph)	769	1285		163			273	
v/c	0.05	0.01		0.28			0.19	
95% queue length	0.16	0.02		1.07			0.69	
Control Delay	9.9	7.8		35.3			21.3	
LOS	A	A		E			C	
Approach Delay				35.3			21.3	
Approach LOS				E			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.95	0.99
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.9	7.8
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E Rice St & Bahnson Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Rice St
North/South Street: Bahnson Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	575	13	4	364	4
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	5	618	13	4	391	4
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	1	1	1	1	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	27	4	4	4	4	26
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	29	4	4	4	4	27
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	4		37			35	
C(m) (vph)	1142	933		212			447	
v/c	0.00	0.00		0.17			0.08	
95% queue length	0.01	0.01		0.62			0.25	
Control Delay	8.2	8.9		25.5			13.7	
LOS	A	A		D			B	
Approach Delay				25.5			13.7	
Approach LOS				D			B	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E Rice St & Bahnson Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Rice St
North/South Street: Bahnson Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	5	575	13	4	364	4
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	1	155	3	1	98	1
Hourly Flow Rate, HFR	5	618	13	4	391	4
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			No
Lanes	1	1	1	1	1	1
Configuration	L	T	R	L	T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	27	4	4	4	4	26
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	7	1	1	1	1	7
Hourly Flow Rate, HFR	29	4	4	4	4	27
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	6	6	2	2	2	2	2	2
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.2	4.2	7.1	6.5	6.2	7.1	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	6	6	2	2	2	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	395	631	1044	1031	618	1037	1040	391
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	618	391
Potential Capacity	489	658
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	489	658
Probability of Queue free St.	0.99	0.96

Step 2: LT from Major St.	4	1
Conflicting Flows	631	395
Potential Capacity	933	1142
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	933	1142
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1031	1040
Potential Capacity	233	230
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	231	228
Probability of Queue free St.	0.98	0.98

Step 4: LT from Minor St.	7	10
Conflicting Flows	1044	1037
Potential Capacity	207	209
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.97
Maj. L, Min T Adj. Imp Factor.	0.98	0.98
Cap. Adj. factor due to Impeding mvmnt	0.94	0.97
Movement Capacity	195	203

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1031	1040
Potential Capacity	233	230
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	231	228

Result for 2 stage process:		
a		
y		
C t	231	228
Probability of Queue free St.	0.98	0.98

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1044	1037
Potential Capacity	207	209
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.97	0.97
Maj. L, Min T Adj. Imp Factor.	0.98	0.98
Cap. Adj. factor due to Impeding mvmnt	0.94	0.97
Movement Capacity	195	203

Results for Two-stage process:		
a		
y		
C t	195	203

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	29	4	4	4	4	27
Movement Capacity (vph)	195	231	489	203	228	658
Shared Lane Capacity (vph)		212			447	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	195	231	489	203	228	658
Volume	29	4	4	4	4	27
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		212			447	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

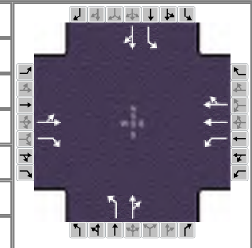
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	5	4		37			35	
C(m) (vph)	1142	933		212			447	
v/c	0.00	0.00		0.17			0.08	
95% queue length	0.01	0.01		0.62			0.25	
Control Delay	8.2	8.9		25.5			13.7	
LOS	A	A		D			B	
Approach Delay				25.5			13.7	
Approach LOS				D			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.2	8.9
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

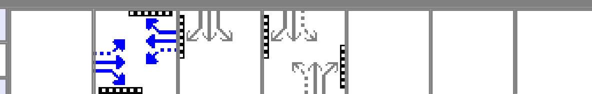
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Rice St & I-229 NB / Clevel	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Rice_St_AM.xus				
Project Description	Existing AM				

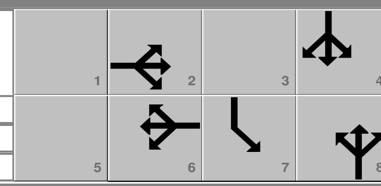


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	38	112	127	44	659	31	233	175	44	82	13	170

Signal Information			
Cycle, s	87.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	40.7	4.0	23.3	0.0	0.0	0.0
Yellow	5.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8	7	4
Case Number		7.0		6.0		6.3	1.0	4.0
Phase Duration, s		47.7		47.7		29.3	10.0	39.3
Change Period, ($Y+R_c$), s		7.0		7.0		6.0	6.0	6.0
Max Allow Headway (*MAH*), s		0.0		0.0		4.3	4.1	4.3
Queue Clearance Time (g_s), s						21.3	6.0	6.6
Green Extension Time (g_e), s		0.0		0.0		2.0	0.0	2.8
Phase Call Probability						1.00	0.92	1.00
Max Out Probability						0.22	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		188	93	55	251	605	291	260		103	110	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		582	1390	1099	659	1585	1250	1679		1535	1398	
Queue Service Time (g_s), s		5.1	2.8	4.2	28.6	28.6	19.3	11.7		4.0	4.6	
Cycle Queue Clearance Time (g_c), s		33.4	2.8	37.7	28.6	28.6	19.3	11.7		4.0	4.6	
Green Ratio (*g/C*)		0.47	0.47	0.47	0.47	0.47	0.27	0.27		0.34	0.38	
Capacity (*c*), veh/h		324	650	174	308	741	418	450		290	535	
Volume-to-Capacity Ratio (*X*)		0.579	0.142	0.317	0.816	0.816	0.697	0.577		0.354	0.205	
Available Capacity (c_a), veh/h		324	650	174	308	741	528	598		290	659	
Back of Queue (*Q*), veh/ln (95th percentile)		4.6	1.6	2.4	9.7	17.1	9.9	8.3		2.6	2.5	
Queue Storage Ratio (*RQ*) (95th percentile)		0.11	0.04	0.06	0.25	0.45	1.26	0.21		0.55	0.08	
Uniform Delay (d_1), s/veh		16.7	11.1	38.5	19.9	19.9	30.4	27.6		22.0	18.0	
Incremental Delay (d_2), s/veh		7.2	0.4	4.7	20.7	9.7	2.9	1.2		0.7	0.2	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		23.9	11.6	43.3	40.7	29.6	33.3	28.7		22.7	18.2	
Level of Service (LOS)		C	B	D	D	C	C	C		C	B	
Approach Delay, s/veh / LOS	19.8		B	33.5		C	31.1		C	20.4		C
Intersection Delay, s/veh / LOS	29.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.4	B	2.4	B	2.8	C
Bicycle LOS Score / LOS	0.9	A	1.2	A	1.4	A	0.8	A

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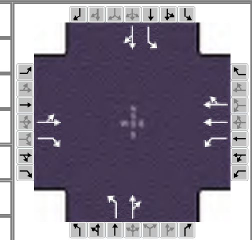
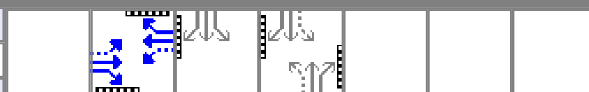
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & I-229 NB / Clevel	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Rice_St_PM.xus				
Project Description	Existing PM				

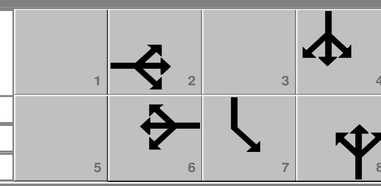


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	300	456	65	314	38	152	76	59	234	16	126

Signal Information			
Cycle, s	76.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	40.3	4.0	12.7	0.0	0.0	0.0
Yellow	5.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8	7	4
Case Number		7.0		6.0		6.3	1.0	4.0
Phase Duration, s		47.3		47.3		18.7	10.0	28.7
Change Period, (Y+R_c), s		7.0		7.0		6.0	6.0	6.0
Max Allow Headway (*MAH*), s		0.0		0.0		4.3	4.1	4.3
Queue Clearance Time (g_s), s						11.7	6.0	6.1
Green Extension Time (g_e), s		0.0		0.0		1.0	0.0	1.5
Phase Call Probability						1.00	1.00	1.00
Max Out Probability						0.18	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h		376	333	70	127	239	163	126		252	99	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1563	1421	745	838	1570	1233	1588		1563	1400	
Queue Service Time (g_s), s		0.3	13.6	4.9	6.3	6.4	9.7	5.4		4.0	4.1	
Cycle Queue Clearance Time (g_c), s		11.5	13.6	16.3	6.3	6.4	9.7	5.4		4.0	4.1	
Green Ratio (*g/C*)		0.53	0.53	0.53	0.53	0.53	0.17	0.17		0.25	0.30	
Capacity (*c*), veh/h		884	754	378	445	833	300	265		288	417	
Volume-to-Capacity Ratio (*X*)		0.426	0.442	0.185	0.285	0.287	0.544	0.475		0.873	0.237	
Available Capacity (c_a), veh/h		884	754	378	445	833	419	418		288	552	
Back of Queue (*Q*), veh/ln (95th percentile)		7.7	8.4	1.6	2.2	3.8	5.2	3.8		8.2	2.3	
Queue Storage Ratio (*RQ*) (95th percentile)		0.19	0.21	0.04	0.06	0.10	0.66	0.10		1.72	0.07	
Uniform Delay (d_1), s/veh		13.1	15.8	16.1	9.9	9.9	30.4	28.7		31.0	20.1	
Incremental Delay (d_2), s/veh		1.4	1.7	1.1	1.6	0.9	1.5	1.3		24.1	0.3	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh		14.5	17.5	17.2	11.5	10.7	32.0	30.0		55.0	20.4	
Level of Service (LOS)		B	B	B	B	B	C	C		E	C	
Approach Delay, s/veh / LOS	15.9		B	12.0		B	31.1		C	45.3		D
Intersection Delay, s/veh / LOS	23.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.5	B	2.9	C
Bicycle LOS Score / LOS	1.7	A	0.8	A	1.0	A	1.1	A

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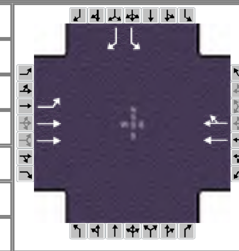
HCS 2010 Signalized Intersection Results Summary

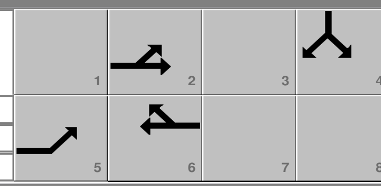
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Rice St & I-229 SB	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Rice_St_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	69	202			691	371				75		63

Signal Information			
Cycle, s	87.0	Reference Phase	2
Offset, s	75	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.5	58.1	7.4	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	8.5	73.6		65.1				13.4
Change Period, (*Y+Rc*), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (*gs*), s	3.4							7.2
Green Extension Time (*ge*), s	0.2	0.0		0.0				0.3
Phase Call Probability	0.88							0.98
Max Out Probability	0.00							0.03

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	86	253			699	628				94		79
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1531	1532			1719	1509				1533		1370
Queue Service Time (*gs*), s	1.4	1.8			29.5	9.8				5.2		4.9
Cycle Queue Clearance Time (*gc*), s	1.4	1.8			29.5	9.8				5.2		4.9
Green Ratio (*g/C*)	0.73	0.77			0.67	0.67				0.09		0.09
Capacity (*c*), veh/h	268	2345			1148	1008				131		117
Volume-to-Capacity Ratio (*X*)	0.322	0.108			0.609	0.624				0.718		0.675
Available Capacity (*ca*), veh/h	533	2345			1148	1008				282		252
Back of Queue (*Q*), veh/ln (95th percentile)	1.2	0.7			4.5	3.3				3.8		3.2
Queue Storage Ratio (*RQ*) (95th percentile)	0.26	0.01			0.11	0.08				0.34		0.08
Uniform Delay (*d1*), s/veh	10.7	2.6			3.3	2.4				38.8		38.6
Incremental Delay (*d2*), s/veh	0.7	0.1			1.4	1.7				7.2		6.6
Initial Queue Delay (*d3*), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	11.4	2.7			4.7	4.1				46.0		45.3
Level of Service (LOS)	B	A			A	A				D		D

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	4.9	A	4.4	A	0.0		45.6	D
Intersection Delay, s/veh / LOS	8.4				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.6	A	2.2	B	2.7	B	2.9	C
Bicycle LOS Score / LOS	0.8	A	1.6	A				F

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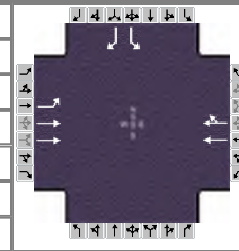
HCS 2010 Signalized Intersection Results Summary

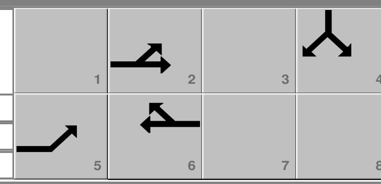
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & I-229 SB	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Rice_St_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	135	616			386	206				190		50

Signal Information			
Cycle, s	76.0	Reference Phase	2
Offset, s	65	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.1	40.8	12.2	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		8.3				9.0
Phase Duration, s	10.1	57.8		47.8				18.2
Change Period, (*Y+Rc*), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.1
Queue Clearance Time (g_s), s	4.9							11.7
Green Extension Time (g_e), s	0.4	0.0		0.0				0.6
Phase Call Probability	0.95							1.00
Max Out Probability	0.00							0.08

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	145	662			335	301				204		54
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1541	1560			1640	1448				1553		1388
Queue Service Time (g_s), s	2.9	6.8			12.6	11.9				9.7		2.6
Cycle Queue Clearance Time (g_c), s	2.9	6.8			12.6	11.9				9.7		2.6
Green Ratio (*g/C*)	0.63	0.67			0.54	0.54				0.16		0.16
Capacity (*c*), veh/h	465	2087			879	776				249		222
Volume-to-Capacity Ratio (*X*)	0.312	0.317			0.381	0.388				0.822		0.242
Available Capacity (c_a), veh/h	825	2087			879	776				409		365
Back of Queue (*Q*), veh/ln (95th percentile)	1.4	3.1			8.4	7.6				6.9		1.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.30	0.02			0.21	0.19				0.60		0.04
Uniform Delay (d_1), s/veh	7.5	5.3			15.7	15.3				30.9		27.9
Incremental Delay (d_2), s/veh	0.3	0.4			1.2	1.4				6.7		0.6
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	7.9	5.6			16.9	16.7				37.5		28.4
Level of Service (LOS)	A	A			B	B				D		C

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	6.0	A	16.8	B	0.0		35.6	D
Intersection Delay, s/veh / LOS	14.5				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.7	A	2.2	B	2.7	B	2.9	C
Bicycle LOS Score / LOS	1.2	A	1.0	A				F

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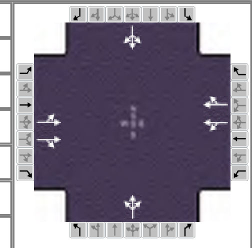
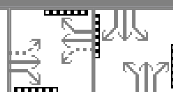
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Rice St & Wayland Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Rice_St_AM.xus				
Project Description	Existing AM				

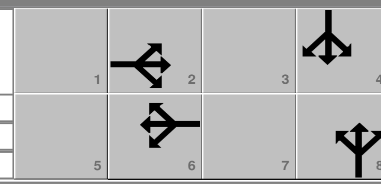


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	6	245	6	6	741	7	19	6	13	13	6	6

Signal Information			
Cycle, s	44.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	24.9	1.3	1.8	0.0	0.0	0.0
Yellow	3.9	3.0	3.0	0.0	0.0	0.0
Red	1.2	2.5	2.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		12.0		12.0
Phase Duration, s		30.0		30.0		7.3		6.8
Change Period, (*Y+Rc*), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		4.1		4.1		4.3		4.2
Queue Clearance Time (*gs*), s		4.1		9.9		3.3		2.8
Green Extension Time (*ge*), s		4.9		4.4		0.0		0.0
Phase Call Probability		1.00		1.00		0.44		0.32
Max Out Probability		0.08		0.20		0.09		0.03

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	168		153	494		448		48			31	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1663		1532	1694		1540		1624			1650	
Queue Service Time (*gs*), s	0.0		2.1	0.0		7.9		1.3			0.8	
Cycle Queue Clearance Time (*gc*), s	2.1		2.1	7.9		7.9		1.3			0.8	
Green Ratio (*g/C*)	0.57		0.57	0.57		0.57		0.04			0.03	
Capacity (*c*), veh/h	1026		866	1041		871		65			48	
Volume-to-Capacity Ratio (*X*)	0.164		0.177	0.475		0.515		0.730			0.656	
Available Capacity (*ca*), veh/h	1026		866	1041		871		350			356	
Back of Queue (*Q*), veh/ln (95th percentile)	0.9		0.9	3.4		3.3		1.2			0.9	
Queue Storage Ratio (*RQ*) (95th percentile)	0.03		0.03	0.03		0.02		0.13			0.09	
Uniform Delay (*d1*), s/veh	4.6		4.6	5.9		5.9		20.9			21.2	
Incremental Delay (*d2*), s/veh	0.3		0.4	1.2		1.7		14.5			14.2	
Initial Queue Delay (*d3*), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	5.0		5.1	7.1		7.6		35.4			35.4	
Level of Service (LOS)	A		A	A		A		D			D	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	5.0	A	7.3	A	35.4	D	35.4	D
Intersection Delay, s/veh / LOS	8.4				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.7	B	2.7	B
Bicycle LOS Score / LOS	0.8	A	1.3	A	0.6	A	0.5	A

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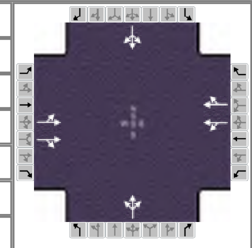
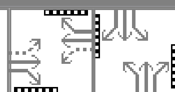
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & Wayland Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Rice_St_PM.xus				
Project Description	Existing PM				

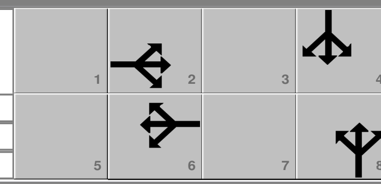


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	12	713	26	16	398	22	22	4	5	33	4	16

Signal Information			
Cycle, s	44.4	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	24.9	2.0	1.3	0.0	0.0	0.0
Yellow	3.9	3.0	3.0	0.0	0.0	0.0
Red	1.2	2.5	2.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		12.0		12.0
Phase Duration, s		30.0		30.0		6.8		7.5
Change Period, (*Y+Rc*), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		4.1		4.1		4.2		4.3
Queue Clearance Time (*gs*), s		8.5		5.4		2.9		3.5
Green Extension Time (*ge*), s		4.6		4.9		0.0		0.1
Phase Call Probability		1.00		1.00		0.34		0.50
Max Out Probability		0.17		0.11		0.04		0.14

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	424		383	245		224		33			57	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1685		1525	1635		1516		1658			1626	
Queue Service Time (*gs*), s	0.0		6.5	0.0		3.4		0.9			1.5	
Cycle Queue Clearance Time (*gc*), s	6.5		6.5	3.3		3.4		0.9			1.5	
Green Ratio (*g/C*)	0.56		0.56	0.56		0.56		0.03			0.05	
Capacity (*c*), veh/h	1029		856	1005		851		50			74	
Volume-to-Capacity Ratio (*X*)	0.412		0.448	0.243		0.264		0.662			0.770	
Available Capacity (*ca*), veh/h	1029		856	1005		851		355			348	
Back of Queue (*Q*), veh/ln (95th percentile)	3.0		2.8	1.4		1.4		0.9			1.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.09		0.08	0.01		0.01		0.09			0.15	
Uniform Delay (*d1*), s/veh	5.7		5.7	5.0		5.0		21.3			20.9	
Incremental Delay (*d2*), s/veh	1.2		1.7	0.5		0.7		13.8			15.3	
Initial Queue Delay (*d3*), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	6.9		7.4	5.5		5.7		35.1			36.3	
Level of Service (LOS)	A		A	A		A		D			D	
Approach Delay, s/veh / LOS	7.1		A	5.6		A	35.1		D	36.3		D
Intersection Delay, s/veh / LOS	8.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.7	B	2.7	B
Bicycle LOS Score / LOS	1.2	A	0.9	A	0.5	A	0.6	A

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TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E Benson Rd & Hall Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Hall Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	6	25	13	6	127	0
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	7	31	16	7	158	0
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	6	0	6	0	0	0
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	7	0	7	0	0	0
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	7	7		14			0	
C(m) (vph)	1398	1535		851				
v/c	0.01	0.00		0.02				
95% queue length	0.02	0.01		0.05				
Control Delay	7.6	7.4		9.3				
LOS	A	A		A				
Approach Delay				9.3				
Approach LOS				A				

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E Benson Rd & Hall Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Hall Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	6	25	13	6	127	0
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	2	8	4	2	40	0
Hourly Flow Rate, HFR	7	31	16	7	158	0
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	6	0	6	0	0	0
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	2	0	2	0	0	0
Hourly Flow Rate, HFR	7	0	7	0	0	0
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	31	158
Shared ln volume, major rt vehicles:	16	0
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6	6	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	6	6	2	2	2	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	158	47	225	225	39	228	233	158
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	39	158
Potential Capacity	1033	887
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1033	887
Probability of Queue free St.	0.99	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	47	158
Potential Capacity	1535	1398
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1535	1398
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.	1.00	0.99

Step 3: TH from Minor St.	8	11
Conflicting Flows	225	233
Potential Capacity	674	667
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	667	660
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	225	228
Potential Capacity	730	727
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.99
Maj. L, Min T Adj. Imp Factor.	0.99	0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	724	717

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	225	233
Potential Capacity	674	667
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	667	660

Result for 2 stage process:		
a		
y		
C t	667	660
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	225	228
Potential Capacity	730	727
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.99
Maj. L, Min T Adj. Imp Factor.	0.99	0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	724	717

Results for Two-stage process:		
a		
y		
C t	724	717

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	7	0	7	0	0	0
Movement Capacity (vph)	724	667	1033	717	660	887
Shared Lane Capacity (vph)		851				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	724	667	1033	717	660	887
Volume	7	0	7	0	0	0
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		851				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	7	7		14			0	
C(m) (vph)	1398	1535		851				
v/c	0.01	0.00		0.02				
95% queue length	0.02	0.01		0.05				
Control Delay	7.6	7.4		9.3				
LOS	A	A		A				
Approach Delay				9.3				
Approach LOS				A				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5	31	158
v(i2), Volume for stream 3 or 6	16	0
s(il), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.99	1.00
d(M,LT), Delay for stream 1 or 4	7.6	7.4
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.0	0.0

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E Benson Rd & Hall Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Hall Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	11	26	12	4	22	0
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	11	27	12	4	23	0
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	4	0	4	0	0	16
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	4	0	4	0	0	17
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	11	4		8			17	
C(m) (vph)	1566	1545		946			1054	
v/c	0.01	0.00		0.01			0.02	
95% queue length	0.02	0.01		0.03			0.05	
Control Delay	7.3	7.3		8.8			8.5	
LOS	A	A		A			A	
Approach Delay				8.8			8.5	
Approach LOS				A			A	

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Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E Benson Rd & Hall Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Hall Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	11	26	12	4	22	0
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	3	7	3	1	6	0
Hourly Flow Rate, HFR	11	27	12	4	23	0
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	4	0	4	0	0	16
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	1	0	1	0	0	4
Hourly Flow Rate, HFR	4	0	4	0	0	17
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	27	23
Shared ln volume, major rt vehicles:	12	0
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6	6	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	6	6	2	2	2	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	23	39	95	86	33	88	92	23
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	33	23
Potential Capacity	1041	1054
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1041	1054
Probability of Queue free St.	1.00	0.98

Step 2: LT from Major St.	4	1
Conflicting Flows	39	23
Potential Capacity	1545	1566
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1545	1566
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.	1.00	0.99

Step 3: TH from Minor St.	8	11
Conflicting Flows	86	92
Potential Capacity	804	798
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	796	790
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	95	88
Potential Capacity	888	897
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.99
Maj. L, Min T Adj. Imp Factor.	0.99	0.99
Cap. Adj. factor due to Impeding mvmnt	0.98	0.99
Movement Capacity	867	887

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	86	92
Potential Capacity	804	798
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity	796	790

Result for 2 stage process:		
a		
y		
C t	796	790
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	95	88
Potential Capacity	888	897
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.99
Maj. L, Min T Adj. Imp Factor.	0.99	0.99
Cap. Adj. factor due to Impeding mvmnt	0.98	0.99
Movement Capacity	867	887

Results for Two-stage process:		
a		
y		
C t	867	887

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	4	0	4	0	0	17
Movement Capacity (vph)	867	796	1041	887	790	1054
Shared Lane Capacity (vph)		946			1054	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	867	796	1041	887	790	1054
Volume	4	0	4	0	0	17
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		946			1054	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

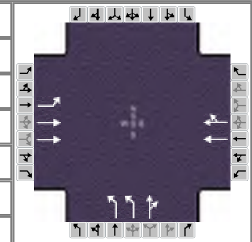
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	11	4		8			17	
C(m) (vph)	1566	1545		946			1054	
v/c	0.01	0.00		0.01			0.02	
95% queue length	0.02	0.01		0.03			0.05	
Control Delay	7.3	7.3		8.8			8.5	
LOS	A	A		A			A	
Approach Delay				8.8			8.5	
Approach LOS				A			A	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5	27	23
v(i2), Volume for stream 3 or 6	12	0
s(il), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.99	1.00
d(M,LT), Delay for stream 1 or 4	7.3	7.3
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.1	0.0

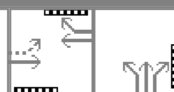
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	6/28/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Benson Rd & I-229 NB Rar	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Benson_Rd_AM.xus				
Project Description	Existing AM				

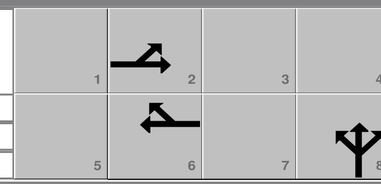


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	69	31			127	6	1496	0	13			

Signal Information			
Cycle, s	111.3	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	10.5	89.8	0.0	0.0	0.0	0.0
Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		8.0		10.0		
Phase Duration, s		16.0		16.0		95.3		
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		
Max Allow Headway (MAH), s		4.2		4.2		4.1		
Queue Clearance Time (g_s), s		12.5		8.7		75.2		
Green Extension Time (g_e), s		0.0		0.2		14.6		
Phase Call Probability		1.00		1.00		1.00		
Max Out Probability		1.00		1.00		0.08		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (v), veh/h	86	39			83	83	1870	16				
Adjusted Saturation Flow Rate (s), veh/h/ln	1169	1617			1698	1671	1210	1439				
Queue Service Time (g_s), s	3.8	1.2			6.7	5.3	73.2	0.2				
Cycle Queue Clearance Time (g_c), s	10.5	1.2			6.7	5.3	73.2	0.2				
Green Ratio (g/C)	0.09	0.09			0.09	0.09	0.81	0.81				
Capacity (c), veh/h	105	305			160	158	1952	1161				
Volume-to-Capacity Ratio (X)	0.822	0.127			0.520	0.526	0.958	0.014				
Available Capacity (c_a), veh/h	105	305			160	158	2555	1520				
Back of Queue (Q), veh/ln (95th percentile)	6.2	0.9			4.1	4.1	19.1	0.1				
Queue Storage Ratio (RQ) (95th percentile)	1.64	0.01			0.11	0.11	0.50	0.00				
Uniform Delay (d_1), s/veh	54.7	46.2			48.0	48.0	9.1	2.1				
Incremental Delay (d_2), s/veh	37.4	0.2			3.0	3.2	8.4	0.0				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (d), s/veh	92.2	46.4			51.0	51.2	17.6	2.1				
Level of Service (LOS)	F	D			D	D	B	A				
Approach Delay, s/veh / LOS	78.0	E		51.1	D		17.5	B		0.0		
Intersection Delay, s/veh / LOS	23.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	A	2.0	A	2.7	B	2.9	C
Bicycle LOS Score / LOS	0.6	A	0.6	A	3.6	D		

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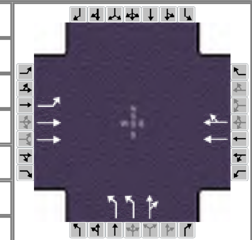
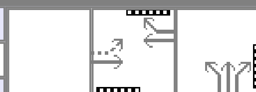
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Jan 27, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & I-229 NB Rar	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Benson_Rd_PM.xus				
Project Description	Existing PM				

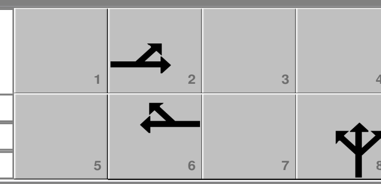


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	147	38			38	4	326	0	11			

Signal Information			
Cycle, s	20.6	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.4	5.2	0.0	0.0	0.0	0.0
Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		8.0		10.0		
Phase Duration, s		9.9		9.9		10.7		
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		
Max Allow Headway (*MAH*), s		4.1		4.1		4.1		
Queue Clearance Time (g_s), s		5.5		3.1		4.4		
Green Extension Time (g_e), s		0.4		0.5		1.6		
Phase Call Probability		0.75		0.75		0.87		
Max Out Probability		0.59		0.12		0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	158	41			23	23	351	12				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1304	1617			1698	1642	1318	1439				
Queue Service Time (g_s), s	2.4	0.2			1.1	0.2	2.4	0.1				
Cycle Queue Clearance Time (g_c), s	3.5	0.2			1.1	0.2	2.4	0.1				
Green Ratio (g/C)	0.21	0.21			0.21	0.21	0.25	0.25				
Capacity (*c*), veh/h	557	688			361	350	662	362				
Volume-to-Capacity Ratio (*X*)	0.284	0.059			0.063	0.065	0.529	0.033				
Available Capacity (c_a), veh/h	946	1654			869	840	8797	4803				
Back of Queue (*Q*), veh/ln (95th percentile)	0.5	0.0			0.1	0.1	0.4	0.0				
Queue Storage Ratio (*RQ*) (95th percentile)	0.14	0.00			0.00	0.00	0.01	0.00				
Uniform Delay (d_1), s/veh	8.3	6.4			6.4	6.4	6.6	5.8				
Incremental Delay (d_2), s/veh	0.2	0.0			0.1	0.1	0.7	0.0				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (*d*), s/veh	8.5	6.5			6.5	6.5	7.3	5.8				
Level of Service (LOS)	A	A			A	A	A	A				

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	8.1	A	6.5	A	7.2	A	0.0	
Intersection Delay, s/veh / LOS	7.5				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	1.9	A	2.7	B	2.8	C
Bicycle LOS Score / LOS	0.7	A	0.5	A	1.1	A		

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______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:                 JKM
Agency/Co.:              HDR
Date Performed:          11/13/2013
Analysis Time Period: AM Peak
Intersection:            E Benson Rd & I-229 SB Ramps
Jurisdiction:            Sioux Falls, SD
Units: U. S. Customary
Analysis Year:           Existing (2013)
Project ID:  I-229 MIS
East/West Street:        E Benson Rd
North/South Street:      I-229 SB Ramps
Intersection Orientation: EW                Study period (hrs):  0.25

_____________________Vehicle Volumes and Adjustments__________________________
Major Street:  Approach        Eastbound                  Westbound
               Movement     1       2      3      |  4      5      6
                            L       T      R      |  L      T      R
______________________________________________________________________________
Volume                              94     295       13     1610
Peak-Hour Factor, PHF               0.80   0.80      0.80   0.80
Hourly Flow Rate, HFR               117    368       16     2012
Percent Heavy Vehicles              --     --        6      --     --
Median Type/Storage         Undivided            /
RT Channelized?
Lanes                               2    0              1   2
Configuration                       T   TR               L  T
Upstream Signal?                    Yes                     Yes
______________________________________________________________________________
Minor Street:  Approach        Northbound                 Southbound
               Movement     7       8      9      |  10     11     12
                            L       T      R      |  L      T      R
______________________________________________________________________________
Volume                                               6      0      107
Peak Hour Factor, PHF                                0.80   0.80   0.80
Hourly Flow Rate, HFR                                7      0      133
Percent Heavy Vehicles                               6      6      6
Percent Grade (%)                   0                       0
Flared Approach:  Exists?/Storage               /              No     /
Lanes                                                   1   1    0
Configuration                                            L      TR
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach              EB     WB          Northbound            Southbound
Movement              1      4    |  7      8      9     |  10     11     12
Lane Config                  L    |                      |  L             TR
______________________________________________________________________________
v (vph)                      16                             7             133
C(m) (vph)                   1046                           41            282
v/c                          0.02                           0.17          0.47
95% queue length             0.05                           0.55          2.38
Control Delay                8.5                            110.1         28.7
LOS                           A                              F             D
Approach Delay                                                     32.7
Approach LOS                                                        D
______________________________________________________________________________
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HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E Benson Rd & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: I-229 SB Ramps
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		94	295	13	1610	
Peak-Hour Factor, PHF		0.80	0.80	0.80	0.80	
Peak-15 Minute Volume		29	92	4	503	
Hourly Flow Rate, HFR		117	368	16	2012	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				6	0	107
Peak Hour Factor, PHF				0.80	0.80	0.80
Peak-15 Minute Volume				2	0	33
Hourly Flow Rate, HFR				7	0	133
Percent Heavy Vehicles				6	6	6
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				1	1	0
Configuration				L		TR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	72	40	1950
	Through	321	1800	3	37	72	40	1950
S5	Left-Turn	0	1800	3	0	111	40	1050
	Through	127	1800	3	11	111	40	1050

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1				7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			6				6	6	6
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00				0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2				6.9	6.6	6.3
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20				3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		6				6	6	6
t(f)		2.3				3.6	4.1	3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	321	0	127	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	37	0	11	0
Cycle Length, C (sec)	72	72	111	111
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.514	0.000	0.099	0.000
g(q1)	3.1	0.0	3.5	0.0
g(q2)	0.3	0.0	0.1	0.0
g(q)	3.4	0.0	3.7	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	33.163		17.857	
Smoothing Factor, F	0.083		0.144	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	924	0	1560	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	0.0	0.0
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	1.000		
p(7)			
p(8)			
p(9)			
p(10)	1.000		
p(11)	1.000		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		485				2102	2529	1006
s		3000				3000	3000	3000
Px		1.000				1.000	1.000	1.000
V c,u,x		485				2102	2529	1006
C r,x		1046				42	26	282
C plat,x		1046				42	26	282

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					3000	3000	3000	3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		1006
Potential Capacity		282
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		282
Probability of Queue free St.	1.00	0.53

Step 2: LT from Major St.	4	1
Conflicting Flows	485	
Potential Capacity	1046	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1046	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		2529
Potential Capacity		26
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		26
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		2102
Potential Capacity		42
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.52	0.98
Movement Capacity		41

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		2529
Potential Capacity		26
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		26

Result for 2 stage process:		
a		
y		
C t		26
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		2102
Potential Capacity		42
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.98	
Maj. L, Min T Adj. Imp Factor.	0.99	
Cap. Adj. factor due to Impeding mvmnt	0.52	0.98
Movement Capacity		41
Results for Two-stage process:		
a		
y		
C t		41

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				7	0	133
Movement Capacity (vph)				41	26	282
Shared Lane Capacity (vph)						282

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				41	26	282
Volume				7	0	133
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						282
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L				L		TR
v (vph)		16				7		133
C(m) (vph)		1046				41		282
v/c		0.02				0.17		0.47
95% queue length		0.05				0.55		2.38
Control Delay		8.5				110.1		28.7
LOS		A				F		D
Approach Delay							32.7	
Approach LOS							D	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		8.5
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E Benson Rd & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: I-229 SB Ramps
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		163	1225	16	348	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Hourly Flow Rate, HFR		175	1317	17	374	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				22	0	50
Peak Hour Factor, PHF				0.93	0.93	0.93
Hourly Flow Rate, HFR				23	0	53
Percent Heavy Vehicles				6	6	6
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L				L		TR
v (vph)		17				23		53
C(m) (vph)		446				628		841
v/c		0.04				0.04		0.06
95% queue length		0.12				0.11		0.20
Control Delay		13.4				11.0		9.6
LOS		B				B		A
Approach Delay							10.0-	
Approach LOS							A	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E Benson Rd & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: I-229 SB Ramps
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		163	1225	16	348	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Peak-15 Minute Volume		44	329	4	94	
Hourly Flow Rate, HFR		175	1317	17	374	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				22	0	50
Peak Hour Factor, PHF				0.93	0.93	0.93
Peak-15 Minute Volume				6	0	13
Hourly Flow Rate, HFR				23	0	53
Percent Heavy Vehicles				6	6	6
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				1	1	0
Configuration				L		TR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	77	40	1950
	Through	849	1800	3	35	77	40	1950
S5	Left-Turn	0	1800	3	0	20	40	1050
	Through	38	1800	3	4	20	40	1050

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1				7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			6				6	6	6
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00				0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2				6.9	6.6	6.3
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20				3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		6				6	6	6
t(f)		2.3				3.6	4.1	3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	849	0	38	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	35	0	4	0
Cycle Length, C (sec)	77	77	20	20
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.455	0.000	0.200	0.000
g(q1)	9.9	0.0	0.2	0.0
g(q2)	3.1	0.0	0.0	0.0
g(q)	13.0	0.0	0.2	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	33.163		17.857	
Smoothing Factor, F	0.083		0.144	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	2428	0	94	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	7.2	0.0	0.0	0.0
Proportion time blocked, p	0.094		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.094
p(5)	0.000
p(dom)	0.094
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	0.906		
p(7)			
p(8)			
p(9)			
p(10)	0.906		
p(11)	0.906		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		1492				495	1900	187
s		3000				3000	3000	3000
Px		0.906				0.906	0.906	1.000
V c,u,x		1335				235	1786	187
C r,x		492				721	77	841
C plat,x		446				653	70	841

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					3000	3000	3000	3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		187
Potential Capacity		841
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		841
Probability of Queue free St.	1.00	0.94

Step 2: LT from Major St.	4	1
Conflicting Flows	1492	
Potential Capacity	446	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	446	
Probability of Queue free St.	0.96	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		1900
Potential Capacity		70
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		67
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		495
Potential Capacity		653
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.91	0.96
Movement Capacity		628

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		1900
Potential Capacity		70
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		67

Result for 2 stage process:		
a		
y		
C t		67
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		495
Potential Capacity		653
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.91	0.96
Movement Capacity		628
Results for Two-stage process:		
a		
y		
C t		628

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				23	0	53
Movement Capacity (vph)				628	67	841
Shared Lane Capacity (vph)						841

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				628	67	841
Volume				23	0	53
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						841
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L				L		TR
v (vph)		17				23		53
C(m) (vph)		446				628		841
v/c		0.04				0.04		0.06
95% queue length		0.12				0.11		0.20
Control Delay		13.4				11.0		9.6
LOS		B				B		A
Approach Delay							10.0-	
Approach LOS							A	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.96
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		13.4
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E Benson Rd & Potsdam Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Potsdam Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	31	308	44	113	1302	302
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	38	384	54	141	1627	377
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	25	6	75	6	6	19
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Hourly Flow Rate, HFR	31	7	93	7	7	23
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1	1	0	0	1	0
Configuration	L		TR		LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR		LTR	
v (vph)	38	141	31		100		37	
C(m) (vph)	267	1090	38		163		28	
v/c	0.14	0.13	0.82		0.61		1.32	
95% queue length	0.49	0.44	3.00		3.34		4.33	
Control Delay	20.7	8.8	249.3		57.0		491.7	
LOS	C	A	F		F		F	
Approach Delay				102.5			491.7	
Approach LOS				F			F	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: E Benson Rd & Potsdam Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Potsdam Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	31	308	44	113	1302	302
Peak-Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	10	96	14	35	407	94
Hourly Flow Rate, HFR	38	384	54	141	1627	377
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	25	6	75	6	6	19
Peak Hour Factor, PHF	0.80	0.80	0.80	0.80	0.80	0.80
Peak-15 Minute Volume	8	2	23	2	2	6
Hourly Flow Rate, HFR	31	7	93	7	7	23
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1	1	0	0	1	0
Configuration	L		TR		LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	72	40	1425
	Through	321	1800	3	37	72	40	1425
S5	Left-Turn	0	1800	3	0	111	40	1575
	Through	127	1800	3	11	111	40	1575

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.2	7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		6	6	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.5	6.5	6.2	7.5	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	6	6	2	2	2	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	321	0	127	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	37	0	11	0
Cycle Length, C (sec)	72	72	111	111
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.514	0.000	0.099	0.000
g(q1)	3.1	0.0	3.5	0.0
g(q2)	0.3	0.0	0.1	0.0
g(q)	3.4	0.0	3.7	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	24.235		26.786	
Smoothing Factor, F	0.110		0.101	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	1187	0	1158	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	0.0	0.0
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)	1.000		
p(7)	1.000		
p(8)	1.000		
p(9)	1.000		
p(10)	1.000		
p(11)	1.000		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	2004	438	1585	2773	219	2370	2612	1002
s	3000	3000	3000	3000	3000	3000	3000	3000
Px	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
V c,u,x	2004	438	1585	2773	219	2370	2612	1002
C r,x	267	1090	73	19	819	18	24	293
C plat,x	267	1090	73	19	819	18	24	293

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	3000	3000	3000	3000	3000	3000	3000	3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	219	1002
Potential Capacity	819	293
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	819	293
Probability of Queue free St.	0.89	0.92

Step 2: LT from Major St.	4	1
Conflicting Flows	438	2004
Potential Capacity	1090	267
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1090	267
Probability of Queue free St.	0.87	0.86
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	2773	2612
Potential Capacity	19	24
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.75	0.75
Movement Capacity	14	18
Probability of Queue free St.	0.50	0.61

Step 4: LT from Minor St.	7	10
Conflicting Flows	1585	2370
Potential Capacity	73	18
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.46	0.37
Maj. L, Min T Adj. Imp Factor.	0.57	0.50
Cap. Adj. factor due to Impeding mvmnt	0.53	0.44
Movement Capacity	38	8

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	2773	2612
Potential Capacity	19	24
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.75	0.75
Movement Capacity	14	18

Result for 2 stage process:		
a		
y		
C t	14	18
Probability of Queue free St.	0.50	0.61

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1585	2370
Potential Capacity	73	18
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.46	0.37
Maj. L, Min T Adj. Imp Factor.	0.57	0.50
Cap. Adj. factor due to Impeding mvmnt	0.53	0.44
Movement Capacity	38	8

Results for Two-stage process:		
a		
y		
C t	38	8

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	31	7	93	7	7	23
Movement Capacity (vph)	38	14	819	8	18	293
Shared Lane Capacity (vph)			163		28	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	38	14	819	8	18	293
Volume	31	7	93	7	7	23
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			163		28	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR		LTR	
v (vph)	38	141	31		100		37	
C(m) (vph)	267	1090	38		163		28	
v/c	0.14	0.13	0.82		0.61		1.32	
95% queue length	0.49	0.44	3.00		3.34		4.33	
Control Delay	20.7	8.8	249.3		57.0		491.7	
LOS	C	A	F		F		F	
Approach Delay				102.5			491.7	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.86	0.87
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	20.7	8.8
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E Benson Rd & Potsdam Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Potsdam Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	16	1246	43	44	332	22
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	17	1339	46	47	356	23
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	22	4	77	65	4	59
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	23	4	82	69	4	63
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1	1	0	0	1	0
Configuration	L		TR		LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR		LTR	
v (vph)	17	47	23		86		136	
C(m) (vph)	1148	511	64		456		242	
v/c	0.01	0.09	0.36		0.19		0.56	
95% queue length	0.05	0.30	1.34		0.69		3.12	
Control Delay	8.2	12.8	89.9		14.7		37.4	
LOS	A	B	F		B		E	
Approach Delay				30.6			37.4	
Approach LOS				D			E	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: PM Peak
Intersection: E Benson Rd & Potsdam Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Potsdam Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	16	1246	43	44	332	22
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	4	335	12	12	89	6
Hourly Flow Rate, HFR	17	1339	46	47	356	23
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	22	4	77	65	4	59
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	6	1	21	17	1	16
Hourly Flow Rate, HFR	23	4	82	69	4	63
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1	1	0	0	1	0
Configuration	L		TR		LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	77	40	1425
	Through	849	1800	3	35	77	40	1425
S5	Left-Turn	0	1800	3	0	20	40	1575
	Through	38	1800	3	4	20	40	1575

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.2	7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		6	6	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.5	6.5	6.2	7.5	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	6	6	2	2	2	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	849	0	38	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	35	0	4	0
Cycle Length, C (sec)	77	77	20	20
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.455	0.000	0.200	0.000
g(q1)	9.9	0.0	0.2	0.0
g(q2)	3.1	0.0	0.0	0.0
g(q)	13.0	0.0	0.2	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	24.235		26.786	
Smoothing Factor, F	0.110		0.101	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	2807	0	65	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	10.6	0.0	0.0	0.0
Proportion time blocked, p	0.137		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.137
p(5)	0.000
p(dom)	0.137
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)	0.863		
p(7)	0.863		
p(8)	0.863		
p(9)	0.863		
p(10)	0.863		
p(11)	0.863		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	379	1385	1670	1869	692	1167	1881	190
s	3000	3000	3000	3000	3000	3000	3000	3000
Px	1.000	0.863	0.863	0.863	0.863	0.863	0.863	1.000
V c,u,x	379	1128	1458	1689	325	875	1703	190
C r,x	1148	592	91	93	714	243	91	850
C plat,x	1148	511	79	80	616	210	79	850

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	3000	3000	3000	3000	3000	3000	3000	3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	692	190
Potential Capacity	616	850
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	616	850
Probability of Queue free St.	0.87	0.93

Step 2: LT from Major St.	4	1
Conflicting Flows	1385	379
Potential Capacity	511	1148
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	511	1148
Probability of Queue free St.	0.91	0.99
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1869	1881
Potential Capacity	80	79
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity	72	71
Probability of Queue free St.	0.94	0.94

Step 4: LT from Minor St.	7	10
Conflicting Flows	1670	1167
Potential Capacity	79	210
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.84	0.84
Maj. L, Min T Adj. Imp Factor.	0.88	0.88
Cap. Adj. factor due to Impeding mvmnt	0.82	0.76
Movement Capacity	64	160

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1869	1881
Potential Capacity	80	79
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.89
Movement Capacity	72	71

Result for 2 stage process:		
a		
y		
C t	72	71
Probability of Queue free St.	0.94	0.94

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1670	1167
Potential Capacity	79	210
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.84	0.84
Maj. L, Min T Adj. Imp Factor.	0.88	0.88
Cap. Adj. factor due to Impeding mvmnt	0.82	0.76
Movement Capacity	64	160

Results for Two-stage process:		
a		
y		
C t	64	160

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	23	4	82	69	4	63
Movement Capacity (vph)	64	72	616	160	71	850
Shared Lane Capacity (vph)			456		242	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	64	72	616	160	71	850
Volume	23	4	82	69	4	63
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			456		242	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

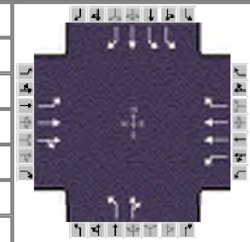
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR		LTR	
v (vph)	17	47	23		86		136	
C(m) (vph)	1148	511	64		456		242	
v/c	0.01	0.09	0.36		0.19		0.56	
95% queue length	0.05	0.30	1.34		0.69		3.12	
Control Delay	8.2	12.8	89.9		14.7		37.4	
LOS	A	B	F		B		E	
Approach Delay				30.6			37.4	
Approach LOS				D			E	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.91
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.2	12.8
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS 2010 Signalized Intersection Results Summary

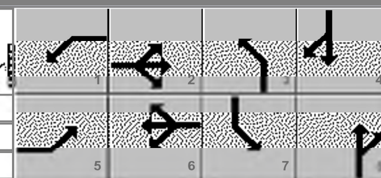
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	6/28/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Benson Rd & Lewis Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Benson_Rd_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	127	321	31	31	817	277	25	19	31	57	25	108

Signal Information				
Cycle, s	71.5	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.1	3.2	33.9	1.9	1.2	7.8
Yellow	3.9	0.0	3.9	3.6	0.0	3.6
Red	1.0	0.0	2.2	1.0	0.0	2.3



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	10.2	43.2	7.0	40.0	6.5	13.7	7.6	14.9
Change Period, ($Y+R_c$), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	4.1	4.0	4.1	4.0	4.1	4.3	4.2	4.3
Queue Clearance Time (g_s), s	5.5	7.3	2.9	19.4	3.3	4.6	3.5	8.2
Green Extension Time (g_e), s	0.1	9.0	0.0	6.9	0.0	0.6	0.2	0.8
Phase Call Probability	0.96	1.00	0.54	1.00	0.46	0.99	0.76	1.00
Max Out Probability	1.00	0.14	0.81	0.40	1.00	0.04	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	159	222	218	39	1022	346	31	63		71	31	135
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1645	1617	1617	1439	1681	1588		1632	1765	1496
Queue Service Time (g_s), s	3.5	5.2	5.3	0.9	17.4	11.9	1.3	2.6		1.5	1.1	6.2
Cycle Queue Clearance Time (g_c), s	3.5	5.2	5.3	0.9	17.4	11.9	1.3	2.6		1.5	1.1	6.2
Green Ratio (*g/C*)	0.55	0.52	0.52	0.50	0.47	0.47	0.03	0.11		0.04	0.13	0.13
Capacity (*c*), veh/h	309	880	853	528	1532	682	43	173		138	221	187
Volume-to-Capacity Ratio (*X*)	0.514	0.253	0.255	0.073	0.667	0.508	0.718	0.362		0.515	0.141	0.720
Available Capacity (c_a), veh/h	349	880	853	640	1532	682	174	313		931	668	567
Back of Queue (*Q*), veh/ln (95th percentile)	2.0	3.2	3.1	0.5	7.4	4.9	1.4	1.8		1.2	0.9	0.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.26	0.03	0.03	0.16	0.06	0.74	0.69	0.05		0.07	0.02	0.01
Uniform Delay (d_1), s/veh	11.7	9.6	9.6	9.1	14.5	13.0	34.6	29.6		33.5	27.9	30.1
Incremental Delay (d_2), s/veh	1.3	0.7	0.7	0.0	0.6	0.7	19.7	1.3		2.9	0.3	5.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	13.0	10.2	10.3	9.2	15.1	13.8	54.3	30.8		36.5	28.1	35.2
Level of Service (LOS)	B	B	B	A	B	B	D	C		D	C	D
Approach Delay, s/veh / LOS	11.0	B		14.6	B		38.7	D		34.7	C	
Intersection Delay, s/veh / LOS	16.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.5	B	3.0	C	2.8	C
Bicycle LOS Score / LOS	1.0	A	1.6	A	0.6	A	0.9	A

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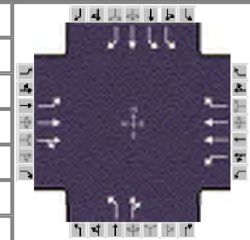
HCS 2010 Signalized Intersection Results Summary

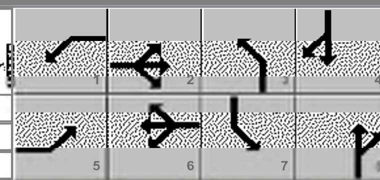
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Jan 27, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & Lewis Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Benson_Rd_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	65	849	17	38	332	71	33	22	87	306	22	141

Signal Information			
Cycle, s	77.3	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.3	0.8	33.9	2.1	3.8	8.3
Yellow	3.9	0.0	3.9	3.6	3.6	3.6
Red	1.0	0.0	2.2	1.0	1.0	2.3



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	8.0	40.8	7.2	40.0	6.7	14.2	15.1	22.5
Change Period, (Y+R_c), s	4.9	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0	4.1	4.4	4.2	4.4
Queue Clearance Time (g_s), s	3.8	18.2	3.1	7.4	3.6	7.7	9.5	8.8
Green Extension Time (g_e), s	0.0	4.9	0.0	5.7	0.0	0.6	1.0	1.0
Phase Call Probability	0.78	1.00	0.58	1.00	0.53	1.00	1.00	1.00
Max Out Probability	1.00	0.19	1.00	0.04	1.00	0.34	0.02	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	70	467	464	41	357	76	35	117		329	24	152
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1686	1617	1617	1439	1681	1543		1632	1765	1496
Queue Service Time (g_s), s	1.8	16.2	16.2	1.1	5.4	2.4	1.6	5.7		7.5	0.8	6.8
Cycle Queue Clearance Time (g_c), s	1.8	16.2	16.2	1.1	5.4	2.4	1.6	5.7		7.5	0.8	6.8
Green Ratio (g/C)	0.48	0.45	0.45	0.47	0.44	0.44	0.03	0.11		0.14	0.22	0.22
Capacity (c), veh/h	496	762	756	265	1418	631	46	165		444	380	322
Volume-to-Capacity Ratio (X)	0.141	0.613	0.613	0.154	0.252	0.121	0.765	0.710		0.741	0.062	0.471
Available Capacity (c_a), veh/h	579	762	756	365	1418	631	161	281		861	619	524
Back of Queue (Q), veh/ln (95th percentile)	1.1	9.6	9.6	0.6	3.3	1.4	1.7	4.1		5.4	0.6	4.4
Queue Storage Ratio (RQ) (95th percentile)	0.14	0.10	0.09	0.22	0.03	0.21	0.85	0.10		0.34	0.02	0.11
Uniform Delay (d_1), s/veh	11.2	16.2	16.2	13.3	13.7	12.9	37.3	33.4		32.1	24.1	26.5
Incremental Delay (d_2), s/veh	0.1	2.8	2.9	0.2	0.4	0.3	22.5	5.5		2.5	0.1	1.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (d), s/veh	11.3	19.1	19.1	13.5	14.1	13.2	59.8	38.9		34.5	24.2	27.5
Level of Service (LOS)	B	B	B	B	B	B	E	D		C	C	C
Approach Delay, s/veh / LOS	18.5	B		13.9	B		43.8	D		31.9	C	
Intersection Delay, s/veh / LOS	22.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.6	B	3.0	C	2.8	C
Bicycle LOS Score / LOS	1.3	A	0.9	A	0.7	A	1.3	A

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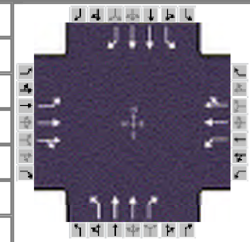
HCS 2010 Signalized Intersection Results Summary

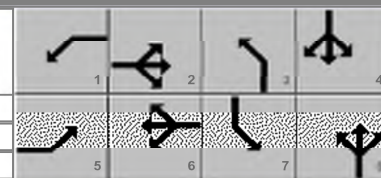
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	6/28/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Benson Rd & Cliff Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Benson_Rd_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	94	303	50	63	629	258	113	239	82	94	283	138

Signal Information			
Cycle, s	107.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.0	44.5	8.0	32.5	0.0	0.0
Yellow	3.0	3.5	3.0	3.5	0.0	0.0
Red	1.0	2.0	1.0	2.0	0.0	0.0



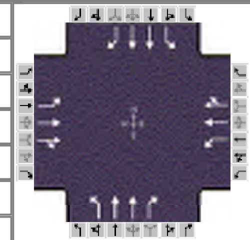
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	7.0	50.0	7.0	50.0	12.0	38.0	12.0	38.0
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (MAH), s	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	5.0	11.7	5.0	34.8	8.2	9.3	7.1	11.8
Green Extension Time (g_e), s	0.0	7.1	0.0	4.5	0.0	3.8	0.0	3.7
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	0.05	1.00	0.55	1.00	0.01	1.00	0.02

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	118	225	217	79	583	526	141	299	103	118	354	173
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1614	1617	1698	1529	1664	1664	1481	1664	1664	1481
Queue Service Time (g_s), s	3.0	9.5	9.7	3.0	32.7	32.8	6.2	7.3	5.5	5.1	8.9	9.8
Cycle Queue Clearance Time (g_c), s	3.0	9.5	9.7	3.0	32.7	32.8	6.2	7.3	5.5	5.1	8.9	9.8
Green Ratio (g/C)	0.44	0.42	0.42	0.44	0.42	0.42	0.38	0.30	0.30	0.38	0.30	0.30
Capacity (c), veh/h	157	706	671	391	706	636	367	1011	450	402	1011	450
Volume-to-Capacity Ratio (X)	0.749	0.318	0.323	0.201	0.825	0.827	0.385	0.296	0.228	0.293	0.350	0.383
Available Capacity (c_a), veh/h	157	706	671	391	706	636	367	1011	450	402	1011	450
Back of Queue (Q), veh/ln (95th percentile)	5.3	6.9	6.7	2.1	19.0	17.5	4.7	5.3	3.7	3.8	6.4	6.7
Queue Storage Ratio (RQ) (95th percentile)	0.70	0.18	0.18	0.37	0.19	0.17	0.41	0.14	0.38	0.49	0.16	0.57
Uniform Delay (d_1), s/veh	33.9	21.0	21.1	18.2	27.8	27.8	23.2	28.5	27.9	22.7	29.0	29.4
Incremental Delay (d_2), s/veh	27.5	1.2	1.3	0.8	7.5	8.4	3.0	0.7	1.2	1.8	1.0	2.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	61.4	22.2	22.4	19.0	35.3	36.2	26.3	29.2	29.0	24.5	30.0	31.8
Level of Service (LOS)	E	C	C	B	D	D	C	C	C	C	C	C
Approach Delay, s/veh / LOS	30.5	C		34.6	C		28.4	C		29.5	C	
Intersection Delay, s/veh / LOS	31.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.8	C	2.8	C
Bicycle LOS Score / LOS	0.9	A	1.5	A	0.9	A	1.0	A

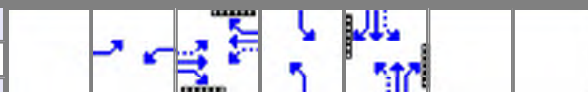
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Jan 27, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & Cliff Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_Benson_Rd_PM.xus				
Project Description	Existing PM				

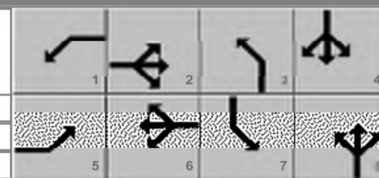


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	120	561	135	97	327	82	104	344	87	283	332	97

Signal Information			
Cycle, s	107.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.0	44.5	8.0	32.5	0.0	0.0
Yellow	3.0	3.5	3.0	3.5	0.0	0.0
Red	1.0	2.0	1.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	7.0	50.0	7.0	50.0	12.0	38.0	12.0	38.0
Change Period, ($Y+R_c$), s	4.0	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	4.0	4.1	4.0	4.1	4.0	4.1	4.0
Queue Clearance Time (g_s), s	5.0	20.5	5.0	11.8	6.8	11.3	10.0	11.0
Green Extension Time (g_e), s	0.0	4.6	0.0	4.7	0.0	3.7	0.0	3.7
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	0.04	1.00	0.01	1.00	0.01	1.00	0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	387	362	104	226	214	112	370	94	304	357	104
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1584	1617	1698	1581	1664	1664	1481	1664	1664	1481
Queue Service Time (g_s), s	3.0	18.4	18.5	3.0	9.6	9.8	4.8	9.3	5.0	8.0	9.0	5.6
Cycle Queue Clearance Time (g_c), s	3.0	18.4	18.5	3.0	9.6	9.8	4.8	9.3	5.0	8.0	9.0	5.6
Green Ratio (*g/C*)	0.44	0.42	0.42	0.44	0.42	0.42	0.38	0.30	0.30	0.38	0.30	0.30
Capacity (*c*), veh/h	391	706	659	266	706	658	377	1011	450	373	1011	450
Volume-to-Capacity Ratio (*X*)	0.330	0.547	0.549	0.392	0.319	0.326	0.297	0.366	0.208	0.816	0.353	0.232
Available Capacity (c_a), veh/h	391	706	659	266	706	658	377	1011	450	373	1011	450
Back of Queue (*Q*), veh/ln (95th percentile)	2.3	12.1	11.6	2.1	7.0	6.7	3.6	6.8	3.4	9.5	6.5	3.8
Queue Storage Ratio (*RQ*) (95th percentile)	0.30	0.32	0.30	0.36	0.07	0.07	0.31	0.17	0.34	1.22	0.17	0.32
Uniform Delay (d_1), s/veh	22.2	23.6	23.7	23.8	21.0	21.1	22.8	29.2	27.7	32.3	29.1	27.9
Incremental Delay (d_2), s/veh	2.3	3.0	3.3	4.1	1.1	1.2	2.0	1.0	1.0	17.6	1.0	1.2
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	24.4	26.7	26.9	27.8	22.2	22.4	24.8	30.2	28.7	49.9	30.0	29.1
Level of Service (LOS)	C	C	C	C	C	C	C	C	C	D	C	C
Approach Delay, s/veh / LOS	26.4	C		23.3	C		28.9	C		37.8	D	
Intersection Delay, s/veh / LOS	29.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.2	A	0.9	A	1.0	A	1.1	A

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_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/12/2013
Analysis Time Period: AM Peak
Intersection:         N 60th St & Lewis Ave
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        Existing (2013)
Project ID:  I-229 MIS
East/West Street:     N 60th St
North/South Street:   Lewis Ave
Intersection Orientation: EW                 Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments__________________________
Major Street:  Approach        Eastbound              Westbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
_______________________________________________________________________________
Volume                             69     164      120    182
Peak-Hour Factor, PHF              0.80   0.80     0.80   0.80
Hourly Flow Rate, HFR              86     204      149    227
Percent Heavy Vehicles             --     --       2      --     --
Median Type/Storage         Undivided             /
RT Channelized?
Lanes                              1    0             0   1
Configuration                         TR               LT
Upstream Signal?                   No                     No

_______________________________________________________________________________
Minor Street:  Approach        Northbound             Southbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
_______________________________________________________________________________
Volume                      82            25
Peak Hour Factor, PHF       0.80          0.80
Hourly Flow Rate, HFR       102           31
Percent Heavy Vehicles      2             2
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage                /                      /
Lanes                          1        1
Configuration                   L      R
_______________________________________________________________________________

_________________Delay, Queue Length, and Level of Service_____________________
Approach            EB     WB          Northbound             Southbound
Movement            1      4   |  7      8      9     |  10     11     12
Lane Config                LT  |  L             R     |
_______________________________________________________________________________
v (vph)                    149    102           31
C(m) (vph)                 1272   351           854
v/c                        0.12   0.29          0.04
95% queue length           0.40   1.18          0.11
Control Delay              8.2    19.4          9.4
LOS                         A      C             A
Approach Delay                           17.1
Approach LOS                              C
_______________________________________________________________________________
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Phone:                                            Fax:
E-Mail:

______________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_____________________

Analyst:               JKM
Agency/Co.:            HDR
Date Performed:        11/12/2013
Analysis Time Period: AM Peak
Intersection:          N 60th St & Lewis Ave
Jurisdiction:          Sioux Falls, SD
Units: U. S. Customary
Analysis Year:         Existing (2013)
Project ID:  I-229 MIS
East/West Street:      N 60th St
North/South Street:    Lewis Ave
Intersection Orientation: EW                  Study period (hrs):  0.25

________________________Vehicle Volumes and Adjustments________________________
Major Street Movements      1      2      3      4      5      6
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                             69     164    120    182
Peak-Hour Factor, PHF              0.80   0.80   0.80   0.80
Peak-15 Minute Volume              22     51     38     57
Hourly Flow Rate, HFR              86     204    149    227
Percent Heavy Vehicles             --     --     2      --     --
Median Type/Storage         Undivided              /
RT Channelized?
Lanes                              1    0           0   1
Configuration                          TR            LT
Upstream Signal?                   No                   No
______________________________________________________________________________
Minor Street Movements      7      8      9      10     11     12
                            L      T      R      L      T      R

______________________________________________________________________________
Volume                     82            25
Peak Hour Factor, PHF      0.80          0.80
Peak-15 Minute Volume      26            8
Hourly Flow Rate, HFR      102           31
Percent Heavy Vehicles     2             2
Percent Grade (%)                  0                    0
Flared Approach:  Exists?/Storage               /                      /
RT Channelized?                          No
Lanes                         1        1
Configuration                  L      R
______________________________________________________________________________

______________________Pedestrian Volumes and Adjustments_______________________
Movements                    13     14     15     16

______________________________________________________________________________
Flow (ped/hr)                0      0      0      0
```

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		227
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1800
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			2	2		2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		2	2		2			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		290	713		188			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	188	
Potential Capacity	854	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	854	
Probability of Queue free St.	0.96	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	290	
Potential Capacity	1272	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1272	
Probability of Queue free St.	0.88	1.00
Maj L-Shared Prob Q free St.	0.87	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	713	
Potential Capacity	398	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.87
Maj. L, Min T Adj. Imp Factor.		0.90
Cap. Adj. factor due to Impeding mvmnt	0.88	0.86
Movement Capacity	351	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.87
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	713	
Potential Capacity	398	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.87
Maj. L, Min T Adj. Imp Factor.		0.90
Cap. Adj. factor due to Impeding mvmnt	0.88	0.86
Movement Capacity	351	
Results for Two-stage process:		
a		
y		
C t	351	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	102		31			
Movement Capacity (vph)	351		854			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	351		854			
Volume	102		31			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT	L		R			
v (vph)		149	102		31			
C(m) (vph)		1272	351		854			
v/c		0.12	0.29		0.04			
95% queue length		0.40	1.18		0.11			
Control Delay		8.2	19.4		9.4			
LOS		A	C		A			
Approach Delay				17.1				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.88
v(il), Volume for stream 2 or 5		227
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.87
d(M,LT), Delay for stream 1 or 4		8.2
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		1.1

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TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/12/2013
Analysis Time Period: PM Peak
Intersection: N 60th St & Lewis Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: N 60th St
North/South Street: Lewis Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		131	59	27	87	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Hourly Flow Rate, HFR		140	63	29	93	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration		TR		LT		
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	147		76			
Peak Hour Factor, PHF	0.93		0.93			
Hourly Flow Rate, HFR	158		81			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	1		1			
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT	L		R			
v (vph)		29	158		81			
C(m) (vph)		1369	657		872			
v/c		0.02	0.24		0.09			
95% queue length		0.06	0.94		0.31			
Control Delay		7.7	12.2		9.6			
LOS		A	B		A			
Approach Delay				11.3				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/12/2013
Analysis Time Period: PM Peak
Intersection: N 60th St & Lewis Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: N 60th St
North/South Street: Lewis Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		131	59	27	87	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Peak-15 Minute Volume		35	16	7	23	
Hourly Flow Rate, HFR		140	63	29	93	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration		TR		LT		
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	147		76			
Peak Hour Factor, PHF	0.93		0.93			
Peak-15 Minute Volume	40		20			
Hourly Flow Rate, HFR	158		81			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1	1				
Configuration	L	R				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		93
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1800
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2		2			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.1	6.4		6.2			
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		2	2		2			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		203	323		172			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	172	
Potential Capacity	872	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	872	
Probability of Queue free St.	0.91	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	203	
Potential Capacity	1369	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1369	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	323	
Potential Capacity	671	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.89
Movement Capacity	657	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		

Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	323	
Potential Capacity	671	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.89
Movement Capacity	657	

Results for Two-stage process:		
a		
y		
C t	657	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	158		81			
Movement Capacity (vph)	657		872			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	657		872			
Volume	158		81			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

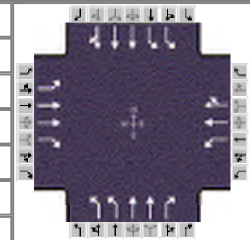
Movement	1	4	7	8	9	10	11	12
Lane Config		LT	L		R			
v (vph)		29	158		81			
C(m) (vph)		1369	657		872			
v/c		0.02	0.24		0.09			
95% queue length		0.06	0.94		0.31			
Control Delay		7.7	12.2		9.6			
LOS		A	B		A			
Approach Delay				11.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(il), Volume for stream 2 or 5		93
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1800
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		7.7
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

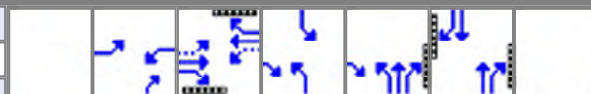
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 14, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	57th St & Louise Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_57th_St_AM.xus				
Project Description	Existing AM				

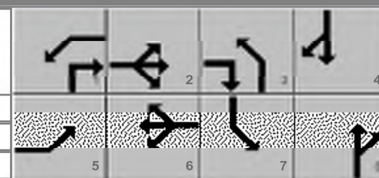


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	108	698	579	89	440	138	573	592	94	120	339	63

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.0	30.0	8.0	11.0	26.0	0.0
Yellow	4.0	4.0	4.0	4.0	4.0	0.0
Red	1.0	2.0	2.0	2.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	3.0	1.1	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	11.0	36.0	11.0	36.0	31.0	49.0	14.0	32.0
Change Period, ($Y+R_c$), s	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.1	4.1	4.1	4.1	4.1	4.1	4.2	4.1
Queue Clearance Time (g_s), s	8.0	32.0	6.9	21.9	25.8	18.4	6.9	10.7
Green Extension Time (g_e), s	0.0	0.0	0.0	5.8	0.0	6.2	0.1	5.3
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	1.00	1.00	0.83	1.00	0.05	1.00	0.19

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	135	873	724	103	349	323	716	740	118	150	340	162
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	1681	1765	1620	1632	1680	1496	1632	1765	1623
Queue Service Time (g_s), s	6.0	28.1	30.0	4.9	19.7	19.9	23.8	16.4	4.2	4.9	8.3	8.7
Cycle Queue Clearance Time (g_c), s	6.0	28.1	30.0	4.9	19.7	19.9	23.8	16.4	4.2	4.9	8.3	8.7
Green Ratio (*g/C*)	0.33	0.27	0.50	0.33	0.27	0.27	0.23	0.39	0.45	0.07	0.24	0.24
Capacity (*c*), veh/h	213	916	748	157	481	442	742	1313	666	237	834	384
Volume-to-Capacity Ratio (*X*)	0.633	0.952	0.968	0.658	0.725	0.730	0.966	0.563	0.176	0.632	0.408	0.423
Available Capacity (c_a), veh/h	213	916	748	157	481	442	742	1313	666	237	834	384
Back of Queue (*Q*), veh/ln (95th percentile)	6.0	19.8	29.9	2.8	10.0	9.3	16.6	9.6	2.6	4.2	6.5	6.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.76	0.50	1.78	0.57	0.25	0.24	2.11	0.42	0.22	0.61	0.16	0.17
Uniform Delay (d_1), s/veh	31.0	39.3	26.6	30.6	36.3	36.3	37.9	20.0	14.2	48.3	31.6	31.7
Incremental Delay (d_2), s/veh	13.5	20.2	26.0	2.6	1.2	1.3	25.6	1.8	0.6	12.1	1.5	3.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	44.5	59.5	52.6	33.2	37.4	37.6	63.5	21.7	14.8	60.4	33.1	35.1
Level of Service (LOS)	D	E	D	C	D	D	E	C	B	E	C	D
Approach Delay, s/veh / LOS	55.4	E		36.9	D		40.2	D		39.9	D	
Intersection Delay, s/veh / LOS	45.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.1	C	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.9	A	1.2	A	1.8	A	0.8	A

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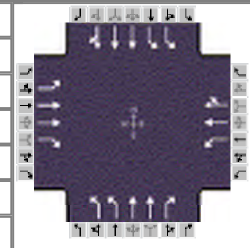
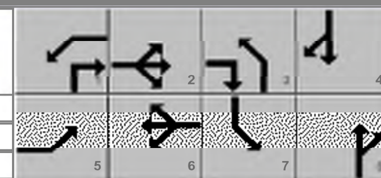
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 14, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	57th St & Louise Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_57th_St_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	164	593	545	131	593	217	516	790	120	278	916	158

Signal Information										
Cycle, s	100.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	7.0	23.0	13.0	1.0	27.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	4.0	4.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.0	2.0	2.0	2.0	0.0



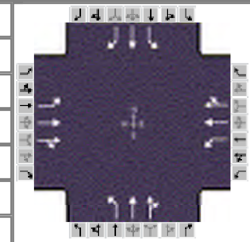
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	3.0	1.1	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	12.0	29.0	12.0	29.0	26.0	40.0	19.0	33.0
Change Period, ($Y+R_c$), s	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (MAH), s	4.1	4.1	4.1	4.1	4.1	4.1	4.2	4.1
Queue Clearance Time (g_s), s	9.0	25.0	8.4	25.0	18.1	22.8	10.6	22.5
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.5	7.0	0.3	3.4
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	1.00	1.00	1.00	1.00	1.00	0.64	1.00	0.97

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	176	638	586	140	453	412	555	849	129	299	789	365
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1680	1496	1681	1765	1602	1632	1680	1496	1632	1765	1628
Queue Service Time (g_s), s	7.0	18.0	23.0	6.4	23.0	23.0	16.1	20.8	4.8	8.6	20.4	20.5
Cycle Queue Clearance Time (g_c), s	7.0	18.0	23.0	6.4	23.0	23.0	16.1	20.8	4.8	8.6	20.4	20.5
Green Ratio (g/C)	0.30	0.23	0.43	0.30	0.23	0.23	0.20	0.34	0.41	0.13	0.27	0.27
Capacity (c), veh/h	190	773	643	203	406	369	653	1142	613	424	953	440
Volume-to-Capacity Ratio (X)	0.930	0.825	0.911	0.689	1.117	1.118	0.850	0.744	0.210	0.705	0.828	0.831
Available Capacity (c_a), veh/h	190	773	643	203	406	369	653	1142	613	424	953	440
Back of Queue (Q), veh/ln (95th percentile)	9.7	12.8	21.9	5.0	23.5	21.8	11.2	12.1	2.9	7.0	13.8	14.3
Queue Storage Ratio (RQ) (95th percentile)	1.23	0.33	1.31	1.01	0.60	0.55	1.42	0.53	0.25	1.01	0.35	0.36
Uniform Delay (d_1), s/veh	32.3	36.6	26.7	29.2	38.5	38.5	35.2	23.7	15.6	39.5	29.9	29.9
Incremental Delay (d_2), s/veh	49.2	9.8	19.4	9.1	68.6	70.3	13.1	4.4	0.8	9.4	8.2	16.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	81.5	46.4	46.1	38.4	107.1	108.8	48.3	28.1	16.4	49.0	38.1	46.5
Level of Service (LOS)	F	D	D	D	F	F	D	C	B	D	D	D
Approach Delay, s/veh / LOS	50.7	D		98.2	F		34.5	C		42.5	D	
Intersection Delay, s/veh / LOS	52.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.1	C	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.6	A	1.3	A	1.8	A	1.3	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 14, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	57th St & Western Ave	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_57th_St_AM.xus				
Project Description	Existing AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	289	365	138	75	490	270	164	604	44	120	409	251

Signal Information			
Cycle, s	94.0	Reference Phase	6
Offset, s	27	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.4	12.1	12.1	6.1	13.1	9.8
Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Red	2.0	2.0	2.0	2.0	2.0	2.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.3	4.0	1.2	4.0	1.3	4.0	1.2	3.0
Phase Duration, s	18.0	36.0	11.3	29.3	15.7	34.7	12.0	31.0
Change Period, (Y+R_c), s	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Max Allow Headway (MAH), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.2
Queue Clearance Time (g_s), s	14.1		6.4		8.8	21.7	8.1	27.1
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	1.0	2.7	0.0	0.0
Phase Call Probability	1.00		0.91		1.00	1.00	0.98	1.00
Max Out Probability	1.00		1.00		1.00	0.43	1.00	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	361	328	301	94	505	445	205	410	400	150	511	314
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1600	1681	1765	1553	1681	1765	1722	1681	1765	1496
Queue Service Time (g_s), s	12.1	14.6	14.8	4.4	23.4	23.4	6.8	19.7	19.7	6.1	25.1	18.3
Cycle Queue Clearance Time (g_c), s	12.1	14.6	14.8	4.4	23.4	23.4	6.8	19.7	19.7	6.1	25.1	18.3
Green Ratio (g/C)	0.24	0.32	0.32	0.21	0.25	0.25	0.22	0.31	0.31	0.23	0.27	0.27
Capacity (c), veh/h	293	565	512	173	439	387	252	541	527	186	471	399
Volume-to-Capacity Ratio (X)	1.233	0.580	0.587	0.541	1.150	1.150	0.815	0.758	0.759	0.808	1.085	0.786
Available Capacity (c_a), veh/h	293	565	512	173	439	387	275	565	551	186	471	399
Back of Queue (Q), veh/ln (95th percentile)	22.5	8.8	8.3	3.4	30.3	27.5	9.4	13.7	13.5	7.2	27.4	11.9
Queue Storage Ratio (RQ) (95th percentile)	2.86	0.22	0.21	0.49	0.77	0.70	2.40	0.35	0.34	1.21	0.93	0.40
Uniform Delay (d_1), s/veh	39.4	26.7	26.7	32.3	35.3	35.3	39.5	29.5	29.5	33.8	34.5	32.0
Incremental Delay (d_2), s/veh	117.9	2.0	2.2	3.4	90.8	93.3	15.9	5.6	5.8	22.6	66.3	9.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	157.3	28.6	29.0	35.7	126.1	128.6	55.4	35.1	35.3	56.4	100.8	41.9
Level of Service (LOS)	F	C	C	D	F	F	E	D	D	E	F	D
Approach Delay, s/veh / LOS	75.7	E		119.1	F		39.3	D		75.0	E	
Intersection Delay, s/veh / LOS	77.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.8	C	2.8	C	2.9	C
Bicycle LOS Score / LOS	1.3	A	1.3	A	1.3	A	2.1	B

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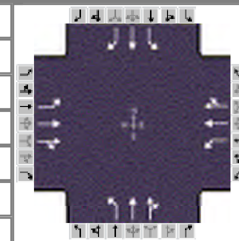
HCS 2010 Signalized Intersection Results Summary

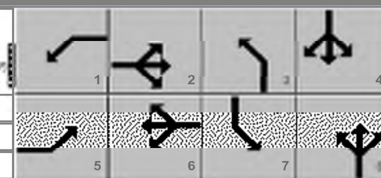
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 14, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	57th St & Western Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_57th_St_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	288	685	158	97	479	186	179	512	65	255	577	306

Signal Information			
Cycle, s	94.0	Reference Phase	6
Offset, s	88	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	6.4	11.8	7.1	15.1	12.1	6.1
Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Red	2.0	2.0	2.0	2.0	2.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.3	4.0	1.2	4.0	1.3	4.0	1.2	3.0
Phase Duration, s	13.0	30.7	12.3	30.0	12.0	30.0	21.0	39.0
Change Period, (Y+R_c), s	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	9.1		6.9		8.1	17.3	14.6	35.0
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	1.8	0.5	0.0
Phase Call Probability	1.00		0.93		0.99	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	0.51	0.26	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	310	468	438	104	374	341	192	316	305	274	620	329
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1650	1681	1765	1596	1681	1765	1695	1681	1765	1496
Queue Service Time (g_s), s	7.1	24.8	24.8	4.9	18.8	19.0	6.1	15.2	15.3	12.6	33.0	17.2
Cycle Queue Clearance Time (g_c), s	7.1	24.8	24.8	4.9	18.8	19.0	6.1	15.2	15.3	12.6	33.0	17.2
Green Ratio (*g/C*)	0.18	0.26	0.26	0.21	0.26	0.26	0.17	0.26	0.26	0.31	0.35	0.35
Capacity (*c*), veh/h	228	465	435	192	452	409	186	452	434	347	621	527
Volume-to-Capacity Ratio (*X*)	1.359	1.008	1.008	0.544	0.827	0.833	1.037	0.699	0.702	0.790	0.998	0.625
Available Capacity (c_a), veh/h	228	465	435	204	452	409	186	452	434	454	621	527
Back of Queue (*Q*), veh/ln (95th percentile)	24.0	19.6	18.7	3.7	14.7	13.9	12.9	11.2	10.9	9.4	26.6	10.2
Queue Storage Ratio (*RQ*) (95th percentile)	3.05	0.50	0.47	0.53	0.37	0.35	3.29	0.28	0.28	1.59	0.90	0.35
Uniform Delay (d_1), s/veh	41.7	34.6	34.6	31.9	33.0	33.0	42.7	31.7	31.7	27.7	30.4	25.3
Incremental Delay (d_2), s/veh	178.5	34.9	36.1	2.6	15.8	17.7	76.0	4.7	5.0	6.9	35.7	2.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	220.2	69.6	70.8	34.5	48.8	50.8	118.7	36.4	36.8	34.6	66.1	27.6
Level of Service (LOS)	F	F	F	C	D	D	F	D	D	C	E	C

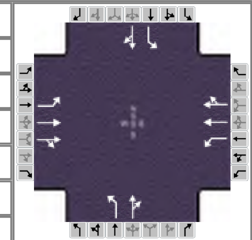
Approach Delay, s/veh / LOS	108.3	F	47.8	D	56.0	E	48.7	D
Intersection Delay, s/veh / LOS	67.8				E			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.9	C	2.8	C	2.9	C
Bicycle LOS Score / LOS	1.5	A	1.2	A	1.2	A	2.5	B

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:09:21 AM

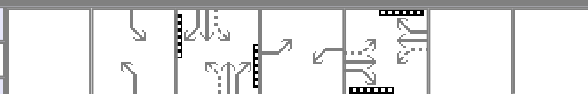
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/2/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.92
Intersection	33rd St & Cliff Ave	Analysis Year	2013	Analysis Period	1> 7:30
File Name	Existing_Yeager_33rd_AM.xus				
Project Description	Existing AM				

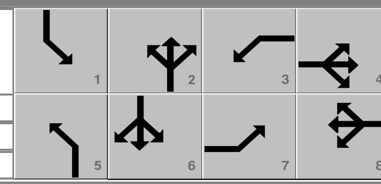


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	0	0	0	0	0	0	0	0	0	0	0	0

Signal Information			
Cycle, s	0.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	1.0	1.9	1.0	1.5	0.0	0.0



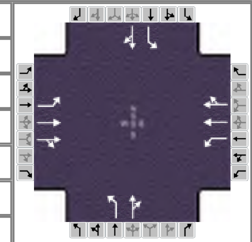
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Change Period, ($Y+R_c$), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Queue Clearance Time (g_s), s								
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phase Call Probability								
Max Out Probability								

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	0	0	0	0	0	0	0	0		0	0	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1714	1800	0	1714	1800	0	1714	0		1714	0	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Cycle Queue Clearance Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Green Ratio (*g/C*)												
Capacity (*c*), veh/h	1203804	58747		1203798	58747		1203335			1203338		
Volume-to-Capacity Ratio (*X*)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	
Available Capacity (c_a), veh/h	3525725	23205227		3525720	23440217		3525256			3525259		
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	0.0		0.0	0.0		0.0			0.0		
Queue Storage Ratio (*RQ*) (95th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	0.0	0.0		0.0	0.0		0.0			0.0		
Incremental Delay (d_2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	0.0	0.0		0.0	0.0		0.0			0.0		
Level of Service (LOS)												
Approach Delay, s/veh / LOS	0.0			0.0			0.0			0.0		
Intersection Delay, s/veh / LOS									F			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.5	B	3.0	C	3.0	C
Bicycle LOS Score / LOS	0.5	A	0.5	A	0.5	A	0.5	A

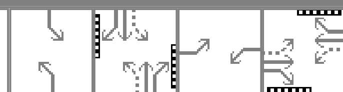
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	7/2/2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.92
Intersection	33rd St & Cliff Ave	Analysis Year	2013	Analysis Period	1> 4:45
File Name	Existing_Yeager_33rd_PM.xus				
Project Description	Existing PM				

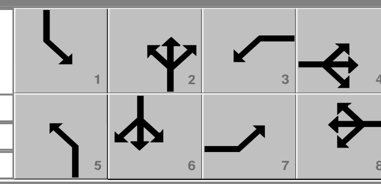


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	0	0	0	0	0	0	0	0	0	0	0	0

Signal Information			
Cycle, s	0.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	1.0	1.9	1.0	1.5	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Change Period, (*Y+Rc*), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Queue Clearance Time (*gs*), s								
Green Extension Time (*ge*), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phase Call Probability								
Max Out Probability								

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	0	0	0	0	0	0	0	0		0	0	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1714	1800	0	1714	1800	0	1714	0		1714	0	
Queue Service Time (*gs*), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Cycle Queue Clearance Time (*gc*), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Green Ratio (*g/C*)												
Capacity (*c*), veh/h	1203804	58747		1203798	58747		1203335			1203338		
Volume-to-Capacity Ratio (*X*)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	
Available Capacity (*ca*), veh/h	3525725	23205227		3525720	23440217		3525256			3525259		
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	0.0		0.0	0.0		0.0			0.0		
Queue Storage Ratio (*RQ*) (95th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	0.0	0.0		0.0	0.0		0.0			0.0		
Incremental Delay (d_2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	0.0	0.0		0.0	0.0		0.0			0.0		
Level of Service (LOS)												
Approach Delay, s/veh / LOS	0.0			0.0			0.0			0.0		
Intersection Delay, s/veh / LOS									F			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.5	B	3.0	C	3.0	C
Bicycle LOS Score / LOS	0.5	A	0.5	A	0.5	A	0.5	A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                 HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY____________________________

Analyst:              JKM
Agency/Co.:           HDR
Date Performed:       11/15/2013
Analysis Time Period: AM Peak
Intersection:         Yeager Road & I-229 SB Ramps
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        Existing (2013)
Project ID:  I-229 MIS
East/West Street:     I-229 SB Ramps
North/South Street:   Yeager Road
Intersection Orientation: NS                 Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments__________________________
Major Street:  Approach        Northbound              Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
_______________________________________________________________________________
Volume                             102    6        686    194
Peak-Hour Factor, PHF              0.80   0.80     0.80   0.80
Hourly Flow Rate, HFR              127    7        857    242
Percent Heavy Vehicles             --     --       2      --     --
Median Type/Storage         TWLTL                 / 1
RT Channelized?
Lanes                              1    0             1   1
Configuration                         TR               L  T
Upstream Signal?                   No                     Yes
_______________________________________________________________________________
Minor Street:  Approach        Westbound               Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
_______________________________________________________________________________
Volume                      63            194
Peak Hour Factor, PHF       0.80          0.80
Hourly Flow Rate, HFR       78            242
Percent Heavy Vehicles      2             2
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage         No     /                     /
Lanes                          0        0
Configuration                      LR
_______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service____________________
Approach           NB     SB         Westbound             Eastbound
Movement           1      4   |  7      8      9    |  10     11     12
Lane Config               L   |         LR          |
_______________________________________________________________________________
v (vph)                   857           320
C(m) (vph)                1451          105
v/c                       0.59          3.05
95% queue length          4.10          30.77
Control Delay             11.0          1009
LOS                        B             F
Approach Delay                          1009
Approach LOS                             F
_______________________________________________________________________________
```

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/15/2013
Analysis Time Period: AM Peak
Intersection: Yeager Road & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: I-229 SB Ramps
North/South Street: Yeager Road
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		102	6	686	194	
Peak-Hour Factor, PHF		0.80	0.80	0.80	0.80	
Peak-15 Minute Volume		32	2	214	61	
Hourly Flow Rate, HFR		127	7	857	242	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes		1	0	1	1	
Configuration		TR		L	T	
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	63		194			
Peak Hour Factor, PHF	0.80		0.80			
Peak-15 Minute Volume	20		61			
Hourly Flow Rate, HFR	78		242			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0	0				
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	817	1800	3	41	146	30	675
	Through	0	1800	3	0	146	30	675

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			2	2		2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage		4.1	5.4		6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		2	2		2			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog			0	817

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	0	41
Cycle Length, C (sec)	146	146
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.000	0.281
g(q1)	0.0	47.7
g(q2)	0.0	39.6
g(q)	0.0	87.3

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.400	
beta			0.714	
Travel time, t(a) (sec)			15.306	
Smoothing Factor, F			0.186	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			0	1800
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			0.0	37.1
Proportion time blocked, p	0.000		0.254	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.254
p(dom)	0.254
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	1.000		
p(7)	0.746	1.000	0.746
p(8)			
p(9)	1.000		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		134	2086		130			
s		1500	1500		1500			
Px		1.000	0.746		1.000			
V c,u,x		134	2285		130			
C r,x		1451	43		920			
C plat,x		1451	32		920			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	130	1956						
s	1500	1500						
P(x)	1.000	0.746						
V(c,u,x)	130	2111						
C(r,x)	896	101						
C(plat,x)	896	75						

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	130	
Potential Capacity	920	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	920	
Probability of Queue free St.	0.74	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	134	
Potential Capacity	1451	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1451	
Probability of Queue free St.	0.41	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.41	0.41
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2086	
Potential Capacity	32	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.41
Maj. L, Min T Adj. Imp Factor.		0.53
Cap. Adj. factor due to Impeding mvmnt	0.41	0.39
Movement Capacity	13	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	792	69
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.41
Movement Capacity	792	28
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	69	789
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.41	1.00
Movement Capacity	28	789
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.41	0.41
Movement Capacity		
Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows	130	
Potential Capacity	896	76
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.41
Movement Capacity	896	31
Part 2 - Second Stage		
Conflicting Flows	1956	
Potential Capacity	75	795
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.41	0.74
Movement Capacity	31	586
Part 3 - Single Stage		
Conflicting Flows	2086	
Potential Capacity	32	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.41
Maj. L, Min T Adj. Imp Factor.		0.53
Cap. Adj. factor due to Impeding mvmnt	0.41	0.39
Movement Capacity	13	
Results for Two-stage process:		
a	0.91	0.91
y	49.06	
C t	28	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	78		242			
Movement Capacity (vph)	28		920			
Shared Lane Capacity (vph)		105				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	28		920			
Volume	78		242			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		105				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L		LR				
v (vph)		857		320				
C(m) (vph)		1451		105				
v/c		0.59		3.05				
95% queue length		4.10		30.77				
Control Delay		11.0		1009				
LOS		B		F				
Approach Delay				1009				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.41
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		11.0
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/15/2013
Analysis Time Period: PM Peak
Intersection: Yeager Road & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: I-229 SB Ramps
North/South Street: Yeager Road
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		235	5	538	115	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Hourly Flow Rate, HFR		252	5	578	123	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes		1	0	1	1	
Configuration		TR		L	T	
Upstream Signal?		No			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	76		381			
Peak Hour Factor, PHF	0.93		0.93			
Hourly Flow Rate, HFR	81		409			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			/
Lanes	0	0				
Configuration		LR				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L		LR				
v (vph)		578		490				
C(m) (vph)		1308		390				
v/c		0.44		1.26				
95% queue length		2.32		21.18				
Control Delay		9.9		164.4				
LOS		A		F				
Approach Delay				164.4				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: JKM
Agency/Co.: HDR
Date Performed: 11/15/2013
Analysis Time Period: PM Peak
Intersection: Yeager Road & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: Existing (2013)
Project ID: I-229 MIS
East/West Street: I-229 SB Ramps
North/South Street: Yeager Road
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		235	5	538	115	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Peak-15 Minute Volume		63	1	145	31	
Hourly Flow Rate, HFR		252	5	578	123	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes		1	0	1	1	
Configuration			TR	L	T	
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	76		381			
Peak Hour Factor, PHF	0.93		0.93			
Peak-15 Minute Volume	20		102			
Hourly Flow Rate, HFR	81		409			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	566	1800	3	31	146	30	675
	Through	0	1800	3	0	146	30	675

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.1		6.2			
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			2	2		2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1	6.4		6.2			
	2-stage		4.1	5.4		6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		2	2		2			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog			0	566

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	0	31
Cycle Length, C (sec)	146	146
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.000	0.212
g(q1)	0.0	36.2
g(q2)	0.0	16.6
g(q)	0.0	52.7

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.400	
beta			0.714	
Travel time, t(a) (sec)			15.306	
Smoothing Factor, F			0.186	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			0	1800
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			0.0	27.1
Proportion time blocked, p	0.000		0.185	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.185
p(dom)	0.185
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)			
p(4)	1.000		
p(7)	0.815	1.000	0.815
p(8)			
p(9)	1.000		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		257	1533		254			
s		1500	1500		1500			
Px		1.000	0.815		1.000			
V c,u,x		257	1541		254			
C r,x		1308	127		785			
C plat,x		1308	103		785			

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	254	1279						
s	1500	1500						
P(x)	1.000	0.815						
V(c,u,x)	254	1229						
C(r,x)	788	276						
C(plat,x)	788	225						

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	254	
Potential Capacity	785	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	785	
Probability of Queue free St.	0.48	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	257	
Potential Capacity	1308	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1308	
Probability of Queue free St.	0.56	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.56	0.56
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1533	
Potential Capacity	103	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.56
Maj. L, Min T Adj. Imp Factor.		0.65
Cap. Adj. factor due to Impeding mvmnt	0.56	0.31
Movement Capacity	57	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	701	205
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.56
Movement Capacity	701	114
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	205	699
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.56	1.00
Movement Capacity	114	699

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.56	0.56
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows	254	
Potential Capacity	788	227
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.56
Movement Capacity	788	127

Part 2 - Second Stage		
Conflicting Flows	1279	
Potential Capacity	225	641
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.56	0.48
Movement Capacity	126	307

Part 3 - Single Stage		
Conflicting Flows	1533	
Potential Capacity	103	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.56
Maj. L, Min T Adj. Imp Factor.		0.65
Cap. Adj. factor due to Impeding mvmnt	0.56	0.31
Movement Capacity	57	

Results for Two-stage process:		
a	0.91	0.91
y	10.59	
C t	110	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	81		409			
Movement Capacity (vph)	110		785			
Shared Lane Capacity (vph)		390				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	110		785			
Volume	81		409			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		390				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

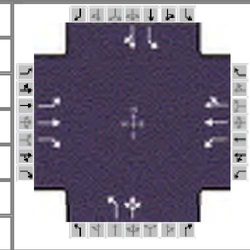
Movement	1	4	7	8	9	10	11	12
Lane Config		L		LR				
v (vph)		578		490				
C(m) (vph)		1308		390				
v/c		0.44		1.26				
95% queue length		2.32		21.18				
Control Delay		9.9		164.4				
LOS		A		F				
Approach Delay				164.4				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.56
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		9.9
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

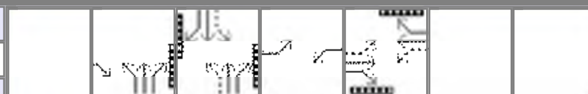
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Southeastern Ave & 18th S	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Southeastern_AM.xus				
Project Description	Existing AM				

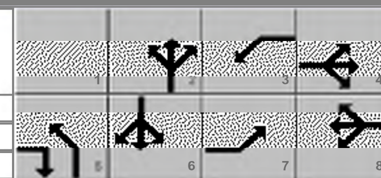


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	0	0	0	0	0	0	0	0	0	0	0	0

Signal Information			
Cycle, s	0.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	2.3	2.3	2.3	2.3	0.0	0.0



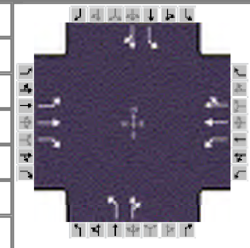
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2		6
Case Number	1.1	3.0	1.1	4.0	1.0	4.0		6.3
Phase Duration, s	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Change Period, (Y+R_c), s	5.9	5.9	5.9	5.9	5.9	5.9		5.9
Max Allow Headway (MAH), s	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Queue Clearance Time (g_s), s								
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Phase Call Probability								
Max Out Probability								

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	0	0	0	0	0	0	0	0		0	0	
Adjusted Saturation Flow Rate (s), veh/h/ln	1714	1800	1525	1714	1800	0	1714	1714		1714	0	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Cycle Queue Clearance Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Green Ratio (g/C)			0.00									
Capacity (c), veh/h	951303	23221		951303	46443		951154	951154		928857		
Volume-to-Capacity Ratio (X)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	
Available Capacity (c_a), veh/h	2278242	5596362	3582449	2278242	11192723		15105161	15105161		4246000		
Back of Queue (Q), veh/ln (95th percentile)												
Queue Storage Ratio (RQ) (95th percentile)												
Uniform Delay (d_1), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0		
Incremental Delay (d_2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh												
Level of Service (LOS)												
Approach Delay, s/veh / LOS												
Intersection Delay, s/veh / LOS												

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS								
Bicycle LOS Score / LOS								

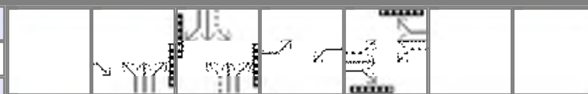
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Aug 6, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.92
Intersection	Southeastern Ave & 18th S	Analysis Year	2013	Analysis Period	1> 4:45
File Name	Existing_Southeastern_PM.xus				
Project Description	Existing PM				

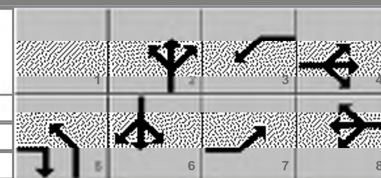


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	0	0	0	0	0	0	0	0	0	0	0	0

Signal Information			
Cycle, s	0.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	2.3	2.3	2.3	2.3	0.0	0.0



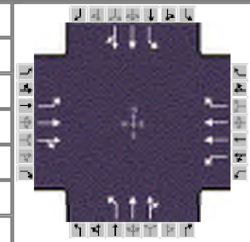
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2		6
Case Number	1.1	3.0	1.1	4.0	1.0	4.0		6.3
Phase Duration, s	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9	5.9	5.9		5.9
Max Allow Headway (*MAH*), s	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Queue Clearance Time (g_s), s								
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Phase Call Probability								
Max Out Probability								

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	0	0	0	0	0	0	0	0		0	0	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1714	1800	1525	1714	1800	0	1714	0		1714	0	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Cycle Queue Clearance Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Green Ratio (*g/C*)			0.00									
Capacity (*c*), veh/h	851651	20768		851651	41537		850701			830738		
Volume-to-Capacity Ratio (*X*)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	
Available Capacity (c_a), veh/h	2038420	13312577	10243745	2038420	26625154		5597775			6764219		
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	0.0	0.0	0.0	0.0		0.0			0.0		
Queue Storage Ratio (*RQ*) (95th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	0.0	0.0	0.0	0.0	0.0		0.0			0.0		
Incremental Delay (d_2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	0.0	0.0	0.0	0.0	0.0		0.0			0.0		
Level of Service (LOS)												
Approach Delay, s/veh / LOS	0.0			0.0			0.0			0.0		
Intersection Delay, s/veh / LOS							F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.5	B	2.6	B	3.0	C
Bicycle LOS Score / LOS	0.5	A	0.5	A	0.5	A	0.5	A

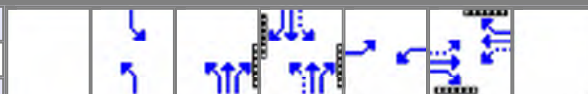
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 13, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.80
Intersection	Southeastern Ave & 26th S	Analysis Year	2013	Analysis Period	1> 7:15
File Name	Existing_Southeastern_AM.xus				
Project Description	Existing AM				

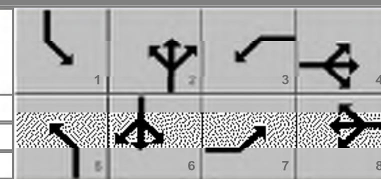


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	57	718	132	57	1240	220	546	446	89	57	69	44

Signal Information			
Cycle, s	134.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.0	43.0	7.9	7.9	54.0	0.0
Yellow	3.9	3.9	3.9	3.9	3.9	0.0
Red	1.0	1.0	1.8	1.0	1.8	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	12.8	59.7	12.8	59.7	47.9	61.5	0.0	13.6
Change Period, (*Y*+*R*c), s	4.9	5.7	4.9	5.7	4.9	5.7	4.9	5.7
Max Allow Headway (*MAH*), s	4.2	4.1	4.2	4.1	4.2	4.1	0.0	4.1
Queue Clearance Time (g_s), s	5.2	34.7	5.2	56.0	45.0	21.0		8.0
Green Extension Time (g_e), s	0.0	14.0	0.0	0.0	0.0	2.8	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00		1.00
Max Out Probability	1.00	0.70	1.00	1.00	1.00	0.01		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	71	546	517	71	1550	275	683	343	325	0	0	71
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1669	1681	1680	1496	1681	1765	1662	1681	1765	1548
Queue Service Time (g_s), s	3.2	32.7	32.7	3.2	54.0	15.1	43.0	18.9	19.0	0.0	0.0	6.0
Cycle Queue Clearance Time (g_c), s	3.2	32.7	32.7	3.2	54.0	15.1	43.0	18.9	19.0	0.0	0.0	6.0
Green Ratio (*g/C*)	0.46	0.40	0.40	0.46	0.40	0.40	0.39	0.42	0.42	0.02	0.06	0.06
Capacity (*c*), veh/h	153	711	672	229	1354	603	613	735	692	100	104	
Volume-to-Capacity Ratio (*X*)	0.466	0.768	0.768	0.311	1.145	0.456	1.114	0.467	0.470	0.000	0.000	0.000
Available Capacity (c_a), veh/h	153	711	672	229	1354	603	613	735	692	198	104	
Back of Queue (*Q*), veh/ln (95th percentile)	3.0	20.1	19.3	2.6	47.3	9.1	43.2	13.3	12.7	0.0	0.0	
Queue Storage Ratio (*RQ*) (95th percentile)	1.52	0.51	0.49	0.67	1.78	0.92	3.66	0.34	0.32	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	30.5	26.1	26.1	24.9	31.0	22.0	39.3	28.3	28.4	0.0	0.0	
Incremental Delay (d_2), s/veh	9.9	7.8	8.2	3.5	74.3	2.5	71.7	2.1	2.3	0.0	0.0	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	40.4	33.8	34.3	28.4	105.3	24.5	111.1	30.5	30.7	0.0	0.0	
Level of Service (LOS)	D	C	C	C	F	C	F	C	C			A
Approach Delay, s/veh / LOS	34.5	C		90.7	F		71.2	E			A	
Intersection Delay, s/veh / LOS	69.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.4	A	2.1	B	1.6	A	0.7	A

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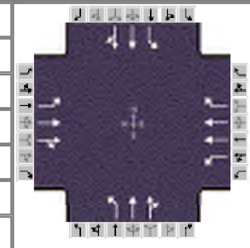
HCS 2010 Signalized Intersection Results Summary

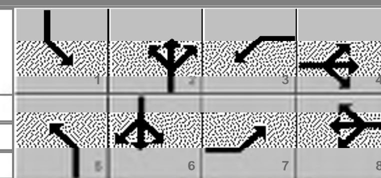
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Aug 6, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.92
Intersection	Southeastern Ave & 26th S	Analysis Year	2013	Analysis Period	1> 4:45
File Name	Existing_Southeastern_PM.xus				
Project Description	Existing PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	0	0	0	0	0	0	0	0	0	0	0	0

Signal Information			
Cycle, s	0.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	3.9	3.9	3.9	3.9	0.0	0.0
Red	1.0	1.8	1.0	1.8	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Change Period, (Y+R_c), s	4.9	5.7	4.9	5.7	4.9	5.7	4.9	5.7
Max Allow Headway (MAH), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Queue Clearance Time (g_s), s								
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phase Call Probability								
Max Out Probability								

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Adjusted Saturation Flow Rate (s), veh/h/ln	1714	1800	0	1714	1714	1525	1714	1800	0	1714	1800	0
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cycle Queue Clearance Time (g_c), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Green Ratio (g/C)						0.00						
Capacity (c), veh/h	828679	40399		828679	38460	17118	827563	40399		827563	40399	
Volume-to-Capacity Ratio (X)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Available Capacity (c_a), veh/h	1790558	31632342		1790558	30113990	13403535	3520823	11028901		3520823	11028901	
Back of Queue (Q), veh/ln (95th percentile)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Queue Storage Ratio (RQ) (95th percentile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uniform Delay (d_1), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Incremental Delay (d_2), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Level of Service (LOS)												
Approach Delay, s/veh / LOS	0.0			0.0			0.0			0.0		
Intersection Delay, s/veh / LOS										F		

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.0	C	3.2	C	3.0	C
Bicycle LOS Score / LOS	0.5	A	0.5	A	0.5	A	0.5	A

FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	I-29 NB to Louise Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	Two-Sided
Weaving number of lanes, N	2
Weaving segment length, L_S	2900ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	820	0.80	14	0	1.5	1.2	0.935	1.00	1097
V_{RF}	424	0.80	10	0	1.5	1.2	0.952	1.00	557
V_{FR}	111	0.80	2	0	1.5	1.2	0.990	1.00	140
V_{RR}	278	0.80	2	0	1.5	1.2	0.990	1.00	351
V_{NW}	1794							V =	2005
V_W	351								
VR	0.164								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	0 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	0 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	1 lc/pc
Minimum weaving lane changes, LC_{MIN}	351 lc/h
Weaving lane changes, LC_W	489 lc/h
Non-weaving lane changes, LC_{NW}	1556 lc/h
Total lane changes, LC_{ALL}	2045 lc/h
Non-weaving vehicle index, I_{NW}	520

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2005 veh/h
Weaving segment capacity, c_w	3856 veh/h
Weaving segment v/c ratio	0.520
Weaving segment density, D	17.5 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.172
Weaving segment speed, S	61.3 mph
Average weaving speed, S_W	61.1 mph
Average non-weaving speed, S_{NW}	61.3 mph
Maximum weaving length, L_{MAX}	7300 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	I-29 NB to Louise Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	Two-Sided
Weaving number of lanes, N	2
Weaving segment length, L_S	2900ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	498	0.93	17	0	1.5	1.2	0.922	1.00	581
V_{RF}	410	0.93	10	0	1.5	1.2	0.952	1.00	463
V_{FR}	101	0.93	2	0	1.5	1.2	0.990	1.00	110
V_{RR}	263	0.93	2	0	1.5	1.2	0.990	1.00	286
V_{NW}	1154							V =	1328
V_W	286								
VR	0.199								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	0 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	0 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	1 lc/pc

Minimum weaving lane changes, LC_{MIN}	286 lc/h
Weaving lane changes, LC_W	424 lc/h
Non-weaving lane changes, LC_{NW}	1424 lc/h
Total lane changes, LC_{ALL}	1848 lc/h
Non-weaving vehicle index, I_{NW}	335

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1328 veh/h
Weaving segment capacity, c_w	3753 veh/h
Weaving segment v/c ratio	0.354
Weaving segment density, D	11.4 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.158
Weaving segment speed, S	63.1 mph
Average weaving speed, S_W	61.6 mph
Average non-weaving speed, S_{NW}	63.5 mph
Maximum weaving length, L_{MAX}	7654 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Louise Off-Ramp to SB On-Ramp*
Date Performed	*11/18/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1244*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*13*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.939*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*828*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*11.8*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Louise Off-Ramp to SB On-Ramp*
Date Performed	*11/18/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*908*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*522*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*7.5*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/3/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Louise SB to Western
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5030ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	978	0.80	13	0	1.5	1.2	0.939	1.00	1302
V_{RF}	407	0.80	2	0	1.5	1.2	0.990	1.00	514
V_{FR}	266	0.80	2	0	1.5	1.2	0.990	1.00	336
V_{RR}	16	0.80	2	0	1.5	1.2	0.990	1.00	20
V_{NW}	1322							V =	2040
V_W	850								
VR	0.391								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	850 lc/h
Weaving lane changes, LC_W	1270 lc/h
Non-weaving lane changes, LC_{NW}	2421 lc/h
Total lane changes, LC_{ALL}	3691 lc/h
Non-weaving vehicle index, I_{NW}	665

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2040 veh/h
Weaving segment capacity, c_w	5758 veh/h
Weaving segment v/c ratio	0.354
Weaving segment density, D	12.1 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.177
Weaving segment speed, S	60.0 mph
Average weaving speed, S_W	60.9 mph
Average non-weaving speed, S_{NW}	59.4 mph
Maximum weaving length, L_{MAX}	6584 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/3/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Louise SB to Western
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5030ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	695	0.93	14	0	1.5	1.2	0.935	1.00	800
V_{RF}	463	0.93	2	0	1.5	1.2	0.990	1.00	503
V_{FR}	213	0.93	2	0	1.5	1.2	0.990	1.00	231
V_{RR}	11	0.93	2	0	1.5	1.2	0.990	1.00	12
V_{NW}	812							V =	1445
V_W	734								
VR	0.475								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	734 lc/h
Weaving lane changes, LC_W	1154 lc/h
Non-weaving lane changes, LC_{NW}	2316 lc/h
Total lane changes, LC_{ALL}	3470 lc/h
Non-weaving vehicle index, I_{NW}	408

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1445 veh/h
Weaving segment capacity, c_w	4724 veh/h
Weaving segment v/c ratio	0.306
Weaving segment density, D	8.4 pc/mi/ln
Level of Service, LOS	A

Weaving intensity factor, W	0.169
Weaving segment speed, S	61.2 mph
Average weaving speed, S_W	61.2 mph
Average non-weaving speed, S_{NW}	61.2 mph
Maximum weaving length, L_{MAX}	7533 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/2/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Louise NB to Western
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3510ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1385	0.80	8	0	1.5	1.2	0.962	1.00	1801
V_{RF}	446	0.80	2	0	1.5	1.2	0.990	1.00	563
V_{FR}	282	0.80	2	0	1.5	1.2	0.990	1.00	356
V_{RR}	70	0.80	2	0	1.5	1.2	0.990	1.00	88
V_{NW}	1889							V =	2700
V_W	919								
VR	0.327								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	563 lc/h
Weaving lane changes, LC_W	909 lc/h
Non-weaving lane changes, LC_{NW}	1714 lc/h
Total lane changes, LC_{ALL}	2623 lc/h
Non-weaving vehicle index, I_{NW}	663

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2700 veh/h
Weaving segment capacity, c_w	6401 veh/h
Weaving segment v/c ratio	0.422
Weaving segment density, D	15.5 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.180
Weaving segment speed, S	60.6 mph
Average weaving speed, S_W	60.8 mph
Average non-weaving speed, S_{NW}	60.5 mph
Maximum weaving length, L_{MAX}	5878 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/2/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Louise NB to Western
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3510ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1158	0.93	8	0	1.5	1.2	0.962	1.00	1295
V_{RF}	267	0.93	2	0	1.5	1.2	0.990	1.00	290
V_{FR}	224	0.93	2	0	1.5	1.2	0.990	1.00	243
V_{RR}	32	0.93	2	0	1.5	1.2	0.990	1.00	35
V_{NW}	1330							V =	1792
V_W	533								
VR	0.286								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	290 lc/h
Weaving lane changes, LC_W	636 lc/h
Non-weaving lane changes, LC_{NW}	1599 lc/h
Total lane changes, LC_{ALL}	2235 lc/h
Non-weaving vehicle index, I_{NW}	467

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1792 veh/h
Weaving segment capacity, c_w	6499 veh/h
Weaving segment v/c ratio	0.276
Weaving segment density, D	9.8 pc/mi/ln
Level of Service, LOS	A
Weaving intensity factor, W	0.158
Weaving segment speed, S	63.3 mph
Average weaving speed, S_W	61.6 mph
Average non-weaving speed, S_{NW}	63.9 mph
Maximum weaving length, L_{MAX}	5435 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Western Off-Ramp to On-Ramp*
Date Performed	*11/18/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1831*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1184*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*16.9*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/18/2013*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Western Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1425*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*793*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*11.3*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Western Ave to Minnesota Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2870ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1418	0.80	7	0	1.5	1.2	0.966	1.00	1835
V_{RF}	481	0.80	2	0	1.5	1.2	0.990	1.00	607
V_{FR}	413	0.80	3	0	1.5	1.2	0.985	1.00	524
V_{RR}	78	0.80	2	0	1.5	1.2	0.990	1.00	98
V_{NW}	1933							V =	2961
V_W	1131								
VR	0.369								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1131 lc/h
Weaving lane changes, LC_W	1441 lc/h
Non-weaving lane changes, LC_{NW}	1376 lc/h
Total lane changes, LC_{ALL}	2817 lc/h
Non-weaving vehicle index, I_{NW}	555

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2961 veh/h
Weaving segment capacity, c_w	6188 veh/h
Weaving segment v/c ratio	0.478
Weaving segment density, D	17.6 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.223
Weaving segment speed, S	58.0 mph
Average weaving speed, S_W	60.0 mph
Average non-weaving speed, S_{NW}	57.0 mph
Maximum weaving length, L_{MAX}	6337 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Western Ave to Minnesota Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2870ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1113	0.93	8	0	1.5	1.2	0.962	1.00	1245
V_{RF}	726	0.93	2	0	1.5	1.2	0.990	1.00	788
V_{FR}	312	0.93	3	0	1.5	1.2	0.985	1.00	341
V_{RR}	37	0.93	2	0	1.5	1.2	0.990	1.00	40
V_{NW}	1285							V =	2322
V_W	1129								
VR	0.468								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1129 lc/h
Weaving lane changes, LC_W	1439 lc/h
Non-weaving lane changes, LC_{NW}	1242 lc/h
Total lane changes, LC_{ALL}	2681 lc/h
Non-weaving vehicle index, I_{NW}	369

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2322 veh/h
Weaving segment capacity, c_w	4934 veh/h
Weaving segment v/c ratio	0.470
Weaving segment density, D	13.6 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.214
Weaving segment speed, S	59.1 mph
Average weaving speed, S_W	60.3 mph
Average non-weaving speed, S_{NW}	58.0 mph
Maximum weaving length, L_{MAX}	7451 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/18/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Minnesota Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1899*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1222*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*17.5*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Minnesota Off-Ramp to On-Ramp*
Date Performed	*11/18/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1839*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1018*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*14.5*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Minnesota Ave to Cliff Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3130ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1460	0.80	6	0	1.5	1.2	0.971	1.00	1880
V_{RF}	275	0.80	3	0	1.5	1.2	0.985	1.00	349
V_{FR}	439	0.80	3	0	1.5	1.2	0.985	1.00	557
V_{RR}	63	0.80	3	0	1.5	1.2	0.985	1.00	80
V_{NW}	1960							V =	2783
V_W	906								
VR	0.316								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	906 lc/h
Weaving lane changes, LC_W	1231 lc/h
Non-weaving lane changes, LC_{NW}	1522 lc/h
Total lane changes, LC_{ALL}	2753 lc/h
Non-weaving vehicle index, I_{NW}	613

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2783 veh/h
Weaving segment capacity, c_w	6405 veh/h
Weaving segment v/c ratio	0.434
Weaving segment density, D	16.1 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.204
Weaving segment speed, S	59.4 mph
Average weaving speed, S_W	60.7 mph
Average non-weaving speed, S_{NW}	58.9 mph
Maximum weaving length, L_{MAX}	5757 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Minnesota Ave to Cliff Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3130ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1381	0.93	6	0	1.5	1.2	0.971	1.00	1529
V_{RF}	440	0.93	3	0	1.5	1.2	0.985	1.00	480
V_{FR}	458	0.93	3	0	1.5	1.2	0.985	1.00	500
V_{RR}	21	0.93	3	0	1.5	1.2	0.985	1.00	23
V_{NW}	1552							V =	2459
V_W	980								
VR	0.387								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	980 lc/h
Weaving lane changes, LC_W	1305 lc/h
Non-weaving lane changes, LC_{NW}	1438 lc/h
Total lane changes, LC_{ALL}	2743 lc/h
Non-weaving vehicle index, I_{NW}	486

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2459 veh/h
Weaving segment capacity, c_w	6020 veh/h
Weaving segment v/c ratio	0.408
Weaving segment density, D	14.2 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.204
Weaving segment speed, S	59.6 mph
Average weaving speed, S_W	60.7 mph
Average non-weaving speed, S_{NW}	58.9 mph
Maximum weaving length, L_{MAX}	6536 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Cliff Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1735*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1111*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*15.9*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Cliff Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1821*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1004*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*14.3*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Cliff Ave to 26th St
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1280	0.80	9	0	1.5	1.2	0.957	1.00	1672
V_{RF}	431	0.80	3	0	1.5	1.2	0.985	1.00	547
V_{FR}	455	0.80	3	0	1.5	1.2	0.985	1.00	577
V_{RR}	10	0.80	3	0	1.5	1.2	0.985	1.00	13
V_{NW}	1685							V =	2689
V_W	1124								
VR	0.400								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1124 lc/h
Weaving lane changes, LC_W	1426 lc/h
Non-weaving lane changes, LC_{NW}	1260 lc/h
Total lane changes, LC_{ALL}	2686 lc/h
Non-weaving vehicle index, I_{NW}	463

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2689 veh/h
Weaving segment capacity, c_w	5740 veh/h
Weaving segment v/c ratio	0.468
Weaving segment density, D	16.3 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.222
Weaving segment speed, S	57.5 mph
Average weaving speed, S_W	59.2 mph
Average non-weaving speed, S_{NW}	56.4 mph
Maximum weaving length, L_{MAX}	6683 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Cliff Ave to 26th St
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1168	0.93	9	0	1.5	1.2	0.957	1.00	1312
V_{RF}	251	0.93	3	0	1.5	1.2	0.985	1.00	274
V_{FR}	653	0.93	3	0	1.5	1.2	0.985	1.00	713
V_{RR}	10	0.93	3	0	1.5	1.2	0.985	1.00	11
V_{NW}	1323							V =	2211
V_W	987								
VR	0.427								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	987 lc/h
Weaving lane changes, LC_W	1289 lc/h
Non-weaving lane changes, LC_{NW}	1185 lc/h
Total lane changes, LC_{ALL}	2474 lc/h
Non-weaving vehicle index, I_{NW}	364

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2211 veh/h
Weaving segment capacity, c_w	5375 veh/h
Weaving segment v/c ratio	0.411
Weaving segment density, D	13.1 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.208
Weaving segment speed, S	58.8 mph
Average weaving speed, S_W	59.7 mph
Average non-weaving speed, S_{NW}	58.2 mph
Maximum weaving length, L_{MAX}	6989 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*26th St Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*
Project Description	*I-229 MIS*		

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1711*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1107*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*15.8*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*26th St Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1419*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	2		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*68.0*	mph	FFS	*68.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*793*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*11.3*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*B*		Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	26th St On-Ramp
Date Performed	11/20/2013	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	1711
Ramp Volume, V_R	452
Freeway Free-Flow Speed, S_{FF}	68.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1711	0.80	Level	7	0	0.966	1.00	2214
Ramp	452	0.80	Level	3	0	0.985	1.00	573
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2214 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2787	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2787	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 21.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.321 (Exibit 13-11)

S_R= 59.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 59.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	26th St On-Ramp
Date Performed	11/20/2013	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	1419
Ramp Volume, V_R	169
Freeway Free-Flow Speed, S_{FF}	68.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1419	0.93	Level	8	0	0.962	1.00	1587
Ramp	169	0.93	Level	3	0	0.985	1.00	184
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1587 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1771	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1771	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 13.6 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.281 (Exibit 13-11)

S_R= 60.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 60.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*26th St to 10th St*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2163*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1413*	pc/h/ln
S	*69.5*	mph
D = v_p / S	*20.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*26th St to 10th St*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1588*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*892*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*12.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	10th St Off-Ramp
Date Performed	11/20/2013	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	2163
Ramp Volume, V_R	566
Freeway Free-Flow Speed, S_{FF}	68.0
Ramp Free-Flow Speed, S_{FR}	58.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2163	0.80	Level	9	0	0.957	1.00	2825
Ramp	566	0.80	Level	6	0	0.971	1.00	729
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2825 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2825	Exhibit 13-8	4760	No
$V_{FO} = V_F - V_R$	2096	Exhibit 13-8	4760	No
V_R	729	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2825	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 22.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.195 (Exhibit 13-12)

S_R= 62.9 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	10th St Off-Ramp
Date Performed	11/20/2013	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	1588
Ramp Volume, V_R	654
Freeway Free-Flow Speed, S_{FF}	68.0
Ramp Free-Flow Speed, S_{FR}	58.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1588	0.93	Level	9	0	0.957	1.00	1784
Ramp	654	0.93	Level	6	0	0.971	1.00	724
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1784 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1784	Exhibit 13-8	4760	No
$V_{FO} = V_F - V_R$	1060	Exhibit 13-8	4760	No
V_R	724	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1784	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 13.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.194 (Exhibit 13-12)

S_R= 63.0 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 63.0 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*10th St Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1597*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1048*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*15.0*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*10th St Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*934*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*530*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*7.6*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/4/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	10th to Rice
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5110ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1359	0.80	10	0	1.5	1.2	0.952	1.00	1784
V_{RF}	538	0.80	6	0	1.5	1.2	0.971	1.00	693
V_{FR}	238	0.80	6	0	1.5	1.2	0.971	1.00	306
V_{RR}	27	0.80	6	0	1.5	1.2	0.971	1.00	35
V_{NW}	1819							V =	2684
V_W	999								
VR	0.355								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	999 lc/h
Weaving lane changes, LC_W	1423 lc/h
Non-weaving lane changes, LC_{NW}	2567 lc/h
Total lane changes, LC_{ALL}	3990 lc/h
Non-weaving vehicle index, I_{NW}	930

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2684 veh/h
Weaving segment capacity, c_w	6448 veh/h
Weaving segment v/c ratio	0.416
Weaving segment density, D	16.6 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.186
Weaving segment speed, S	56.5 mph
Average weaving speed, S_W	58.8 mph
Average non-weaving speed, S_{NW}	55.3 mph
Maximum weaving length, L_{MAX}	6176 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/4/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	10th to Rice
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5110ft
Freeway free-flow speed, FFS	67 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	568	0.93	12	0	1.5	1.2	0.943	1.00	647
V_{RF}	427	0.93	6	0	1.5	1.2	0.971	1.00	473
V_{FR}	366	0.93	6	0	1.5	1.2	0.971	1.00	405
V_{RR}	10	0.93	6	0	1.5	1.2	0.971	1.00	11
V_{NW}	658							V =	1450
V_W	878								
VR	0.572								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	878 lc/h
Weaving lane changes, LC_W	1302 lc/h
Non-weaving lane changes, LC_{NW}	2327 lc/h
Total lane changes, LC_{ALL}	3629 lc/h
Non-weaving vehicle index, I_{NW}	336

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1450 veh/h
Weaving segment capacity, c_w	3961 veh/h
Weaving segment v/c ratio	0.366
Weaving segment density, D	8.7 pc/mi/ln
Level of Service, LOS	A

Weaving intensity factor, W	0.173
Weaving segment speed, S	58.9 mph
Average weaving speed, S_W	59.3 mph
Average non-weaving speed, S_{NW}	58.2 mph
Maximum weaving length, L_{MAX}	8675 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Rice Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1897*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1239*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*19.1*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Rice Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*995*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*559*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*8.6*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/6/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Rice to Benson
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	4510ft
Freeway free-flow speed, FFS	72 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	441	0.80	9	0	1.5	1.2	0.957	1.00	576
V_{RF}	191	0.80	6	0	1.5	1.2	0.971	1.00	246
V_{FR}	1456	0.80	6	0	1.5	1.2	0.971	1.00	1875
V_{RR}	53	0.80	6	0	1.5	1.2	0.971	1.00	68
V_{NW}	644							V =	2646
V_W	2121								
VR	0.767								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	246 lc/h
Weaving lane changes, LC_W	643 lc/h
Non-weaving lane changes, LC_{NW}	1999 lc/h
Total lane changes, LC_{ALL}	2642 lc/h
Non-weaving vehicle index, I_{NW}	290

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2646 veh/h
Weaving segment capacity, c_w	2994 veh/h
Weaving segment v/c ratio	0.884
Weaving segment density, D	14.2 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.148
Weaving segment speed, S	64.9 mph
Average weaving speed, S_W	64.6 mph
Average non-weaving speed, S_{NW}	65.8 mph
Maximum weaving length, L_{MAX}	11111 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/6/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Rice to Benson
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	4510ft
Freeway free-flow speed, FFS	72 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	684	0.93	7	0	1.5	1.2	0.966	1.00	761
V_{RF}	138	0.93	6	0	1.5	1.2	0.971	1.00	153
V_{FR}	311	0.93	6	0	1.5	1.2	0.971	1.00	344
V_{RR}	26	0.93	6	0	1.5	1.2	0.971	1.00	29
V_{NW}	790							V =	1244
V_W	497								
VR	0.386								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	153 lc/h
Weaving lane changes, LC_W	550 lc/h
Non-weaving lane changes, LC_{NW}	2029 lc/h
Total lane changes, LC_{ALL}	2579 lc/h
Non-weaving vehicle index, I_{NW}	356

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1244 veh/h
Weaving segment capacity, c_w	6005 veh/h
Weaving segment v/c ratio	0.207
Weaving segment density, D	6.4 pc/mi/ln
Level of Service, LOS	A
Weaving intensity factor, W	0.145
Weaving segment speed, S	67.2 mph
Average weaving speed, S_W	64.8 mph
Average non-weaving speed, S_{NW}	68.8 mph
Maximum weaving length, L_{MAX}	6526 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Benson On-Ramp to Off-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*632*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*72.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*72.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*411*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*5.9*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Benson On-Ramp to Off-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*822*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*72.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*72.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*457*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*6.5*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	mph
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	Benson Rd On-Ramp
Date Performed	11/19/2013	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1300
Deceleration Lane Length L_D	
Freeway Volume, V_F	632
Ramp Volume, V_R	75
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	632	0.80	Level	9	0	0.957	1.00	826
Ramp	75	0.80	Level	6	0	0.971	1.00	97
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 826 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	923	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	923	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 4.5 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.175 (Exibit 13-11)

S_R= 65.1 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 65.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	Benson Rd On-Ramp
Date Performed	11/19/2013	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1300
Deceleration Lane Length L_D	
Freeway Volume, V_F	822
Ramp Volume, V_R	151
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	822	0.93	Level	9	0	0.957	1.00	924
Ramp	151	0.93	Level	6	0	0.971	1.00	167
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 924 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1091	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1091	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 5.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.177 (Exibit 13-11)

S_R= 65.1 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 65.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Benson On-Ramp to I-90*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*707*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*460*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*6.6*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Benson On-Ramp to I-90*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*973*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*544*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*7.8*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	I-90 Off-Ramp
Date Performed	10/30/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	600
Freeway Volume, V_F	707
Ramp Volume, V_R	311
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	707	0.80	Level	9	0	0.957	1.00	924
Ramp	311	0.80	Level	9	0	0.957	1.00	406
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 924 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	924	Exhibit 13-8	4800	No
$V_{FO} = V_F - V_R$	518	Exhibit 13-8	4800	No
V_R	406	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	924	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 6.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.140 (Exhibit 13-12)

S_R= 66.1 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 66.1 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	I-90 Off-Ramp
Date Performed	10/30/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	600
Freeway Volume, V_F	973
Ramp Volume, V_R	456
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	973	0.93	Level	9	0	0.957	1.00	1093
Ramp	456	0.93	Level	9	0	0.957	1.00	512
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\,v_R + 0.0078\,V_{12} - 0.00627\,L_A$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1093 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1093	Exhibit 13-8	4800	No
$V_{FO} = V_F - V_R$	581	Exhibit 13-8	4800	No
V_R	512	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1093	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\,V_{12} - 0.009\,L_D$$

D_R = 8.3 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

D_s = 0.149 (Exhibit 13-12)

S_R= 65.8 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 65.8 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	I-90 On-Ramp
Date Performed	10/30/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	950
Deceleration Lane Length L_D	
Freeway Volume, V_F	671
Ramp Volume, V_R	369
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	59.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	671	0.80	Level	8	0	0.962	1.00	872
Ramp	369	0.80	Level	8	0	0.962	1.00	480
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 872 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1352	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1352	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 9.8 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.224 (Exibit 13-11)

S_R= 63.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 63.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	I-90 On-Ramp
Date Performed	10/30/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	950
Deceleration Lane Length L_D	
Freeway Volume, V_F	438
Ramp Volume, V_R	447
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	59.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	438	0.93	Level	8	0	0.962	1.00	490
Ramp	447	0.93	Level	8	0	0.962	1.00	500
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 490 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	990	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	990	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 7.0 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.219 (Exibit 13-11)

S_R= 63.1 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 63.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*I-90 to Benson Off-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1040*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
			Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*676*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S	*70.0*	mph	S		mph
D = v_p / S	*9.7*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*A*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*I-90 to Benson Off-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*885*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*495*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*7.1*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	Benson Rd Off-Ramp
Date Performed	11/19/2013	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	275
Freeway Volume, V_F	1040
Ramp Volume, V_R	113
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	59.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1040	0.80	Level	8	0	0.962	1.00	1352
Ramp	113	0.80	Level	6	0	0.971	1.00	145
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1352 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1352	Exhibit 13-8	4780	No
$V_{FO} = V_F - V_R$	1207	Exhibit 13-8	4780	No
V_R	145	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1352	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = 13.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.129 (Exhibit 13-12)

S_R= 65.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 65.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	Benson Rd Off-Ramp
Date Performed	11/19/2013	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	275
Freeway Volume, V_F	885
Ramp Volume, V_R	72
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	59.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	885	0.93	Level	8	0	0.962	1.00	990
Ramp	72	0.93	Level	6	0	0.971	1.00	80
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 990 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	990	Exhibit 13-8	4780	No
$V_{FO} = V_F - V_R$	910	Exhibit 13-8	4780	No
V_R	80	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	990	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = 10.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.123 (Exhibit 13-12)

S_R= 65.7 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 65.7 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*Benson Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*927*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*605*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*8.6*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Benson Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*813*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*457*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*6.5*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/10/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Benson to Rice
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5670ft
Freeway free-flow speed, FFS	68 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	799	0.80	7	0	1.5	1.2	0.966	1.00	1034
V_{RF}	298	0.80	6	0	1.5	1.2	0.971	1.00	384
V_{FR}	128	0.80	6	0	1.5	1.2	0.971	1.00	165
V_{RR}	10	0.80	6	0	1.5	1.2	0.971	1.00	13
V_{NW}	1047							V =	1543
V_W	549								
VR	0.344								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	549 lc/h
Weaving lane changes, LC_W	997 lc/h
Non-weaving lane changes, LC_{NW}	2711 lc/h
Total lane changes, LC_{ALL}	3708 lc/h
Non-weaving vehicle index, I_{NW}	594

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1543 veh/h
Weaving segment capacity, c_w	6741 veh/h
Weaving segment v/c ratio	0.229
Weaving segment density, D	8.7 pc/mi/ln
Level of Service, LOS	A

Weaving intensity factor, W	0.162
Weaving segment speed, S	61.2 mph
Average weaving speed, S_W	60.6 mph
Average non-weaving speed, S_{NW}	61.5 mph
Maximum weaving length, L_{MAX}	6061 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/10/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Benson to Rice
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5670ft
Freeway free-flow speed, FFS	68 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	583	0.93	9	0	1.5	1.2	0.957	1.00	655
V_{RF}	1231	0.93	6	0	1.5	1.2	0.971	1.00	1363
V_{FR}	230	0.93	6	0	1.5	1.2	0.971	1.00	255
V_{RR}	10	0.93	6	0	1.5	1.2	0.971	1.00	11
V_{NW}	666							V =	2186
V_W	1618								
VR	0.708								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1618 lc/h
Weaving lane changes, LC_W	2066 lc/h
Non-weaving lane changes, LC_{NW}	2633 lc/h
Total lane changes, LC_{ALL}	4699 lc/h
Non-weaving vehicle index, I_{NW}	378

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2186 veh/h
Weaving segment capacity, c_w	3242 veh/h
Weaving segment v/c ratio	0.674
Weaving segment density, D	13.3 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.195
Weaving segment speed, S	57.2 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	52.7 mph
Maximum weaving length, L_{MAX}	10362 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*Rice Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1097*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*710*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*10.1*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Rice Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1814*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1009*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*14.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/10/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Rice to 10th St
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	4840ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	642	0.80	12	0	1.5	1.2	0.943	1.00	851
V_{RF}	430	0.80	6	0	1.5	1.2	0.971	1.00	554
V_{FR}	455	0.80	6	0	1.5	1.2	0.971	1.00	586
V_{RR}	10	0.80	6	0	1.5	1.2	0.971	1.00	13
V_{NW}	864							V =	1891
V_W	1140								
VR	0.569								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1140 lc/h
Weaving lane changes, LC_W	1552 lc/h
Non-weaving lane changes, LC_{NW}	2223 lc/h
Total lane changes, LC_{ALL}	3775 lc/h
Non-weaving vehicle index, I_{NW}	418

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	1891 veh/h
Weaving segment capacity, c_w	3980 veh/h
Weaving segment v/c ratio	0.475
Weaving segment density, D	11.3 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.186
Weaving segment speed, S	59.2 mph
Average weaving speed, S_W	60.5 mph
Average non-weaving speed, S_{NW}	57.6 mph
Maximum weaving length, L_{MAX}	8642 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	12/10/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Rice to 10th St
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	4840ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1252	0.93	10	0	1.5	1.2	0.952	1.00	1414
V_{RF}	331	0.93	6	0	1.5	1.2	0.971	1.00	367
V_{FR}	562	0.93	6	0	1.5	1.2	0.971	1.00	622
V_{RR}	10	0.93	6	0	1.5	1.2	0.971	1.00	11
V_{NW}	1425							V =	2300
V_W	989								
VR	0.410								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	989 lc/h
Weaving lane changes, LC_W	1401 lc/h
Non-weaving lane changes, LC_{NW}	2339 lc/h
Total lane changes, LC_{ALL}	3740 lc/h
Non-weaving vehicle index, I_{NW}	690

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2300 veh/h
Weaving segment capacity, c_w	5579 veh/h
Weaving segment v/c ratio	0.412
Weaving segment density, D	13.6 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.184
Weaving segment speed, S	59.0 mph
Average weaving speed, S_W	60.6 mph
Average non-weaving speed, S_{NW}	58.0 mph
Maximum weaving length, L_{MAX}	6790 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*10th St Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*
Project Description *I-229 MIS*			

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1072*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*703*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*10.8*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*10th St Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1583*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*889*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*13.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

- N - Number of lanes
- V - Hourly volume
- v_p - Flow rate
- LOS - Level of service
- S - Speed
- D - Density
- FFS - Free-flow speed
- BFFS - Base free-flow speed
- DDHV - Directional design hour volume

Factor Location

- E_R - Exhibits 11-10, 11-12
- E_T - Exhibits 11-10, 11-11, 11-13
- f_p - Page 11-18
- LOS, S, FFS, v_p - Exhibits 11-2, 11-3
- f_{LW} - Exhibit 11-8
- f_{LC} - Exhibit 11-9
- TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	10th St On-Ramp
Date Performed	11/20/2013	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	575
Deceleration Lane Length L_D	
Freeway Volume, V_F	1072
Ramp Volume, V_R	629
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	57.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1072	0.80	Level	10	0	0.952	1.00	1407
Ramp	629	0.80	Level	6	0	0.971	1.00	810
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1407 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2217	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2217	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = 18.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.291 (Exibit 13-11)

S_R= 59.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 59.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	10th St On-Ramp
Date Performed	11/20/2013	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	575
Deceleration Lane Length L_D	
Freeway Volume, V_F	1583
Ramp Volume, V_R	653
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	57.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1583	0.93	Level	10	0	0.952	1.00	1787
Ramp	653	0.93	Level	6	0	0.971	1.00	723
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1787 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2510	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2510	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 21.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.303 (Exibit 13-11)

S_R= 59.4 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 59.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*10th St to 26th St*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1701*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1111*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*17.1*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

- N - Number of lanes
- V - Hourly volume
- v_p - Flow rate
- LOS - Level of service
- DDHV - Directional design hour volume
- S - Speed
- D - Density
- FFS - Free-flow speed
- BFFS - Base free-flow speed

Factor Location

- E_R - Exhibits 11-10, 11-12
- E_T - Exhibits 11-10, 11-11, 11-13
- f_p - Page 11-18
- LOS, S, FFS, v_p - Exhibits 11-2, 11-3
- f_{LW} - Exhibit 11-8
- f_{LC} - Exhibit 11-9
- TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*10th St to 26th St*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2236*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1256*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*19.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	26th St Off-Ramp
Date Performed	11/20/2013	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	400
Freeway Volume, V_F	1701
Ramp Volume, V_R	257
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1701	0.80	Level	9	0	0.957	1.00	2222
Ramp	257	0.80	Level	3	0	0.985	1.00	326
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2222 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2222	Exhibit 13-8	4740	No
$V_{FO} = V_F - V_R$	1896	Exhibit 13-8	4740	No
V_R	326	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2222	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 19.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.457 (Exhibit 13-12)

S_R= 55.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 55.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	26th St Off-Ramp
Date Performed	11/20/2013	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	400
Freeway Volume, V_F	2236
Ramp Volume, V_R	457
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2236	0.93	Level	9	0	0.957	1.00	2512
Ramp	457	0.93	Level	3	0	0.985	1.00	499
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2512 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2512	Exhibit 13-8	4740	No
$V_{FO} = V_F - V_R$	2013	Exhibit 13-8	4740	No
V_R	499	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2512	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = 22.3 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.473 (Exhibit 13-12)

S_R= 55.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 55.2 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*26th St Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1444*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*948*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*14.6*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*26th St Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1779*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1004*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*15.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	26th St to Cliff Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2670ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1234	0.80	9	0	1.5	1.2	0.957	1.00	1612
V_{RF}	682	0.80	3	0	1.5	1.2	0.985	1.00	865
V_{FR}	210	0.80	3	0	1.5	1.2	0.985	1.00	266
V_{RR}	10	0.80	3	0	1.5	1.2	0.985	1.00	13
V_{NW}	1625							V =	2638
V_W	1131								
VR	0.410								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1131 lc/h
Weaving lane changes, LC_W	1429 lc/h
Non-weaving lane changes, LC_{NW}	1204 lc/h
Total lane changes, LC_{ALL}	2633 lc/h
Non-weaving vehicle index, I_{NW}	434

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2638 veh/h
Weaving segment capacity, c_w	5596 veh/h
Weaving segment v/c ratio	0.471
Weaving segment density, D	16.0 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.224
Weaving segment speed, S	57.5 mph
Average weaving speed, S_W	59.1 mph
Average non-weaving speed, S_{NW}	56.4 mph
Maximum weaving length, L_{MAX}	6798 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	26th St to Cliff Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2670ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1397	0.93	8	0	1.5	1.2	0.962	1.00	1562
V_{RF}	533	0.93	3	0	1.5	1.2	0.985	1.00	582
V_{FR}	382	0.93	3	0	1.5	1.2	0.985	1.00	417
V_{RR}	10	0.93	3	0	1.5	1.2	0.985	1.00	11
V_{NW}	1573							V =	2474
V_W	999								
VR	0.388								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	999 lc/h
Weaving lane changes, LC_W	1297 lc/h
Non-weaving lane changes, LC_{NW}	1193 lc/h
Total lane changes, LC_{ALL}	2490 lc/h
Non-weaving vehicle index, I_{NW}	420

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2474 veh/h
Weaving segment capacity, c_w	5941 veh/h
Weaving segment v/c ratio	0.416
Weaving segment density, D	14.7 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.214
Weaving segment speed, S	58.4 mph
Average weaving speed, S_W	59.5 mph
Average non-weaving speed, S_{NW}	57.7 mph
Maximum weaving length, L_{MAX}	6552 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*Cliff Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1916*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1239*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*17.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/19/2013*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*Cliff Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1930*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1074*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*15.3*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Cliff Ave to Minnesota Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3120ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1639	0.80	6	0	1.5	1.2	0.971	1.00	2110
V_{RF}	429	0.80	3	0	1.5	1.2	0.985	1.00	544
V_{FR}	277	0.80	3	0	1.5	1.2	0.985	1.00	351
V_{RR}	99	0.80	3	0	1.5	1.2	0.985	1.00	126
V_{NW}	2236							V =	3040
V_W	895								
VR	0.286								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	895 lc/h
Weaving lane changes, LC_W	1220 lc/h
Non-weaving lane changes, LC_{NW}	1574 lc/h
Total lane changes, LC_{ALL}	2794 lc/h
Non-weaving vehicle index, I_{NW}	698

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3040 veh/h
Weaving segment capacity, c_w	6329 veh/h
Weaving segment v/c ratio	0.480
Weaving segment density, D	18.6 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.207
Weaving segment speed, S	56.2 mph
Average weaving speed, S_W	58.1 mph
Average non-weaving speed, S_{NW}	55.5 mph
Maximum weaving length, L_{MAX}	5433 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Cliff Ave to Minnesota Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3120ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1559	0.93	6	0	1.5	1.2	0.971	1.00	1727
V_{RF}	519	0.93	3	0	1.5	1.2	0.985	1.00	566
V_{FR}	371	0.93	3	0	1.5	1.2	0.985	1.00	405
V_{RR}	27	0.93	3	0	1.5	1.2	0.985	1.00	29
V_{NW}	1756							V =	2648
V_W	971								
VR	0.356								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	971 lc/h
Weaving lane changes, LC_W	1296 lc/h
Non-weaving lane changes, LC_{NW}	1475 lc/h
Total lane changes, LC_{ALL}	2771 lc/h
Non-weaving vehicle index, I_{NW}	548

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2648 veh/h
Weaving segment capacity, c_w	6160 veh/h
Weaving segment v/c ratio	0.430
Weaving segment density, D	16.1 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.206
Weaving segment speed, S	56.5 mph
Average weaving speed, S_W	58.1 mph
Average non-weaving speed, S_{NW}	55.6 mph
Maximum weaving length, L_{MAX}	6193 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Minnesota Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2068*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1325*	pc/h/ln
S	*69.8*	mph
D = v_p / S	*19.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		**Site Information**	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Minnesota Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2078*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1145*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*16.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Minnesota Ave to Western Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3220ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1264	0.80	8	0	1.5	1.2	0.962	1.00	1643
V_{RF}	359	0.80	3	0	1.5	1.2	0.985	1.00	455
V_{FR}	804	0.80	2	0	1.5	1.2	0.990	1.00	1015
V_{RR}	50	0.80	2	0	1.5	1.2	0.990	1.00	63
V_{NW}	1706							V =	3054
V_W	1470								
VR	0.463								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1470 lc/h
Weaving lane changes, LC_W	1800 lc/h
Non-weaving lane changes, LC_{NW}	1519 lc/h
Total lane changes, LC_{ALL}	3319 lc/h
Non-weaving vehicle index, I_{NW}	549

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3054 veh/h
Weaving segment capacity, c_w	4986 veh/h
Weaving segment v/c ratio	0.612
Weaving segment density, D	19.0 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.231
Weaving segment speed, S	55.8 mph
Average weaving speed, S_W	58.9 mph
Average non-weaving speed, S_{NW}	53.3 mph
Maximum weaving length, L_{MAX}	7395 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Minnesota Ave to Western Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3220ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1348	0.93	8	0	1.5	1.2	0.962	1.00	1507
V_{RF}	566	0.93	3	0	1.5	1.2	0.985	1.00	618
V_{FR}	730	0.93	2	0	1.5	1.2	0.990	1.00	793
V_{RR}	33	0.93	2	0	1.5	1.2	0.990	1.00	36
V_{NW}	1543							V =	2841
V_W	1411								
VR	0.478								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1411 lc/h
Weaving lane changes, LC_W	1741 lc/h
Non-weaving lane changes, LC_{NW}	1485 lc/h
Total lane changes, LC_{ALL}	3226 lc/h
Non-weaving vehicle index, I_{NW}	497

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2841 veh/h
Weaving segment capacity, c_w	4831 veh/h
Weaving segment v/c ratio	0.588
Weaving segment density, D	17.5 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.226
Weaving segment speed, S	56.4 mph
Average weaving speed, S_W	59.0 mph
Average non-weaving speed, S_{NW}	54.1 mph
Maximum weaving length, L_{MAX}	7566 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Western Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1623*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*67.0*	mph	FFS	*67.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1050*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*65.0*	mph	S	mph
D = v_p / S	*16.2*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Western Off-Ramp to On-Ramp*
Date Performed	*11/19/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1914*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1060*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*16.3*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Western Ave to Louise Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3500ft
Freeway free-flow speed, FFS	67 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	923	0.80	10	0	1.5	1.2	0.952	1.00	1211
V_{RF}	116	0.80	2	0	1.5	1.2	0.990	1.00	146
V_{FR}	700	0.80	2	0	1.5	1.2	0.990	1.00	884
V_{RR}	53	0.80	2	0	1.5	1.2	0.990	1.00	67
V_{NW}	1278							V =	2199
V_W	1030								
VR	0.446								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	146 lc/h
Weaving lane changes, LC_W	492 lc/h
Non-weaving lane changes, LC_{NW}	1582 lc/h
Total lane changes, LC_{ALL}	2074 lc/h
Non-weaving vehicle index, I_{NW}	447

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2199 veh/h
Weaving segment capacity, c_w	5122 veh/h
Weaving segment v/c ratio	0.429
Weaving segment density, D	12.5 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.150
Weaving segment speed, S	61.3 mph
Average weaving speed, S_W	60.2 mph
Average non-weaving speed, S_{NW}	62.3 mph
Maximum weaving length, L_{MAX}	7205 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	JKM
Agency/Company	HDR
Date Performed	11/18/2013
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Western Ave to Louise Ave
Analysis Year	2013

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3500ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	942	0.93	11	0	1.5	1.2	0.948	1.00	1069
V_{RF}	259	0.93	2	0	1.5	1.2	0.990	1.00	281
V_{FR}	972	0.93	2	0	1.5	1.2	0.990	1.00	1056
V_{RR}	58	0.93	2	0	1.5	1.2	0.990	1.00	63
V_{NW}	1132							V =	2341
V_W	1337								
VR	0.542								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	281 lc/h
Weaving lane changes, LC_W	627 lc/h
Non-weaving lane changes, LC_{NW}	1552 lc/h
Total lane changes, LC_{ALL}	2179 lc/h
Non-weaving vehicle index, I_{NW}	396

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2341 veh/h
Weaving segment capacity, c_w	4201 veh/h
Weaving segment v/c ratio	0.557
Weaving segment density, D	13.6 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.155
Weaving segment speed, S	60.5 mph
Average weaving speed, S_W	60.0 mph
Average non-weaving speed, S_{NW}	61.0 mph
Maximum weaving length, L_{MAX}	8316 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Louise Off-Ramp to On-Ramp*
Date Performed	*11/18/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1039*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*67.0*	mph	FFS	*67.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*679*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*65.0*	mph	S	mph
D = v_p / S	*10.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary

N - Number of lanes S - Speed
V - Hourly volume D - Density
v_p - Flow rate FFS - Free-flow speed
LOS - Level of service BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12 f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13 f_{LC} - Exhibit 11-9
f_p - Page 11-18 TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Louise Off-Ramp to On-Ramp*
Date Performed	*11/18/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1201*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*67.0*	mph	FFS	*67.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*675*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*65.0*	mph	S	mph
D = v_p / S	*10.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	Louise On-Ramp
Date Performed	11/18/2013	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1200
Deceleration Lane Length L_D	
Freeway Volume, V_F	1039
Ramp Volume, V_R	383
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	57.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1039	0.80	Level	9	0	0.957	1.00	1357
Ramp	383	0.80	Level	2	0	0.990	1.00	484
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1357 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1841	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1841	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 12.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.209 (Exibit 13-11)

S_R= 61.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 61.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	JKM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	Louise On-Ramp
Date Performed	11/18/2013	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2013

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1200
Deceleration Lane Length L_D	
Freeway Volume, V_F	1201
Ramp Volume, V_R	518
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	57.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1201	0.93	Level	9	0	0.957	1.00	1350
Ramp	518	0.93	Level	2	0	0.990	1.00	563
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1350 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1913	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1913	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 12.6 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.211 (Exibit 13-11)

S_R= 61.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 61.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Louise On-Ramp to I-29 NB*
Date Performed	*11/18/2013*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1422*	veh/h	Peak-Hour Factor, PHF	*0.80*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*933*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*14.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*JKM*
Agency or Company	*HDR*
Date Performed	*11/18/2013*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*Louise On-Ramp to I-29 NB*
Jurisdiction	*Sioux Falls*
Analysis Year	*2013*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1719*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*970*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*14.9*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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APPENDIX E3. YEAR 2035 FUTURE VOLUMES

The Sioux Falls MPO supplied 2035 socioeconomic data, which includes number of households and number of employees per travel analysis zone (TAZ). This land use data was modified to reflect incorporation of a Cost-Co discount store that was planned after the 2035 regional socioeconomic dataset was established by the Sioux Falls MPO. TAZ 141 (bound 41st Street, 49th Street, Minnesota Avenue and Grange Avenue) was adjusted through coordination with the Sioux Falls MPO based on land use data supplied in the ***CostCo 41st and Grange Avenue Traffic Impact Study*** from July 2012. Land use data adjustments for this TAZ are shown in TABLE 1.

Table 1. Year 2035 TAZ 141 Modifications

Category	2008	2035 (Original)	2035 (I-229 MIS)
Households	28	28	292
Industrial Employment	51	209	118
Office Employment	163	163	163
Retail Employment	423	423	702
Other Employment	22	22	22

The Sioux Falls MPO also supplied the remainder of the 2035 travel model files. The original 2035 roadway network was modified to include the extension of Bahnson Road between Benson Road and 60th Street north. This segment of Bahnson Road was not included in the original 2035 LRTP. However, the City of Sioux Falls ***N. Bahnson Avenue Feasibility Study*** (April 2011) and ***2014-18 Capital Improvements Program(CIP)*** identifies this project for near-term construction.

The No-Build condition for this study also includes geometric modifications associated with the I-229 Exit 5 (26th Street) proposed improvements.

Segment (link-level) volumes output from the macroscopic model (both existing 2008 and future 2035) were combined with existing intersection turning movement percentages, and adjusted for intersection balancing, in order to establish a full 2035 volume set in the study area.

The 2035 daily traffic forecasts were based on a post-processing application of the raw travel model output. Post processing assumes that there is some level of deviation in the base year travel model (2008) between model-estimated traffic (raw volume output) and observed traffic (counts). Post processing assumes that this deviation represents the adjustment, or correction, that needs to be applied to the future year model (2035) output.

APPENDIX E4. 2035 NO-BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM

Year 2035 No Build conditions operational analysis included the analysis of 41 signalized intersections[1] , 6 unsignalized intersections[1], 21 basic freeway segments, 14 weave segments, 4 merge areas, and 3 diverge areas. All locations were analyzed for the AM peak hour and PM peak hour, based on traffic forecasting procedures utilizing output from the Sioux Falls MPO Sioux Falls travel demand model in Cube Voyager. Segment (link-level) volumes output from the static model were combined with existing intersection turning movement percentages, and adjusted for intersection balancing, in order to establish a full volume set in the Sub-study 1 area.

The 2035 No-Build volumes are based on the MPO's future travel demand model, reflective of fiscally constrained planned projects included in the 2035 Long Range Transportation Plan (LRTP). The No-Build condition for this study also includes geometric modifications associated with the I-229 Exit 5 (26th Street) proposed improvements. The LRTP includes capacity-related roadway segment improvements at a high-level, and does not include intersection-level geometrics associated with the improvements. Thus, intersection-level geometrics were assumed for the No-Build condition where necessary in order to capture planned development in the study area.

Worst Case Analysis Results

During the 2035 no-build analysis, the Highway Capacity Software (HCS) 2010 identified capacity constraints at upstream intersections that limited traffic that would get to downstream intersections along a given corridor. In an effort to provide a conservative estimate of future no-build traffic operations, a procedure was devised to ensure that each study area intersection received the full projected demand. After meetings with the Study Advisory Team (SAT) and Federal Highway Administration (FHWA), it was decided that some of the no-build analysis results may indicate higher projected delays than will actually be realized because not all capacity constraints may be eliminated at upstream intersections as assumed in the analysis. For instance, a roadway may have a future demand that warrants additional capacity, but if the hurdles to adding that capacity are insurmountable, then the roadway would not be widened and continue to meter traffic to downstream intersections. As the no-build traffic analysis results potentially error on the side of higher traffic demand at all study area intersections, that analysis has been named the "Worst Case" scenario.

2010 Highway Capacity Software (HCS 2010) from McTrans was used to conduct no-build traffic operations analysis, in a similar fashion to the existing conditions traffic operations analysis. Common practice for no-build analysis dictates that the geometry of the subject intersection is analyzed under the future projected traffic demand without modifications to geometry such that any anticipated deficiencies in the no-build condition may be identified. One

[1] Additional signalized and unsignalized intersections were analyzed for the related corridor studies on Minnesota Avenue, 10th Street, Rice Street, and Benson Road but are not included in this report.

difficulty in maintaining this practice is the software's treatment of adjacent intersections in a connected manner, such that if an upstream intersection has a failing movement (movement demand / movement capacity > 1.0) then the demand beyond the capacity threshold is not perpetuated to the downstream intersections. While this operation in the programming of the HCS 2010 software has benefits when conducting a multi-period analysis, the software does not provide a built-in feature to bypass this part of the computations. This results in a situation where intersections downstream of intersections with failing movements only experience a portion of the projected demand. In order to allow each intersection to fully reach its projected demand, the project team developed a method for isolating the traffic operations for groups of intersections that could all be analyzed in a single HCS 2010 file while still receiving all projected demand. This method is as follows:

1. Develop a master file for the corridor of interest, including all study intersections along the corridor. Master street files were developed sequentially from South to North and West to East.
2. Starting at the southernmost or westernmost intersection, check to see if the southbound or westbound projected demand is fully received at the intersection.
3. If the full demand is not received, then separate the southernmost or westernmost intersection out as its own group (called "Group 1") by making multiple copies of the master corridor file. All intersections not in "Group 1" are currently in "Group 2".
4. Open the HCS file for "Group 1" and make necessary changes to non-"Group 1" intersections to get all projected demand to reach all "Group 1" intersections.
5. Report the LOS for the southernmost or westernmost intersection from the "Group 1" HCS file.
6. Open the HCS file for "Group 2".
7. Check the first "Group 2" intersection (southernmost or westernmost intersection in the group) to see if both major approaches to the subject intersection receive all projected demand.
8. If all northbound or eastbound projected demand is not received at the first "Group 2" intersection, then make necessary changes to the "Group 1" intersection to allow all projected demand to reach the first "Group 2" intersection.
9. If all southbound or eastbound projected demand is not received at the first "Group 2" intersection, then call that intersection "Group 2" and all intersections to the north or east of the intersection as "Group 3".
10. Both conditions from Step 8 and Step 9 may exist at any intersection internal to the corridor.
11. Repeat the process until a set number of groups is established (maximum number of groups is the number of intersections along the corridor) where each group only contains intersections that receive their full projected demand.
12. Report LOS results from the group file to which the intersection of interest belongs.

Upon applying the method to isolated groups of intersections, intersection LOS was reported for the condition where the no-build geometry at each intersection experienced the full projected demand from the 2035 AM and PM peak hour volume sets, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.
This Year 2035 conditions analysis found that portions of the freeway facilities operate worse than a desirable LOS of C or better throughout the study area. Ramp terminal intersections and

arterials also show the LOS at a number of key intersections has degraded beyond the acceptable threshold of LOS D. ***Table 1*** highlights intersections that do not meet the project specific LOS thresholds.

Table 1. 2035 No-Build Conditions "Worst Case" Deficient Intersections based on Operational Analysis Results

LOCATION	AM	PM
57th Street & Solberg Avenue	LOS F	LOS F
69th Street & Tallgrass Avenue	LOS F	LOS F
57th Street & Louise Avenue		LOS E
69th Street & Louise Avenue	LOS F	LOS F
49th Street & Western Avenue	LOS E	LOS F
57th Street & Western Avenue	LOS E	LOS E
41st Street & Minnesota Avenue	LOS E	LOS F
49th Street & Minnesota Avenue- Worst stop-controlled approach LOS	LOS F	LOS F
I-229 NB & Minnesota Avenue Ramp Terminal	LOS E	
57th Street & Minnesota Avenue	LOS F	LOS F
I-229 SB on-ramp & Cliff Avenue- Worst stop-controlled movement LOS		LOS F
49th Street & Cliff Avenue	LOS E	
I-229 SB Diverge to 26th Street off-ramp	LOS D	LOS D
I-229 NB Mainline between 26th Street and 10th Street	LOS D	
I-229 SB Mainline between 26th Street and 10th Street	LOS D	LOS D
12th Street & Lowell Avenue- Worst stop-controlled approach LOS	LOS F	LOS F
I-229 NB Diverge to 10th Street off-ramp	LOS D	
I-229 SB Merge from 10th Street on-ramp	LOS D	LOS D
10th Street & I-229 SPUI		LOS E
10th Street & Cleveland Avenue	LOS F	LOS F
6th Street & Lowell Avenue– Worst stop-controlled approach LOS	LOS F	LOS F
I-229 NB & Rice Street Ramp Terminal & Cleveland Avenue	LOS E	LOS E
I-229 SB & Benson Road Ramp Terminal – Worst stop-controlled approach LOS	LOS F	LOS F
I-229 NB & Benson Road Ramp Terminal	LOS F	

Note: Acceptable Threshold is LOS D for intersections, and LOS C for freeway and ramps.

Best Case Analysis Results

In addition to the "Worst Case" scenario, the SAT and FHWA commissioned HDR to perform a variation of the no-build traffic analysis where no capacity constraints were removed from the study area. As this scenario may potentially error on the side of lower traffic demand, and thus lower delay, this new variation on the no-build traffic analysis has been named the "Best Case" scenario.

TABLE 2 shows the intersections that changed LOS between "Worst Case" and "Best Case" conditions.

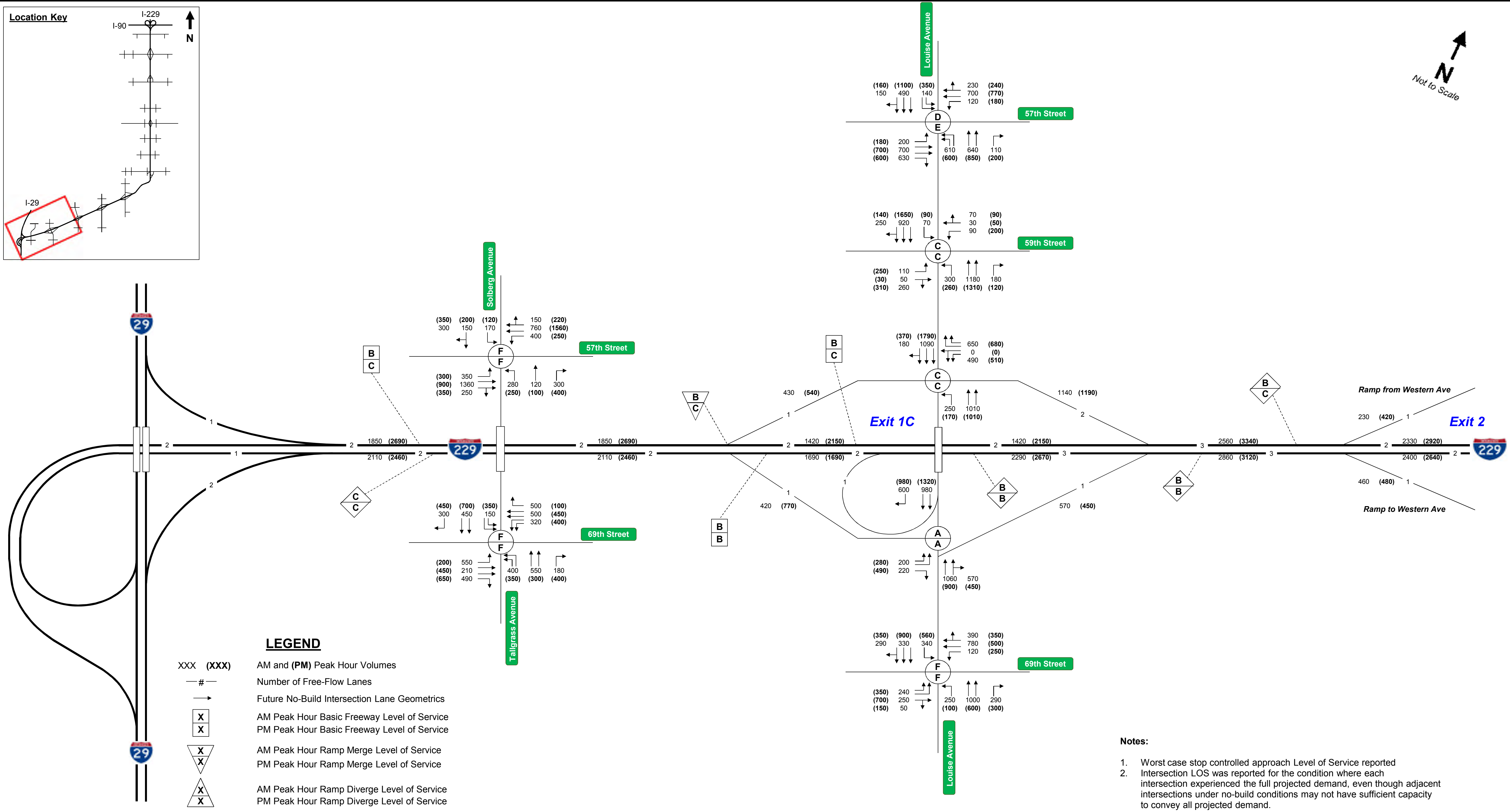
Table 2. LOS Differences between 2035 No-Build "Worst Case" and "Best Case" Scenarios

Location	AM Peak		PM Peak	
	"Worst Case" LOS	"Best Case" LOS	"Worst Case" LOS	"Best Case" LOS
Solberg & 57th			F	E
Western & 49th	E	D		
Western & I-229 SB Ramps	D	C	D	C
Western & 57th	E	D		
Minnesota & 41st	E	D	F	E
Minnesota & I-229 SB Ramps	C	B	B	C
Minnesota & I-229 NB Ramps	E	D		
Cliff & 33rd	C	B		
Cliff & 41st/I-229 SB Off-Ramp	C	B		
10th & Fairfax			B	A
10th & I-229 SPUI	D	C		
10th & Cleveland			F	E
10th & Sycamore			D	C
Rice & Wayland			B	A
Rice & I-229 SB Ramps	B	A		
Rice & I-229 NB Ramps	E	D		
Benson & Cliff	D	C		
Benson & Lewis	C	B		

"Worst Case" and "Best Case" Conditions Operational Results

The 2035 no-build "Worst Case" lane geometrics and LOS results for all locations are shown in *FIGURES 1-5*. The 2035 No-Build "Worst Case" HCS 2010 reports can be found in the *APPENDIX*.

The 2035 no-build "Best Case" lane geometrics and LOS results for all locations are shown in *FIGURES 6-10*. The 2035 No-Build "Best Case" HCS 2010 reports can be found in the *APPENDIX*.



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X / X (square)	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X (inverted triangle)	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X (triangle)	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X (diamond)	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X (circle)	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X (hexagon)	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

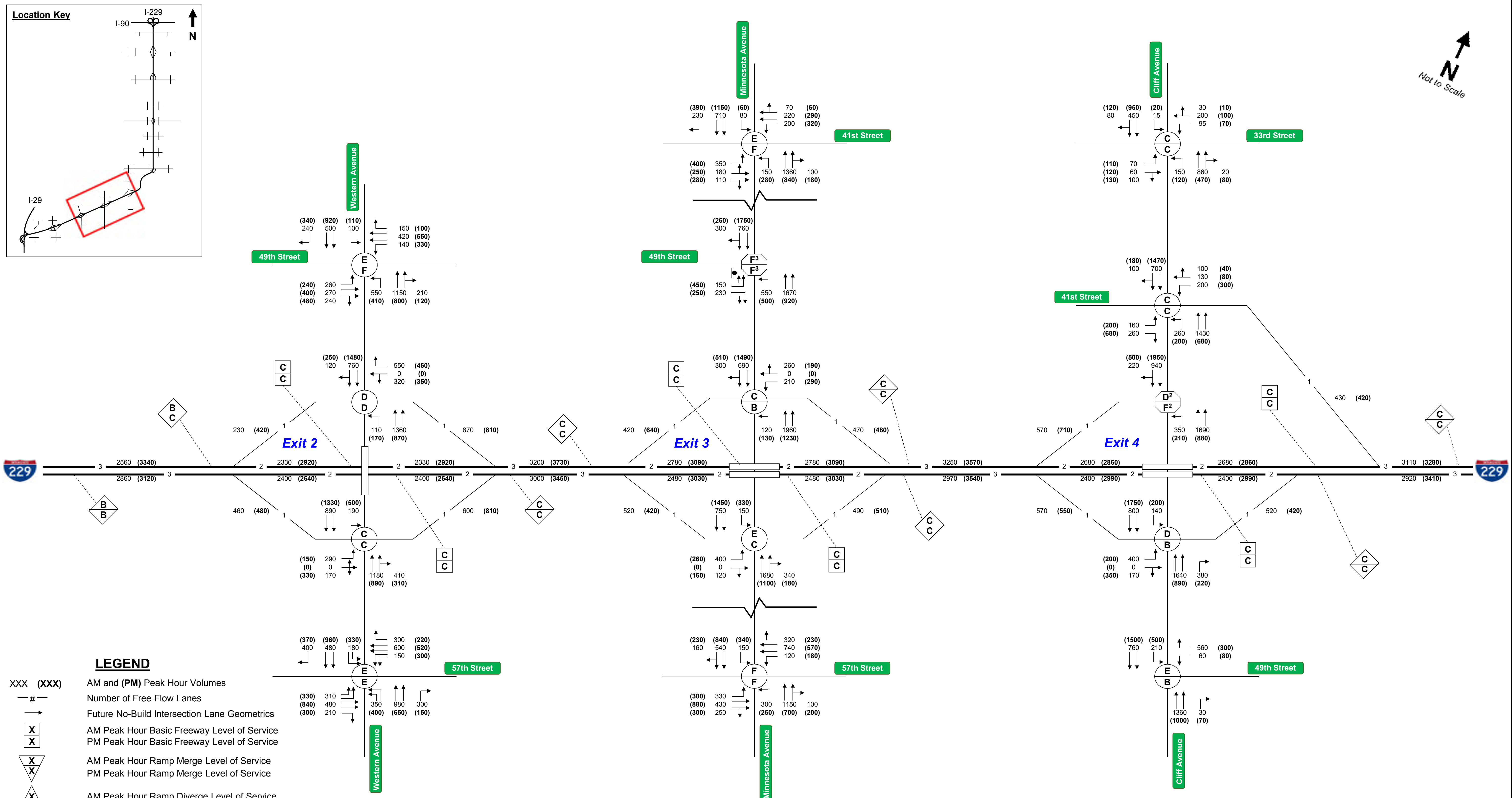
HDR

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
1



LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Worst case stop controlled movement Level of Service reported
3. Level of Service reported from HCS 2010 analysis using a single left-turn lane and a single right-turn lane due to limitations of HCS 2010 software.
4. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity

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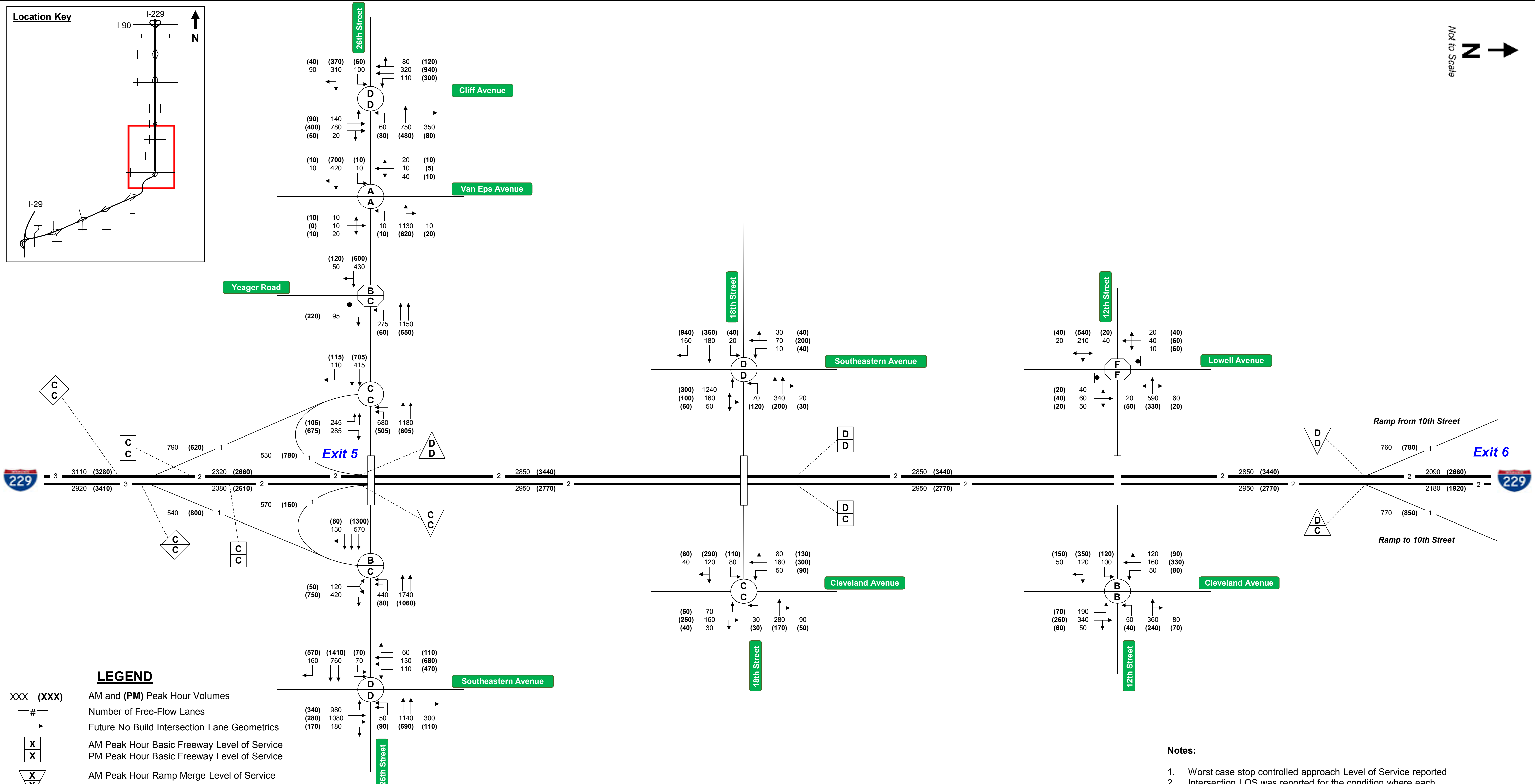
Figure
2



LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

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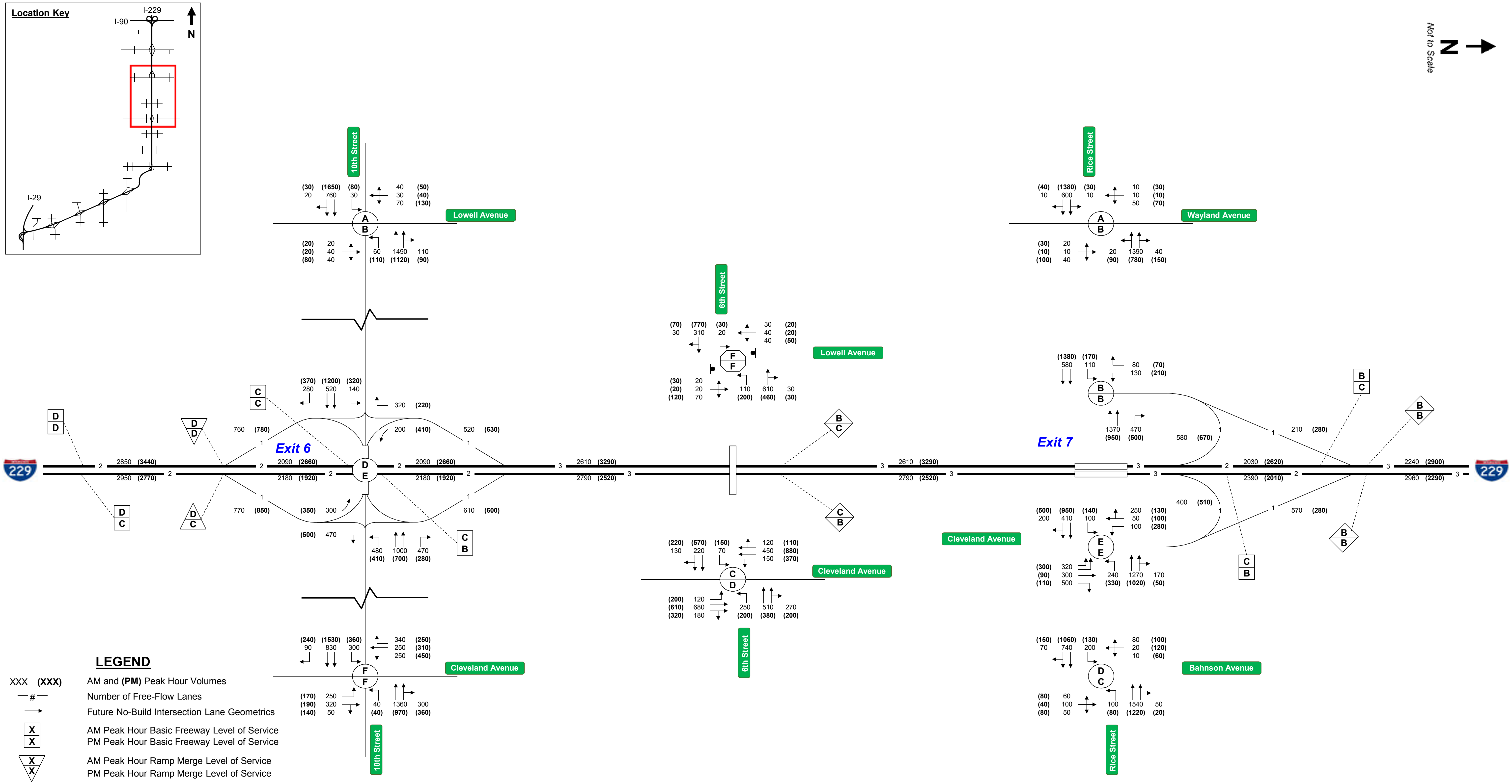
Figure
3



LEGEND

XXX (XXX) — AM and **(PM)** Peak Hour Volumes

—#— Number of Free-Flow Lanes

→ Future No-Build Intersection Lane Geometrics

AM Peak Hour Basic Freeway Level of Service
PM Peak Hour Basic Freeway Level of Service

AM Peak Hour Ramp Merge Level of Service
PM Peak Hour Ramp Merge Level of Service

AM Peak Hour Ramp Diverge Level of Service
PM Peak Hour Ramp Diverge Level of Service

AM Peak Hour Weaving Section Level of Service
PM Peak Hour Weaving Section Level of Service

AM Peak Hour Signalized Intersection Level of Service
PM Peak Hour Signalized Intersection Level of Service

AM Peak Hour Unsignalized Intersection Level of Service
PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

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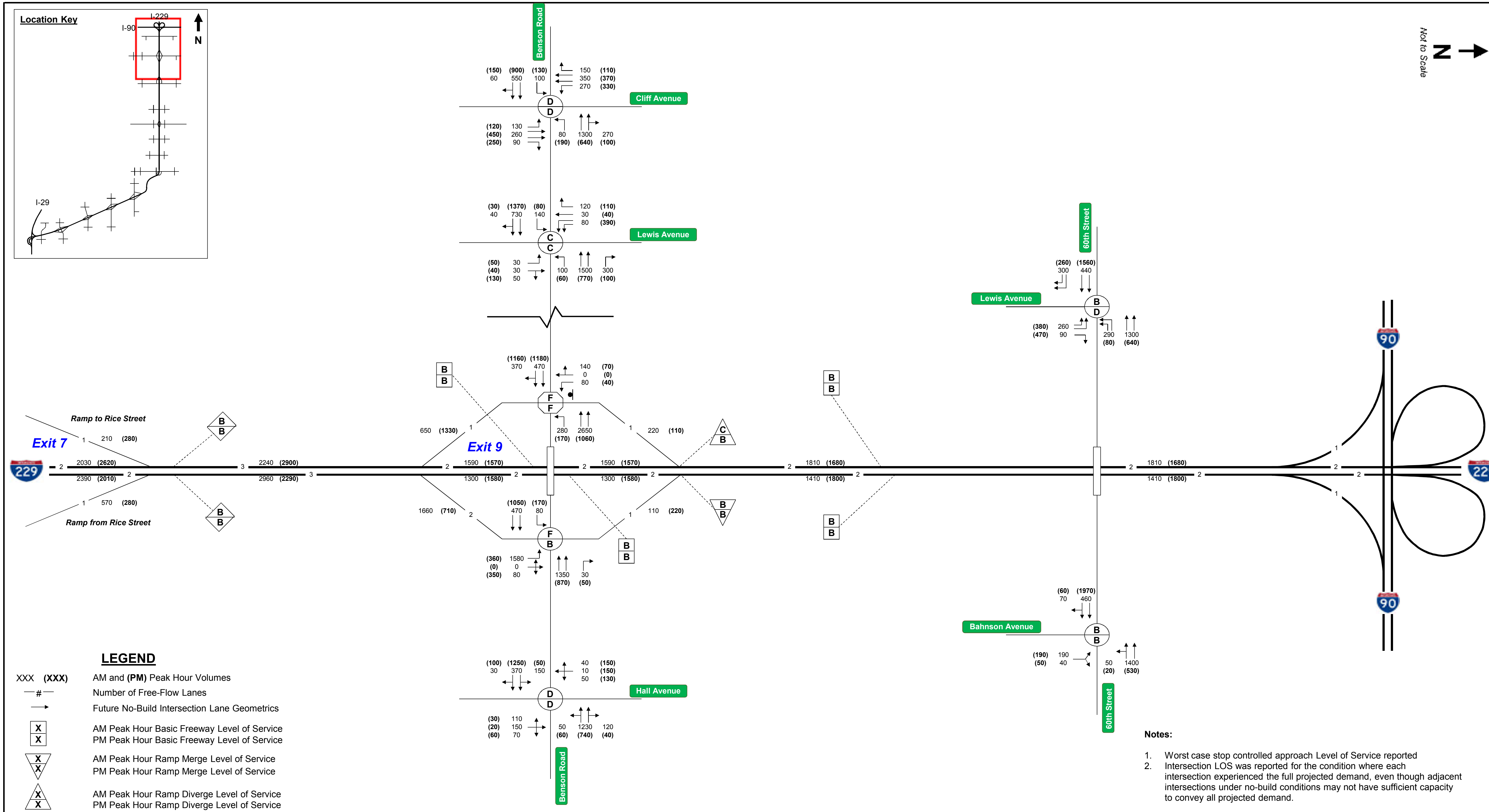
Figure
4



LEGEND

XXX **(XXX)** AM and **(PM)** Peak Hour Volumes

Number of Free-Flow Lanes

Future No-Build Intersection Lane Geometrics

X / X AM Peak Hour Basic Freeway Level of Service / PM Peak Hour Basic Freeway Level of Service

X / X AM Peak Hour Ramp Merge Level of Service / PM Peak Hour Ramp Merge Level of Service

X / X AM Peak Hour Ramp Diverge Level of Service / PM Peak Hour Ramp Diverge Level of Service

X / X AM Peak Hour Weaving Section Level of Service / PM Peak Hour Weaving Section Level of Service

X / X AM Peak Hour Signalized Intersection Level of Service / PM Peak Hour Signalized Intersection Level of Service

X / X AM Peak Hour Unsignalized Intersection Level of Service / PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

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Figure
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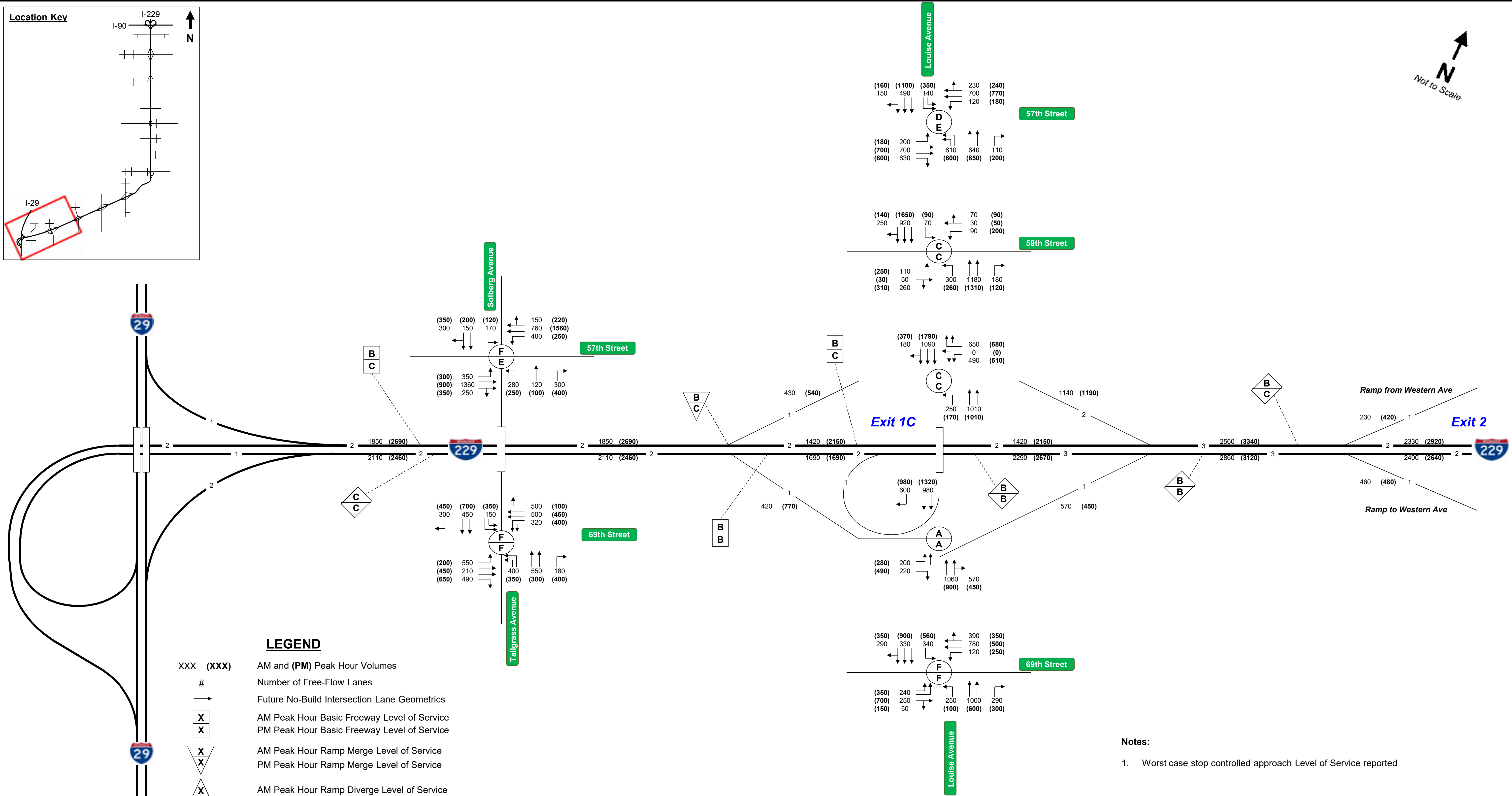


LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported

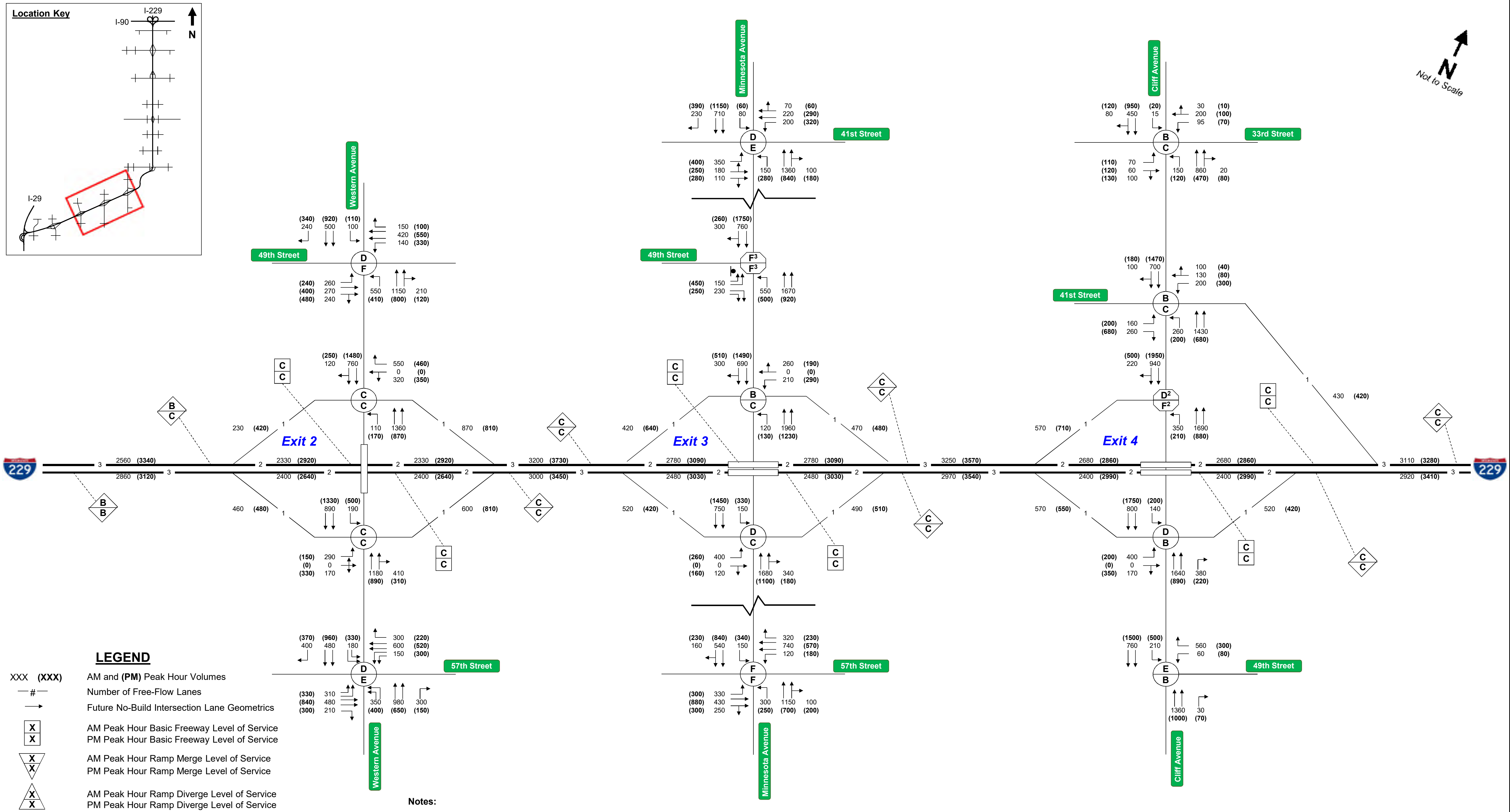
HDR

2035 No-Build "Best Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
I-229 Corridor Study
Sioux Falls, South Dakota

Date
2/12/2015

Figure
6



LEGEND

XXX **(XXX)** AM and **(PM)** Peak Hour Volumes

—#— Number of Free-Flow Lanes

→ Future No-Build Intersection Lane Geometrics

AM Peak Hour Basic Freeway Level of Service
PM Peak Hour Basic Freeway Level of Service

AM Peak Hour Ramp Merge Level of Service
PM Peak Hour Ramp Merge Level of Service

AM Peak Hour Ramp Diverge Level of Service
PM Peak Hour Ramp Diverge Level of Service

AM Peak Hour Weaving Section Level of Service
PM Peak Hour Weaving Section Level of Service

AM Peak Hour Signalized Intersection Level of Service
PM Peak Hour Signalized Intersection Level of Service

AM Peak Hour Unsignalized Intersection Level of Service
PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported
2. Worst case stop controlled movement Level of Service reported
3. Level of Service reported from HCS 2010 analysis using a single left-turn lane and a single right-turn lane due to limitations of HCS 2010 software.

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I-229 Major Investment Corridor Study: Sub-Study 1
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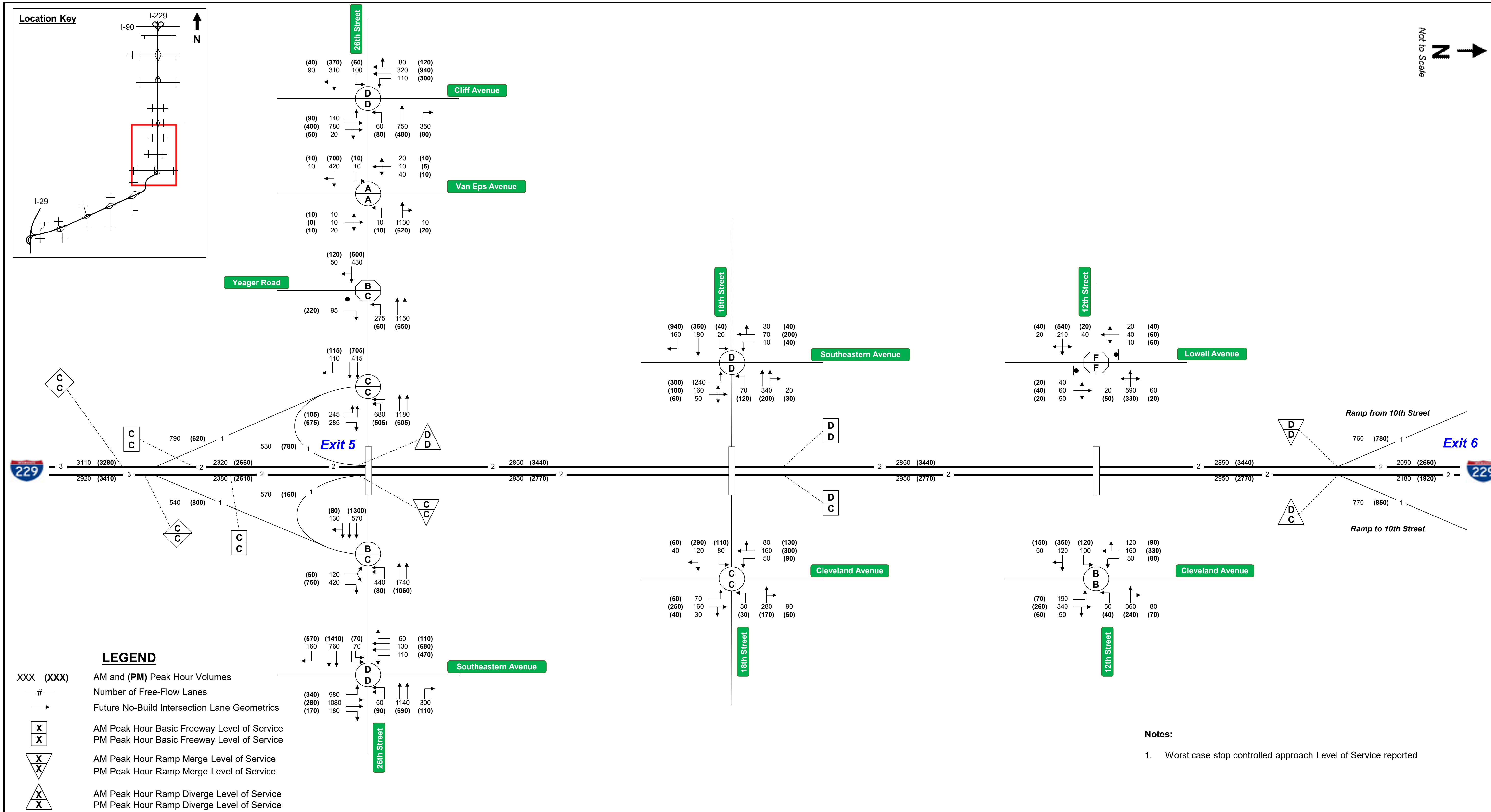
Figure
7



HDR

2035 No-Build "Best Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 1
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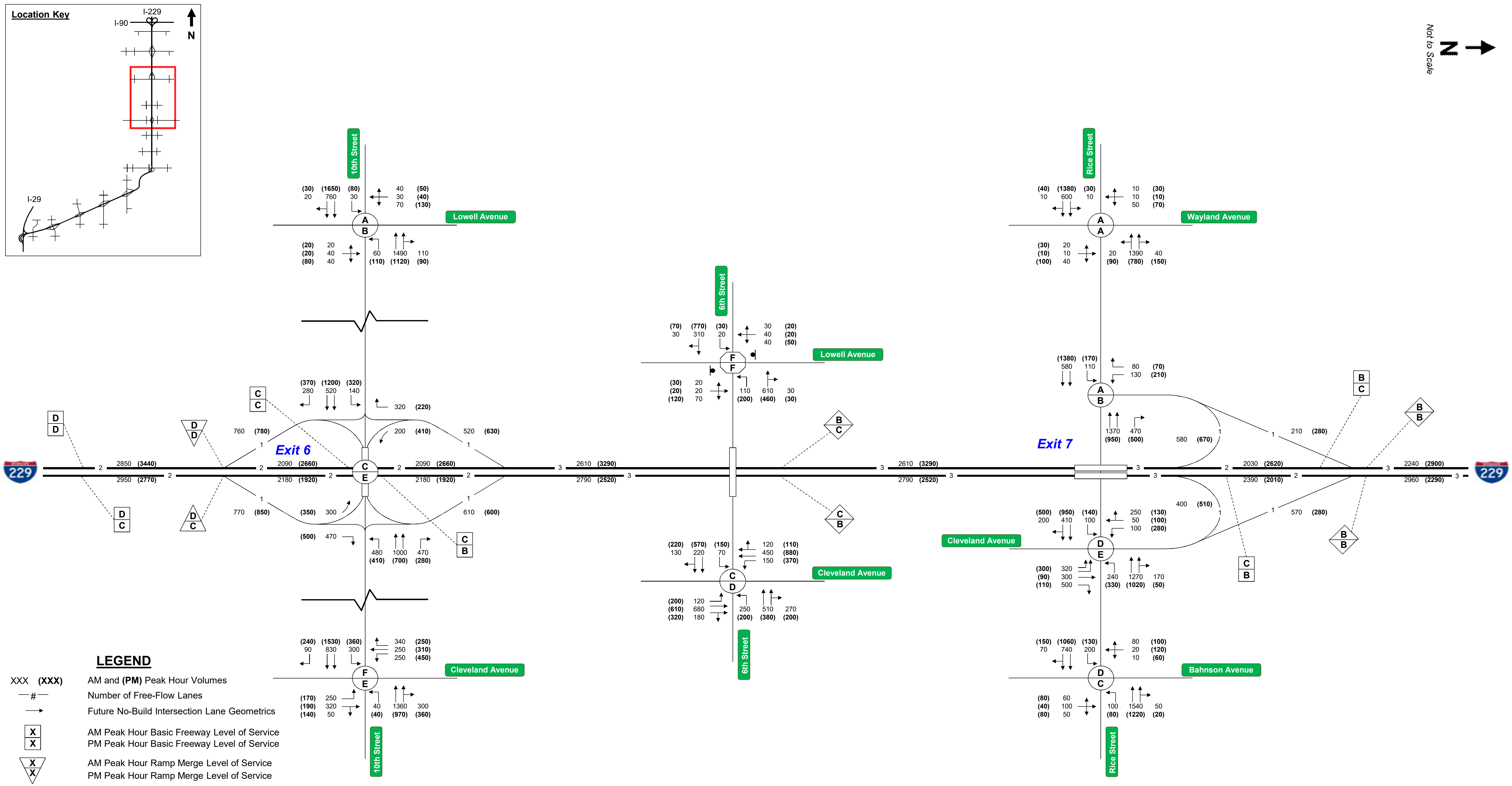
Figure 8



LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X / X	AM Peak Hour Basic Freeway Level of Service PM Peak Hour Basic Freeway Level of Service
X / X	AM Peak Hour Ramp Merge Level of Service PM Peak Hour Ramp Merge Level of Service
X / X	AM Peak Hour Ramp Diverge Level of Service PM Peak Hour Ramp Diverge Level of Service
X / X	AM Peak Hour Weaving Section Level of Service PM Peak Hour Weaving Section Level of Service
X / X	AM Peak Hour Signalized Intersection Level of Service PM Peak Hour Signalized Intersection Level of Service
X / X	AM Peak Hour Unsignalized Intersection Level of Service PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported

HDR

2035 No-Build "Best Case" Conditions Traffic Operations Analysis

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Figure
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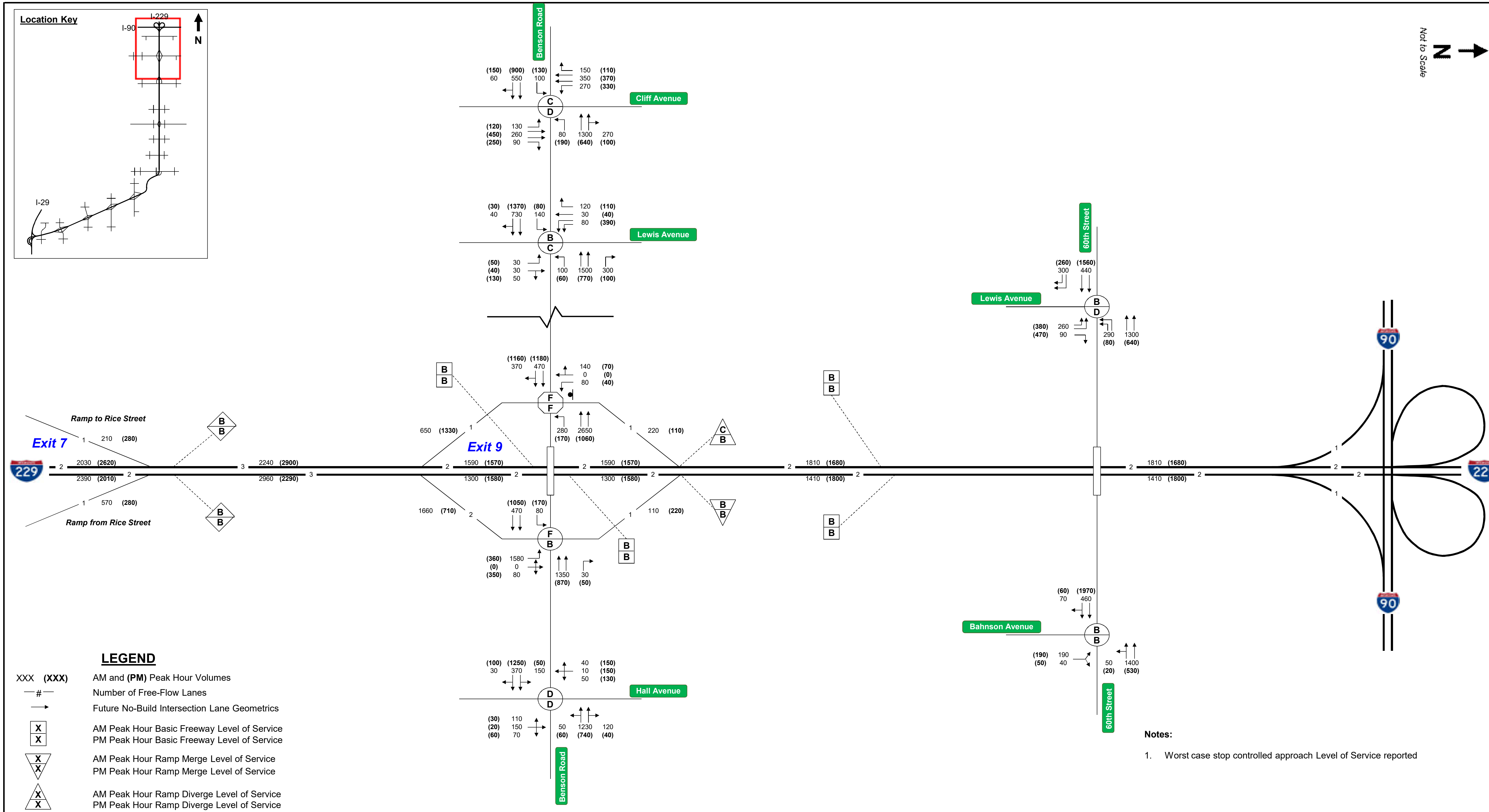

LEGEND

XXX **(XXX)** AM and **(PM)** Peak Hour Volumes

—#— Number of Free-Flow Lanes

→ Future No-Build Intersection Lane Geometrics

AM Peak Hour Basic Freeway Level of Service
PM Peak Hour Basic Freeway Level of Service

AM Peak Hour Ramp Merge Level of Service
PM Peak Hour Ramp Merge Level of Service

AM Peak Hour Ramp Diverge Level of Service
PM Peak Hour Ramp Diverge Level of Service

AM Peak Hour Weaving Section Level of Service
PM Peak Hour Weaving Section Level of Service

AM Peak Hour Signalized Intersection Level of Service
PM Peak Hour Signalized Intersection Level of Service

AM Peak Hour Unsignalized Intersection Level of Service
PM Peak Hour Unsignalized Intersection Level of Service

Notes:

1. Worst case stop controlled approach Level of Service reported

HDR

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I-229 Major Investment Corridor Study: Sub-Study 1
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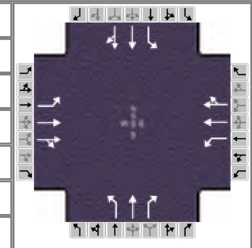
Figure 10

APPENDIX -

2035 NO-BUILD "WORST CASE" AND "BEST CASE" HCS 2010 REPORTS

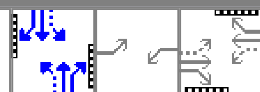
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM PEAK	PHF	0.85
Intersection	Solberg Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Solberg_Tallgrass_AM_BestCase.xus				
Project Description	2035 NB AM				

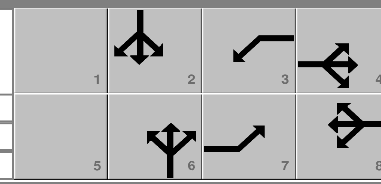


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	350	1360	250	400	760	150	280	120	300	170	150	300

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	78	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	33.2	21.0	74.4	0.0	0.0	0.0
Yellow	3.8	4.0	4.0	0.0	0.0	0.0
Red	2.0	1.0	1.6	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8		6		2
Case Number	1.1	4.0	1.1	4.0		5.0		6.0
Phase Duration, s	26.0	80.0	26.0	80.0		39.0		39.0
Change Period, (Y+R_c), s	5.0	5.6	5.0	5.6		5.8		5.8
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0		0.0		0.0
Queue Clearance Time (g_s), s	19.0	76.4	23.0	33.1				
Green Extension Time (g_e), s	1.6	0.0	0.0	21.6		0.0		0.0
Phase Call Probability	1.00	1.00	1.00	1.00				
Max Out Probability	0.00	1.00	1.00	0.46				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (v), veh/h	412	942	935	471	537	509	161	69	0	200	176	219
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1675	1681	1765	1675	985	1765	1496	1326	1765	1496
Queue Service Time (g_s), s	17.0	74.4	74.4	21.0	31.1	31.1	14.0	4.2	0.0	20.5	12.4	19.2
Cycle Queue Clearance Time (g_c), s	17.0	74.4	74.4	21.0	31.1	31.1	33.2	4.2	0.0	24.1	12.4	19.2
Green Ratio (g/C)	0.65	0.51	0.51	0.65	0.51	0.51	0.23	0.23	0.23	0.23	0.23	0.23
Capacity (c), veh/h	452	905	860	293	899	853	145	404	342	320	404	342
Volume-to-Capacity Ratio (X)	0.911	1.041	1.088	1.606	0.597	0.597	1.113	0.171	0.000	0.624	0.437	0.639
Available Capacity (c_a), veh/h	990	905	860	293	899	853	145	404	342	320	404	342
Back of Queue (Q), veh/ln (95th percentile)	12.7	52.8	56.9	52.2	19.4	18.6	9.1	2.5	0.0	12.0	9.8	12.6
Queue Storage Ratio (RQ) (95th percentile)	3.22	1.34	1.45	13.25	0.49	0.47	2.32	0.01	0.00	1.53	0.25	0.32
Uniform Delay (d_1), s/veh	23.6	35.3	35.3	51.7	25.1	25.1	48.1	41.0	0.0	54.1	47.9	50.5
Incremental Delay (d_2), s/veh	7.5	41.0	57.5	288.0	2.9	3.1	60.2	0.1	0.0	8.9	3.4	8.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	31.1	76.3	92.8	339.7	28.0	28.1	108.3	41.1	0.0	62.9	51.3	59.3
Level of Service (LOS)	C	F	F	F	C	C	F	D		E	D	E
Approach Delay, s/veh / LOS	74.9		E	124.8		F	88.1		F	58.2		E
Intersection Delay, s/veh / LOS	89.7						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	2.6	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.4	B	1.7	A	1.3	A	1.0	A

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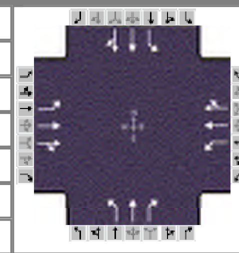
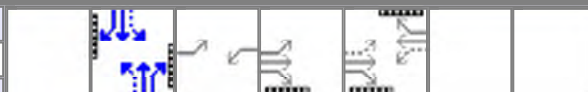
HCS 2010 Signalized Intersection Results Summary



General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM PEAK	PHF	0.93
Intersection	Solberg Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Solberg_Tallgrass_PM_BestCase.xus				
Project Description	2035 NB PM				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	300	900	350	250	1560	220	250	100	400	120	200	350



Signal Information									
Cycle, s	150.0	Reference Phase	2						
Offset, s	65	Reference Point	End	Green	35.2	13.5	4.5	80.4	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.8	4.0	0.0	4.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	1.0	0.0	1.6	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8		6		2
Case Number	1.1	4.0	1.1	4.0		5.0		6.0
Phase Duration, s	23.0	90.5	18.5	86.0		41.0		41.0
Change Period, (*Y+Rc*), s	5.0	5.6	5.0	5.6		5.8		5.8
Max Allow Headway (*MAH*), s	4.1	4.0	4.1	4.0		0.0		0.0
Queue Clearance Time (*gs*), s	20.0	42.8	12.7	82.4				
Green Extension Time (*ge*), s	0.0	25.2	0.9	0.0		0.0		0.0
Phase Call Probability	1.00	1.00	1.00	1.00				
Max Out Probability	1.00	0.56	0.00	1.00				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (*v*), veh/h	323	674	621	269	951	948	235	94	0	129	215	220
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1612	1681	1765	1693	949	1765	1496	1297	1765	1496
Queue Service Time (*gs*), s	18.0	40.2	40.8	10.7	80.4	80.4	15.4	6.5	0.0	13.4	15.9	19.8
Cycle Queue Clearance Time (*gc*), s	18.0	40.2	40.8	10.7	80.4	80.4	35.2	6.5	0.0	20.2	15.9	19.8
Green Ratio (*g/C*)	0.67	0.57	0.57	0.63	0.54	0.54	0.23	0.23	0.23	0.23	0.23	0.23
Capacity (*c*), veh/h	250	998	912	318	946	908	145	414	351	294	414	351
Volume-to-Capacity Ratio (*X*)	1.292	0.675	0.681	0.846	1.006	1.044	1.621	0.227	0.000	0.440	0.519	0.628
Available Capacity (*ca*), veh/h	250	998	912	536	946	908	145	414	351	294	414	351
Back of Queue (*Q*), veh/ln (95th percentile)	30.8	23.9	22.5	9.6	51.4	54.5	28.1	5.3	0.0	8.3	12.0	12.9
Queue Storage Ratio (*RQ*) (95th percentile)	7.82	0.61	0.57	2.43	1.31	1.38	7.15	0.03	0.00	1.06	0.30	0.33
Uniform Delay (*d1*), s/veh	54.6	22.9	23.0	24.9	34.8	34.8	52.6	46.8	0.0	54.7	50.0	51.5
Incremental Delay (*d2*), s/veh	157.9	3.7	4.1	6.2	30.7	42.0	301.3	0.9	0.0	4.7	4.6	8.3
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	212.6	26.5	27.1	31.1	65.5	76.8	353.9	47.7	0.0	59.4	54.6	59.8
Level of Service (LOS)	F	C	C	C	F	F	F	D		E	D	E
Approach Delay, s/veh / LOS	63.9	E		66.2	E		266.4	F		57.7	E	
Intersection Delay, s/veh / LOS	78.4						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	2.6	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	2.3	B	1.1	A	1.0	A

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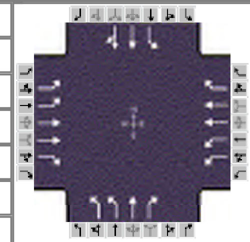
HCS 2010 Signalized Intersection Results Summary

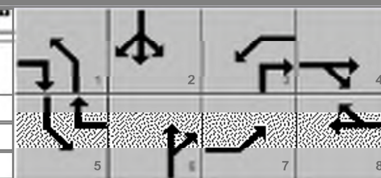
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM PEAK	PHF	0.85
Intersection	Solberg Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Solberg_Tallgrass_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	350	1360	250	400	760	150	280	120	300	170	150	300

Signal Information			
Cycle, s	140.0	Reference Phase	2
Offset, s	56	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	14.0	4.1	14.9	19.0	1.8	65.6
Yellow	4.0	0.0	4.0	4.0	0.0	4.0
Red	1.0	0.0	1.0	1.0	0.0	1.6



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	1	6	5	2
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	1.3	4.0
Phase Duration, s	25.8	73.0	24.0	71.2	19.0	23.1	19.9	24.0
Change Period, (Y+R_c), s	5.0	5.6	5.0	5.6	5.0	5.8	5.8	5.8
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	19.2	68.0	21.0	29.0	15.4		14.1	
Green Extension Time (g_e), s	1.6	0.0	0.0	21.2	0.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	0.00	1.00	1.00	0.41	1.00		1.00	

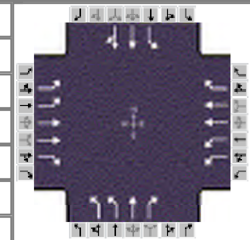
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (v), veh/h	412	1600	278	471	894	152	313	134	335	200	176	219
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1680	1496	1632	1680	1496	1632	1765	1496	1681	1765	1496
Queue Service Time (g_s), s	17.2	66.0	13.4	19.0	27.0	6.8	13.4	9.9	17.2	12.1	13.5	18.2
Cycle Queue Clearance Time (g_c), s	17.2	66.0	13.4	19.0	27.0	6.8	13.4	9.9	17.2	12.1	13.5	18.2
Green Ratio (g/C)	0.15	0.48	0.58	0.14	0.47	0.57	0.10	0.12	0.26	0.10	0.13	0.13
Capacity (c), veh/h	486	1618	870	443	1574	852	326	217	387	221	229	194
Volume-to-Capacity Ratio (X)	0.848	0.989	0.319	1.062	0.568	0.178	0.959	0.617	0.866	0.903	0.769	1.125
Available Capacity (c_a), veh/h	909	1618	870	443	1574	852	326	217	387	222	229	194
Back of Queue (Q), veh/ln (95th percentile)	11.7	39.2	8.2	17.5	16.3	2.0	7.9	6.0	7.3	14.0	11.8	19.0
Queue Storage Ratio (RQ) (95th percentile)	2.98	1.00	2.08	4.44	0.41	0.50	2.00	0.03	1.85	1.77	0.30	0.48
Uniform Delay (d_1), s/veh	58.0	35.9	15.1	60.5	27.0	15.5	61.6	55.5	10.1	60.5	58.9	60.9
Incremental Delay (d_2), s/veh	4.2	19.9	1.0	60.3	1.5	0.5	14.3	2.8	5.8	34.7	21.6	102.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	62.2	55.9	16.0	120.8	28.5	16.0	75.9	58.3	16.0	95.2	80.5	163.2
Level of Service (LOS)	E	E	B	F	C	B	E	E	B	F	F	F
Approach Delay, s/veh / LOS	52.2	D		55.9	E		47.2	D		115.8	F	
Intersection Delay, s/veh / LOS	59.8						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	2.4	B	1.7	A	1.8	A	1.0	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:16:50 AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM PEAK	PHF	0.93
Intersection	Solberg Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Solberg_Tallgrass_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	300	900	350	250	1560	220	250	100	400	120	200	350

Signal Information			
Cycle, s	140.0	Reference Phase	2
Offset, s	136	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	13.5	9.8	5.9	14.0	0.4	70.0
Yellow	4.0	3.8	4.0	4.0	0.0	4.0
Red	1.0	2.0	1.0	1.0	0.0	1.6

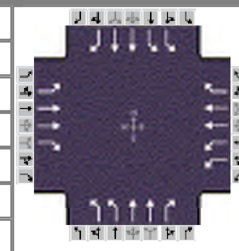
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	1	6	5	2
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	1.3	4.0
Phase Duration, s	19.0	75.6	19.4	76.0	18.5	34.1	10.9	26.5
Change Period, (Y+R_c), s	5.0	5.6	5.0	5.6	5.0	5.8	5.8	5.8
Max Allow Headway (*MAH*), s	4.1	4.0	4.1	4.0	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	15.8	30.3	13.3	71.4	13.3		4.5	
Green Extension Time (g_e), s	0.0	25.0	1.1	0.0	0.3	0.0	0.1	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.99	
Max Out Probability	1.00	0.49	0.00	1.00	0.19		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	1	6	16	5	2	12
Adjusted Flow Rate (*v*), veh/h	323	968	327	269	1677	222	269	108	430	129	215	220
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1632	1680	1496	1632	1680	1496	1632	1765	1496	1681	1765	1496
Queue Service Time (g_s), s	13.8	28.3	15.8	11.3	69.4	11.2	11.3	6.9	28.2	2.5	16.6	20.6
Cycle Queue Clearance Time (g_c), s	13.8	28.3	15.8	11.3	69.4	11.2	11.3	6.9	28.2	2.5	16.6	20.6
Green Ratio (*g/C*)	0.10	0.50	0.60	0.10	0.50	0.54	0.10	0.20	0.31	0.09	0.15	0.15
Capacity (*c*), veh/h	326	1678	892	337	1690	808	316	355	456	159	260	221
Volume-to-Capacity Ratio (*X*)	0.988	0.577	0.367	0.797	0.993	0.274	0.852	0.303	0.944	0.812	0.826	0.999
Available Capacity (c_a), veh/h	326	1678	892	1842	1690	808	420	355	456	162	260	221
Back of Queue (*Q*), veh/ln (95th percentile)	12.3	16.8	9.3	8.4	40.8	8.4	8.2	5.7	11.0	9.4	14.0	16.9
Queue Storage Ratio (*RQ*) (95th percentile)	3.14	0.43	2.36	2.14	1.04	2.14	2.07	0.03	2.79	1.19	0.36	0.43
Uniform Delay (d_1), s/veh	62.9	24.6	14.6	61.3	34.5	25.6	59.7	44.6	5.7	63.9	57.9	59.7
Incremental Delay (d_2), s/veh	46.5	1.4	1.2	4.3	20.3	0.8	8.5	1.9	27.4	23.9	24.9	60.2
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	109.4	26.1	15.8	65.7	54.8	26.4	68.2	46.5	33.1	87.8	82.8	119.9
Level of Service (LOS)	F	C	B	E	D	C	E	D	C	F	F	F
Approach Delay, s/veh / LOS	40.6	D		53.2	D		46.6	D		98.4	F	
Intersection Delay, s/veh / LOS	53.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	3.1	C	3.2	C
Bicycle LOS Score / LOS	1.8	A	2.3	B	1.8	A	1.0	A

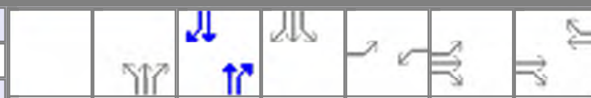
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM PEAK	PHF	0.85
Intersection	Tallgrass Avenue & W 69th	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Solberg_Tallgrass_AM_BestCase.xus				
Project Description	2035 NB AM				

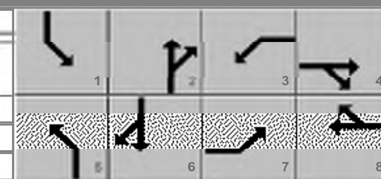


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	550	210	490	320	500	500	400	550	180	150	450	300

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	18.1	4.6	10.1	18.5	14.6	37.1
Yellow	5.0	5.0	5.0	5.0	5.0	5.0
Red	2.0	2.0	2.0	2.0	2.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	47.1	65.7	25.5	44.1	25.1	36.6	17.1	28.7
Change Period, (Y+R_c), s	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Max Allow Headway (MAH), s	3.1	3.2	3.1	3.2	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	40.4	57.2	18.6	38.1	22.8		8.2	
Green Extension Time (g_e), s	1.4	1.4	0.9	0.1	0.0	0.0	1.9	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	0.00	1.00	0.00	1.00	1.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	647	247	576	376	588	588	471	647	212	143	429	286
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1680	1496	1632	1680	1496	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	38.4	7.0	55.2	16.6	23.1	36.1	20.8	26.9	18.6	6.2	18.2	21.8
Cycle Queue Clearance Time (g_c), s	38.4	7.0	55.2	16.6	23.1	36.1	20.8	26.9	18.6	6.2	18.2	21.8
Green Ratio (g/C)	0.28	0.41	0.41	0.13	0.26	0.26	0.12	0.20	0.20	0.07	0.15	0.15
Capacity (c), veh/h	445	1321	588	393	835	372	467	749	334	229	504	224
Volume-to-Capacity Ratio (X)	1.453	0.187	0.980	0.957	0.704	1.582	1.007	0.863	0.635	0.625	0.852	1.276
Available Capacity (c_a), veh/h	785	1407	626	1098	927	413	467	749	334	1193	504	224
Back of Queue (Q), veh/ln (95th percentile)	63.9	5.1	32.8	11.6	14.9	58.1	16.9	18.3	11.3	3.4	9.4	20.5
Queue Storage Ratio (RQ) (95th percentile)	3.25	0.26	1.67	0.84	0.38	5.91	1.23	0.47	1.14	0.29	0.24	2.08
Uniform Delay (d_1), s/veh	53.3	28.8	43.4	63.4	49.6	26.5	62.1	54.2	4.4	66.9	62.4	61.2
Incremental Delay (d_2), s/veh	212.1	0.0	29.8	6.2	1.7	274.4	43.4	12.6	8.9	0.1	1.8	127.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	265.4	28.8	73.3	69.6	51.3	300.9	105.5	66.8	13.3	67.0	64.2	188.5
Level of Service (LOS)	F	C	E	E	D	F	F	E	B	E	E	F

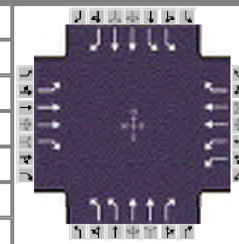
Approach Delay, s/veh / LOS	150.4	F	150.3	F	72.0	E	106.1	F
Intersection Delay, s/veh / LOS	123.0				F			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	3.1	C	3.0	C
Bicycle LOS Score / LOS	1.7	A	1.8	A	1.6	A	1.4	A

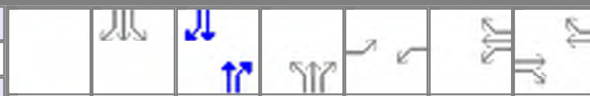
 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:14:20 AM

HCS 2010 Signalized Intersection Results Summary

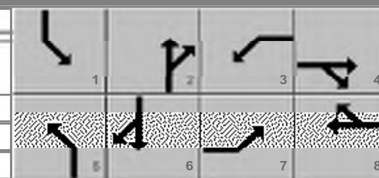
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM PEAK	PHF	0.93
Intersection	Tallgrass Avenue & W 69th	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Solberg_Tallgrass_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	450	650	400	450	100	350	300	400	350	700	450



Signal Information										
Cycle, s	150.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	18.7	10.8	18.0	15.0	0.4	45.1
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.0	5.0	5.0	5.0	5.0	5.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	2.0	2.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	22.0	52.1	29.4	59.5	25.0	42.8	25.7	43.5
Change Period, (*Y+R*$_c$), s	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	17.0	43.7	21.4	19.0	19.2		19.3	
Green Extension Time (g_e), s	0.0	4.7	1.0	4.9	0.0	0.0	0.7	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	0.03	0.00	0.00	1.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	215	484	699	430	484	108	376	323	430	376	753	484
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	1632	1680	1496	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	15.0	18.2	41.7	19.4	17.0	7.8	17.2	11.6	40.4	17.3	31.9	39.9
Cycle Queue Clearance Time (g_c), s	15.0	18.2	41.7	19.4	17.0	7.8	17.2	11.6	40.4	17.3	31.9	39.9
Green Ratio (*g/C*)	0.10	0.30	0.30	0.15	0.35	0.35	0.12	0.24	0.24	0.12	0.24	0.24
Capacity (*c*), veh/h	168	935	416	488	1101	490	392	905	403	379	893	397
Volume-to-Capacity Ratio (*X*)	1.280	0.518	1.680	0.882	0.440	0.219	0.961	0.356	1.067	0.992	0.843	1.218
Available Capacity (c_a), veh/h	168	1513	674	1719	1680	748	392	905	403	767	893	397
Back of Queue (*Q*), veh/ln (95th percentile)	22.0	12.1	66.1	12.8	11.3	5.2	13.9	8.6	31.0	11.3	19.2	31.8
Queue Storage Ratio (*RQ*) (95th percentile)	1.12	0.61	3.36	0.93	0.29	0.52	1.01	0.22	3.15	0.96	0.49	3.23
Uniform Delay (d_1), s/veh	67.5	45.7	8.5	62.5	39.6	36.5	65.6	44.3	54.8	67.0	53.3	2.0
Incremental Delay (d_2), s/veh	163.5	0.2	316.3	2.1	0.1	0.1	35.0	1.1	63.8	8.9	6.5	112.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	231.0	45.8	324.9	64.6	39.7	36.6	100.7	45.4	118.6	75.9	59.8	114.4
Level of Service (LOS)	F	D	F	E	D	D	F	D	F	E	E	F
Approach Delay, s/veh / LOS	213.8	F		49.9	D		91.7	F		79.9	E	
Intersection Delay, s/veh / LOS	112.8						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	3.1	C	3.0	C
Bicycle LOS Score / LOS	1.6	A	1.3	A	1.4	A	1.8	A

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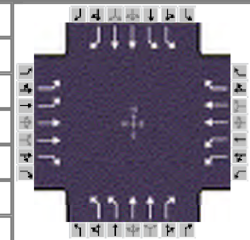
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM PEAK	PHF	0.85
Intersection	Tallgrass Avenue & W 69th	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Solberg_Tallgrass_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	550	210	490	320	500	500	400	550	180	150	450	300

Signal Information			
Cycle, s	140.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	22.9	3.7	11.4	18.7	5.0	36.5
Yellow	5.0	5.0	5.0	5.0	5.0	5.0
Red	2.0	2.0	2.0	2.0	2.0	2.0

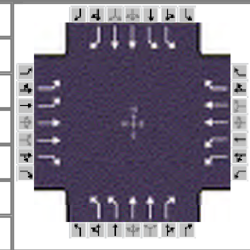
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	37.6	55.5	25.7	43.5	29.9	40.5	18.4	29.0
Change Period, ($Y+R_c$), s	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Max Allow Headway (MAH), s	3.1	3.2	3.1	3.2	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	29.0	45.4	17.8	37.9	21.7		9.1	
Green Extension Time (g_e), s	1.6	2.1	0.8	0.0	1.1	0.0	2.3	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	0.00	0.95	0.00	1.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	647	247	576	376	588	588	471	647	212	172	516	344
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1680	1496	1632	1680	1496	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	27.0	7.3	43.4	15.8	22.1	35.9	19.7	25.3	14.4	7.1	20.9	22.6
Cycle Queue Clearance Time (g_c), s	27.0	7.3	43.4	15.8	22.1	35.9	19.7	25.3	14.4	7.1	20.9	22.6
Green Ratio (g/C)	0.22	0.35	0.51	0.13	0.26	0.34	0.16	0.24	0.37	0.08	0.16	0.38
Capacity (c), veh/h	714	1150	756	435	863	505	533	817	563	265	541	568
Volume-to-Capacity Ratio (X)	0.906	0.215	0.762	0.866	0.682	1.164	0.883	0.792	0.376	0.649	0.952	0.605
Available Capacity (c_a), veh/h	1460	1175	767	900	887	516	1237	817	563	699	541	568
Back of Queue (Q), veh/ln (95th percentile)	16.5	5.3	22.2	10.8	14.3	24.9	12.9	16.8	6.2	4.9	11.6	8.2
Queue Storage Ratio (RQ) (95th percentile)	0.84	0.27	1.13	0.78	0.36	2.53	0.93	0.43	0.63	0.41	0.29	0.83
Uniform Delay (d_1), s/veh	53.3	32.7	27.8	59.4	46.9	10.1	57.3	49.6	17.0	60.2	44.1	24.9
Incremental Delay (d_2), s/veh	1.9	0.0	4.0	2.1	1.7	93.7	2.0	7.7	1.9	0.5	18.7	2.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	55.1	32.7	31.8	61.5	48.6	103.8	59.2	57.4	18.9	60.8	62.8	27.4
Level of Service (LOS)	E	C	C	E	D	F	E	E	B	E	E	C
Approach Delay, s/veh / LOS	42.2	D		72.6	E		51.9	D		50.7	D	
Intersection Delay, s/veh / LOS	55.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.7	A	1.8	A	1.6	A	1.4	A

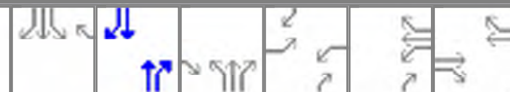
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM PEAK	PHF	0.93
Intersection	Tallgrass Avenue & W 69th	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Solberg_Tallgrass_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	450	650	400	450	100	350	300	400	350	700	450

Signal Information				
Cycle, s	140.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	18.5	5.1	18.0	11.3	2.7	42.4
Yellow	5.0	5.0	5.0	5.0	5.0	5.0
Red	2.0	2.0	2.0	2.0	2.0	2.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	18.3	49.4	28.1	59.1	25.0	37.0	25.5	37.6
Change Period, (*Y+R*$_c$), s	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Max Allow Headway (*MAH*), s	3.1	3.1	3.1	3.1	3.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	11.1	41.0	20.0	17.3	17.9		17.8	
Green Extension Time (g_e), s	0.3	4.7	1.0	4.9	0.0	0.0	0.8	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	0.01	0.03	0.00	0.00	1.00		0.00	

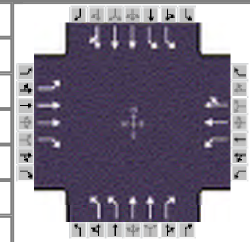
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	215	484	699	430	484	108	376	323	430	376	753	484
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1632	1680	1496	1632	1680	1496	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	9.1	17.0	39.0	18.0	15.3	5.6	15.9	11.3	33.5	15.8	30.3	33.9
Cycle Queue Clearance Time (g_c), s	9.1	17.0	39.0	18.0	15.3	5.6	15.9	11.3	33.5	15.8	30.3	33.9
Green Ratio (*g/C*)	0.08	0.30	0.43	0.15	0.37	0.50	0.13	0.21	0.37	0.13	0.22	0.30
Capacity (*c*), veh/h	264	937	609	492	1171	718	419	803	583	429	813	483
Volume-to-Capacity Ratio (*X*)	0.813	0.517	1.148	0.875	0.413	0.150	0.897	0.402	0.738	0.876	0.925	1.001
Available Capacity (c_a), veh/h	420	1557	885	1795	1792	994	420	803	583	892	813	483
Back of Queue (*Q*), veh/ln (95th percentile)	6.9	11.3	31.6	12.0	10.3	3.5	12.3	8.5	19.7	9.9	18.6	16.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.35	0.58	1.60	0.87	0.26	0.36	0.89	0.22	2.00	0.84	0.47	1.67
Uniform Delay (d_1), s/veh	63.3	42.5	6.6	58.2	34.7	20.4	60.1	44.8	36.6	57.5	46.6	2.8
Incremental Delay (d_2), s/veh	3.0	0.2	78.4	2.0	0.1	0.0	20.9	1.5	8.1	1.7	14.2	35.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	66.2	42.7	85.0	60.1	34.8	20.4	81.0	46.3	44.7	59.2	60.8	38.2
Level of Service (LOS)	E	D	F	E	C	C	F	D	D	E	E	F
Approach Delay, s/veh / LOS	67.5	E		44.0	D		57.3	E		53.7	D	
Intersection Delay, s/veh / LOS	56.3						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.6	A	1.3	A	1.4	A	1.8	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:18:57 AM

HCS 2010 Signalized Intersection Results Summary

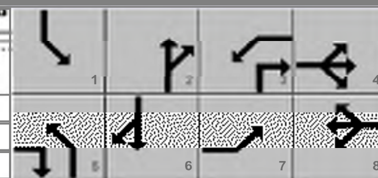
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	700	630	120	700	230	610	640	110	140	490	150

Signal Information			
Cycle, s	130.0	Reference Phase	6
Offset, s	90	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	9.5	1.5	30.3	9.3	4.4	46.0
Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Red	2.0	2.0	2.0	1.0	0.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	18.7	56.4	14.3	52.0	36.3	43.8	15.5	23.0
Change Period, (Y+R_c), s	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.1	6.1	4.1	6.1	5.1	0.0	5.2	0.0
Queue Clearance Time (g_s), s	13.2	31.1	8.9	39.5	25.4		8.4	
Green Extension Time (g_e), s	0.5	17.4	0.5	6.6	4.4	0.0	1.1	0.0
Phase Call Probability	1.00	1.00	0.99	1.00	1.00		1.00	
Max Out Probability	0.04	0.89	0.00	0.99	0.35		0.00	

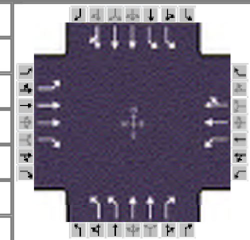
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	235	824	558	141	544	504	667	700	89	165	456	216
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	1681	1765	1634	1632	1680	1496	1632	1765	1635
Queue Service Time (g_s), s	11.2	25.9	29.1	6.9	37.4	37.5	23.4	20.7	3.1	6.4	16.7	16.7
Cycle Queue Clearance Time (g_c), s	11.2	25.9	29.1	6.9	37.4	37.5	23.4	20.7	3.1	6.4	16.7	16.7
Green Ratio (*g/C*)	0.47	0.39	0.62	0.42	0.35	0.35	0.23	0.29	0.36	0.07	0.13	0.13
Capacity (*c*), veh/h	269	1299	933	242	623	577	774	980	543	240	452	209
Volume-to-Capacity Ratio (*X*)	0.876	0.634	0.598	0.583	0.873	0.873	0.863	0.714	0.163	0.688	1.009	1.031
Available Capacity (c_a), veh/h	373	1305	935	714	627	580	1130	980	543	1386	452	209
Back of Queue (*Q*), veh/ln (95th percentile)	9.3	15.9	15.2	5.1	25.1	23.7	10.5	10.2	1.8	5.1	15.5	16.6
Queue Storage Ratio (*RQ*) (95th percentile)	1.19	0.40	0.91	1.04	0.64	0.60	1.34	0.45	0.16	0.74	0.39	0.42
Uniform Delay (d_1), s/veh	29.2	32.4	18.4	26.9	39.3	39.4	31.1	27.2	14.9	58.8	56.7	56.7
Incremental Delay (d_2), s/veh	15.6	1.4	1.6	2.2	13.7	14.7	3.9	3.0	0.4	4.9	44.5	70.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	44.8	33.8	20.0	29.1	53.1	54.0	35.0	30.2	15.4	63.7	101.2	127.1
Level of Service (LOS)	D	C	C	C	D	D	D	C	B	E	F	F
Approach Delay, s/veh / LOS	30.7	C		50.6	D		31.5	C		100.5	F	
Intersection Delay, s/veh / LOS	47.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.2	C	2.9	C	3.2	C
Bicycle LOS Score / LOS	1.8	A	1.5	A	1.8	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:21:08 AM

HCS 2010 Signalized Intersection Results Summary

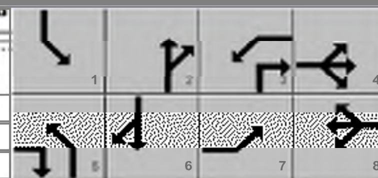
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 57th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	180	700	600	180	770	240	600	850	200	350	1100	160

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	86	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	13.0	5.0	20.0	5.0	3.0	25.0
Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Red	2.0	2.0	2.0	1.0	0.0	2.0



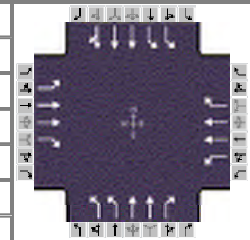
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	10.0	31.0	13.0	34.0	26.0	37.0	19.0	30.0
Change Period, ($Y+R_c$), s	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.1	4.1	4.1	4.1	4.1	0.0	4.2	0.0
Queue Clearance Time (g_s), s	7.0	27.0	10.0	30.0	20.3		13.3	
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	1.00	1.00	1.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	194	753	591	194	551	509	621	879	118	376	904	426
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	1681	1765	1631	1632	1680	1496	1632	1765	1661
Queue Service Time (g_s), s	5.0	21.7	25.0	8.0	28.0	28.0	18.3	22.7	3.2	11.3	24.0	24.0
Cycle Queue Clearance Time (g_c), s	5.0	21.7	25.0	8.0	28.0	28.0	18.3	22.7	3.2	11.3	24.0	24.0
Green Ratio (*g/C*)	0.30	0.25	0.45	0.33	0.28	0.28	0.20	0.31	0.39	0.13	0.24	0.24
Capacity (*c*), veh/h	156	840	673	220	494	457	653	1042	583	424	847	399
Volume-to-Capacity Ratio (*X*)	1.240	0.896	0.879	0.880	1.115	1.115	0.951	0.844	0.202	0.887	1.068	1.068
Available Capacity (c_a), veh/h	156	840	673	220	494	457	653	1042	583	424	847	399
Back of Queue (*Q*), veh/ln (95th percentile)	13.4	15.1	12.0	9.0	31.5	29.7	9.3	10.6	1.7	9.6	23.5	24.3
Queue Storage Ratio (*RQ*) (95th percentile)	1.71	0.38	0.72	1.82	0.80	0.75	1.18	0.47	0.15	1.39	0.60	0.62
Uniform Delay (d_1), s/veh	35.2	36.2	13.5	29.7	36.0	36.0	27.5	23.1	10.8	42.8	38.0	38.0
Incremental Delay (d_2), s/veh	150.9	12.3	12.7	30.9	75.8	77.5	16.4	5.1	0.5	19.7	50.6	64.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	186.0	48.5	26.3	60.6	111.8	113.5	43.8	28.1	11.3	62.5	88.6	102.3
Level of Service (LOS)	F	D	C	E	F	F	D	C	B	E	F	F
Approach Delay, s/veh / LOS	57.3	E		104.6	F		32.9	C		86.3	F	
Intersection Delay, s/veh / LOS	68.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	C	3.1	C	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.8	A	1.5	A	1.9	A	1.4	A

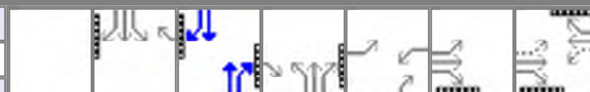
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_WorstCase.xus				
Project Description	2035 NB AM				

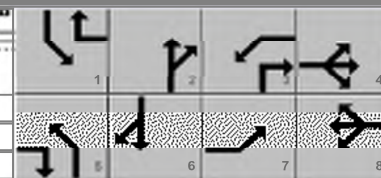


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	200	700	630	120	700	230	610	640	110	140	490	150

Signal Information			
Cycle, s	130.0	Reference Phase	6
Offset, s	90	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.5	7.1	31.7	9.7	4.4	38.6
Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Red	2.0	2.0	2.0	1.0	0.0	2.0



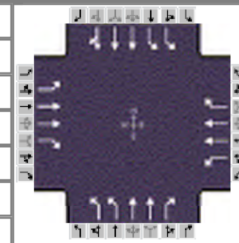
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	3.0	2.0	3.0	2.0	4.0
Phase Duration, s	19.1	49.0	14.7	44.6	37.7	50.8	15.5	28.6
Change Period, (Y+R_c), s	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.1	6.1	4.1	6.1	5.1	0.0	5.2	0.0
Queue Clearance Time (g_s), s	14.3	34.3	9.4	31.4	27.8		8.4	
Green Extension Time (g_e), s	0.1	7.6	0.5	6.3	3.7	0.0	1.1	0.0
Phase Call Probability	1.00	1.00	0.99	1.00	1.00		1.00	
Max Out Probability	1.00	0.98	0.00	0.99	0.60		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	235	824	558	141	824	224	711	746	94	165	456	216
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1680	1496	1681	1680	1496	1632	1680	1496	1632	1765	1635
Queue Service Time (g_s), s	12.3	28.0	32.3	7.4	29.4	14.2	25.8	19.8	2.8	6.4	16.1	16.5
Cycle Queue Clearance Time (g_c), s	12.3	28.0	32.3	7.4	29.4	14.2	25.8	19.8	2.8	6.4	16.1	16.5
Green Ratio (g/C)	0.42	0.33	0.58	0.38	0.30	0.37	0.24	0.34	0.42	0.07	0.17	0.17
Capacity (c), veh/h	287	1130	871	226	1019	563	802	1141	618	240	590	273
Volume-to-Capacity Ratio (X)	0.820	0.728	0.641	0.624	0.809	0.397	0.887	0.654	0.153	0.687	0.773	0.789
Available Capacity (c_a), veh/h	302	1130	871	634	1019	563	1029	1141	618	1396	590	273
Back of Queue (Q), veh/ln (95th percentile)	10.1	17.3	14.2	5.6	18.5	8.9	11.4	8.7	1.6	5.1	12.5	13.0
Queue Storage Ratio (RQ) (95th percentile)	1.28	0.44	0.85	1.14	0.47	2.27	1.45	0.39	0.14	0.74	0.32	0.33
Uniform Delay (d_1), s/veh	30.4	37.9	15.3	31.0	41.8	29.7	33.2	22.7	11.8	58.8	51.8	51.9
Incremental Delay (d_2), s/veh	15.6	3.0	2.2	2.8	5.6	1.0	3.9	1.2	0.2	4.9	9.5	20.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	46.0	40.9	17.6	33.8	47.4	30.7	37.1	24.0	12.0	63.7	61.2	72.3
Level of Service (LOS)	D	D	B	C	D	C	D	C	B	E	E	E
Approach Delay, s/veh / LOS	33.6		C	42.6		D	29.3		C	64.6		E
Intersection Delay, s/veh / LOS	39.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.4	C	3.2	C	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.8	A	1.5	A	1.8	A	0.9	A

HCS 2010 Signalized Intersection Results Summary

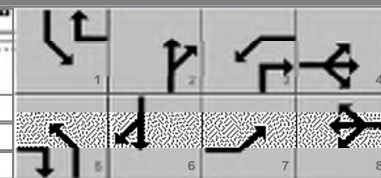
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 57th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	180	700	600	180	770	240	600	850	200	350	1100	160

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	90	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	14.3	7.7	18.0	8.0	1.0	27.0
Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Red	2.0	2.0	2.0	1.0	0.0	2.0



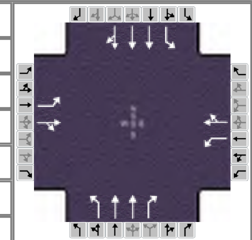
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	3.0	1.1	3.0	2.0	3.0	2.0	4.0
Phase Duration, s	14.0	34.0	13.0	33.0	24.0	37.7	20.3	34.0
Change Period, (*Y*+*R*c), s	5.0	6.0	5.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	4.1	4.1	4.1	4.1	4.1	0.0	4.2	0.0
Queue Clearance Time (*g*s), s	11.0	30.0	10.0	27.5	20.0		13.8	
Green Extension Time (*g*e), s	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	1.00	1.00	1.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	194	753	591	194	828	232	645	914	123	376	904	426
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	1681	1680	1496	1632	1680	1496	1632	1765	1661
Queue Service Time (*g*s), s	9.0	22.2	28.0	8.0	25.5	11.7	18.0	26.2	3.7	11.8	26.5	26.5
Cycle Queue Clearance Time (*g*c), s	9.0	22.2	28.0	8.0	25.5	11.7	18.0	26.2	3.7	11.8	26.5	26.5
Green Ratio (*g/C*)	0.34	0.27	0.44	0.33	0.26	0.39	0.17	0.30	0.38	0.14	0.27	0.27
Capacity (*c*), veh/h	220	896	655	211	864	589	560	1013	565	446	941	443
Volume-to-Capacity Ratio (*X*)	0.879	0.840	0.903	0.917	0.958	0.394	1.153	0.902	0.217	0.845	0.961	0.961
Available Capacity (*c*a), veh/h	220	896	655	211	864	589	560	1013	565	528	941	443
Back of Queue (*Q*), veh/ln (95th percentile)	9.1	14.7	13.7	9.8	18.4	7.2	16.4	12.1	2.1	9.2	20.2	21.1
Queue Storage Ratio (*RQ*) (95th percentile)	1.16	0.37	0.82	1.99	0.47	1.83	2.08	0.53	0.17	1.33	0.51	0.54
Uniform Delay (*d*1), s/veh	29.1	36.4	13.6	31.8	38.4	22.8	35.1	26.0	12.6	44.2	38.0	38.0
Incremental Delay (*d*2), s/veh	30.8	7.2	15.9	39.6	21.1	0.4	78.3	6.3	0.4	10.5	21.3	34.1
Initial Queue Delay (*d*3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	59.8	43.6	29.5	71.5	59.5	23.3	113.3	32.3	13.0	54.7	59.2	72.1
Level of Service (LOS)	E	D	C	E	E	C	F	C	B	D	E	E
Approach Delay, s/veh / LOS	40.2	D		54.6	D		62.0	E		61.4	E	
Intersection Delay, s/veh / LOS	54.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	C	3.1	C	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.8	A	1.5	A	1.9	A	1.4	A

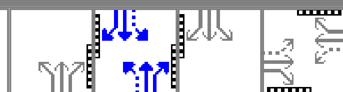
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise Ave & 59th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_BestCase.xus				
Project Description	2035 NB AM				

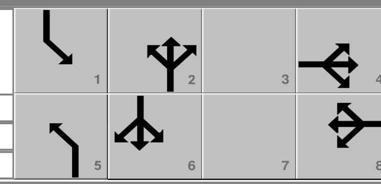


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	110	50	260	90	30	70	300	1180	180	70	920	250

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	121	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	17.6	41.6	11.1	43.7	0.0	0.0
Yellow	3.0	3.5	3.0	3.5	0.0	0.0
Red	0.0	1.5	0.0	1.5	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		6.0		6.0	1.2	3.0	1.3	4.0
Phase Duration, s		48.7		48.7	20.6	67.2	14.1	60.7
Change Period, ($Y+R_c$), s		5.0		5.0	3.0	5.0	5.0	5.0
Max Allow Headway (MAH), s		5.5		5.5	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s		30.1		42.0	17.0		2.0	
Green Extension Time (g_e), s		5.6		5.4	1.2	0.0	7.6	0.0
Phase Call Probability		1.00		1.00	1.00		0.95	
Max Out Probability		0.00		0.01	0.00		0.00	

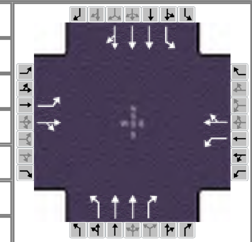
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	129	365		106	118		325	1278	195	81	938	417
Adjusted Saturation Flow Rate (s), veh/h/ln	1269	1533		1013	1567		1681	1680	1496	1681	1765	1569
Queue Service Time (g_s), s	11.5	28.1		7.8	7.3		15.0	39.4	7.3	0.0	26.7	20.1
Cycle Queue Clearance Time (g_c), s	23.2	28.1		40.0	7.3		15.0	39.4	7.3	0.0	26.7	20.1
Green Ratio (g/C)	0.34	0.34		0.34	0.34		0.50	0.48	0.48	0.41	0.43	0.43
Capacity (c), veh/h	332	472		116	482		352	1703	758	264	1628	723
Volume-to-Capacity Ratio (X)	0.389	0.773		0.913	0.244		0.923	0.750	0.257	0.307	0.576	0.576
Available Capacity (c_a), veh/h	701	917		410	938		772	1703	758	1142	1628	723
Back of Queue (Q), veh/ln (95th percentile)	6.8	16.5		7.9	5.1		11.1	21.2	4.3	4.3	15.5	9.0
Queue Storage Ratio (RQ) (95th percentile)	1.14	0.42		2.01	0.22		2.81	0.67	1.10	0.87	0.68	0.40
Uniform Delay (d_1), s/veh	44.2	40.9		62.8	33.7		28.1	25.5	12.8	41.9	28.6	16.7
Incremental Delay (d_2), s/veh	1.1	3.8		28.8	0.4		8.2	2.4	0.6	0.3	0.8	1.8
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	45.3	44.7		91.6	34.0		36.4	27.9	13.4	42.2	29.4	18.4
Level of Service (LOS)	D	D		F	C		D	C	B	D	C	B
Approach Delay, s/veh / LOS	44.9	D		61.3	E		27.9	C		26.9	C	
Intersection Delay, s/veh / LOS	31.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.3	A	0.9	A	2.1	B	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:45:36 PM

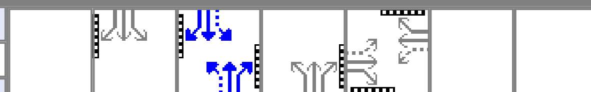
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 59th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_BestCase.xus				
Project Description	2035 NB PM				

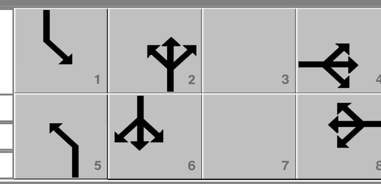


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	250	30	310	200	50	90	260	1310	120	90	1650	140

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	92	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.0	33.4	14.6	31.0	0.0	0.0
Yellow	3.0	3.5	3.0	3.5	0.0	0.0
Red	0.0	1.5	0.0	1.5	0.0	0.0



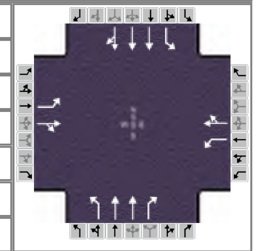
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		6.0		6.0	1.3	3.0	1.2	4.0
Phase Duration, s		36.0		36.0	17.6	56.0	8.0	46.4
Change Period, (Y+R_c), s		5.0		5.0	5.0	5.0	3.0	5.0
Max Allow Headway (*MAH*), s		4.6		4.6	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s		30.5		33.0	10.7		5.5	
Green Extension Time (g_e), s		0.3		0.0	1.6	0.0	0.0	0.0
Phase Call Probability		1.00		1.00	1.00		0.92	
Max Out Probability		1.00		1.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	269	366		215	151		267	1344	123	93	1252	602
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1232	1516		1012	1582		1681	1680	1496	1681	1765	1691
Queue Service Time (g_s), s	21.3	21.9		9.1	7.3		8.7	29.8	3.2	3.5	25.4	24.2
Cycle Queue Clearance Time (g_c), s	28.5	21.9		31.0	7.3		8.7	29.8	3.2	3.5	25.4	24.2
Green Ratio (*g/C*)	0.31	0.31		0.31	0.31		0.44	0.51	0.51	0.40	0.41	0.41
Capacity (*c*), veh/h	364	470		164	490		319	1714	763	164	1453	696
Volume-to-Capacity Ratio (*X*)	0.738	0.778		1.312	0.307		0.838	0.785	0.161	0.567	0.861	0.864
Available Capacity (c_a), veh/h	364	470		164	490		323	1714	763	164	1453	696
Back of Queue (*Q*), veh/ln (95th percentile)	11.4	13.8		20.4	5.0		10.3	13.7	1.8	2.0	5.5	4.8
Queue Storage Ratio (*RQ*) (95th percentile)	1.93	0.35		5.19	0.21		2.63	0.43	0.46	0.40	0.24	0.21
Uniform Delay (d_1), s/veh	37.2	31.4		47.5	26.3		35.8	15.1	9.0	25.6	10.9	9.3
Incremental Delay (d_2), s/veh	7.7	8.1		177.2	0.4		13.5	2.8	0.3	0.5	0.8	1.7
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	44.9	39.5		224.7	26.7		49.3	18.0	9.3	26.1	11.7	11.0
Level of Service (LOS)	D	D		F	C		D	B	A	C	B	B
Approach Delay, s/veh / LOS	41.8	D		143.1	F		22.2	C		12.2	B	
Intersection Delay, s/veh / LOS	30.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.5	A	1.1	A	2.0	A	1.6	A

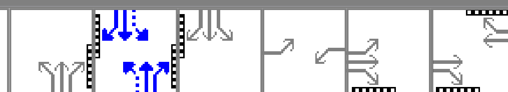
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise Ave & 59th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_WorstCase.xus				
Project Description	2035 NB AM				

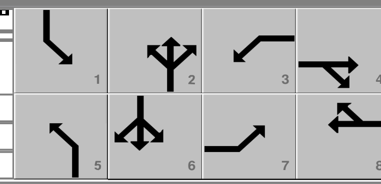


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	110	50	260	90	30	70	300	1180	180	70	920	250

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	129	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	21.4	34.2	11.4	10.0	1.9	32.1
Yellow	3.0	3.5	3.0	3.0	0.0	3.5
Red	0.0	1.5	0.0	0.0	0.0	1.5



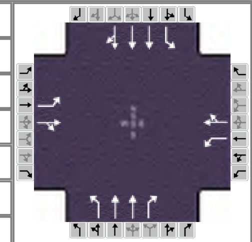
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	4.0	2.0	4.0	1.2	3.0	1.3	4.0
Phase Duration, s	14.9	39.0	13.0	37.1	24.4	63.6	14.4	53.6
Change Period, (Y+R_c), s	3.0	5.0	3.0	5.0	3.0	5.0	5.0	5.0
Max Allow Headway (MAH), s	3.2	5.4	3.2	5.4	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	11.9	32.6	10.1	10.1	21.2		2.0	
Green Extension Time (g_e), s	0.2	3.5	0.2	3.5	1.3	0.0	7.8	0.0
Phase Call Probability	0.99	1.00	0.98	1.00	1.00		0.95	
Max Out Probability	0.00	0.00	0.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	129	365		106	118		349	1374	210	82	953	424
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1533		1681	1567		1681	1680	1496	1681	1765	1569
Queue Service Time (g_s), s	9.9	30.6		8.1	8.1		19.2	48.0	10.0	0.0	28.5	22.1
Cycle Queue Clearance Time (g_c), s	9.9	30.6		8.1	8.1		19.2	48.0	10.0	0.0	28.5	22.1
Green Ratio (g/C)	0.09	0.26		0.08	0.25		0.47	0.45	0.45	0.34	0.37	0.37
Capacity (c), veh/h	153	376		129	362		363	1567	698	219	1405	625
Volume-to-Capacity Ratio (X)	0.846	0.969		0.820	0.325		0.962	0.877	0.300	0.376	0.678	0.678
Available Capacity (c_a), veh/h	1039	949		1039	949		866	1567	698	1195	1405	625
Back of Queue (Q), veh/ln (95th percentile)	7.8	19.7		6.5	5.8		13.9	26.0	5.7	4.9	16.5	9.5
Queue Storage Ratio (RQ) (95th percentile)	1.33	0.50		1.65	0.25		3.52	0.83	1.44	1.00	0.73	0.42
Uniform Delay (d_1), s/veh	58.2	48.6		59.1	41.5		35.9	31.5	1.4	56.1	31.1	17.7
Incremental Delay (d_2), s/veh	4.9	19.4		4.8	0.7		11.8	5.4	0.8	0.7	1.7	3.9
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	63.1	67.9		63.9	42.3		47.7	36.9	2.2	56.8	32.8	21.5
Level of Service (LOS)	E	E		E	D		D	D	A	E	C	C
Approach Delay, s/veh / LOS	66.7	E		52.5	D		35.1	D		30.9	C	
Intersection Delay, s/veh / LOS	38.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.3	A	0.9	A	2.1	B	1.3	A

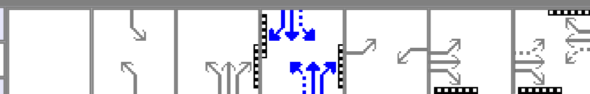
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 59th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_WorstCase.xus				
Project Description	2035 NB PM				

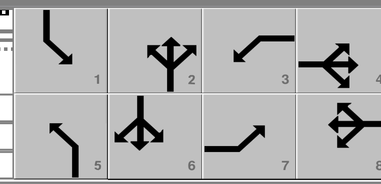


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	250	30	310	200	50	90	260	1310	120	90	1650	140

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	85	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.0	7.8	38.2	10.0	2.6	19.4
Yellow	3.0	3.0	3.5	3.0	3.0	3.5
Red	0.0	0.0	1.5	0.0	0.0	1.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	3.0	1.1	4.0
Phase Duration, s	18.6	30.0	13.0	24.4	18.8	54.0	8.0	43.2
Change Period, (Y+R_c), s	3.0	5.0	3.0	5.0	3.0	5.0	3.0	5.0
Max Allow Headway (*MAH*), s	4.2	4.4	4.2	4.4	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	14.9	27.0	12.0	11.0	14.8		5.8	
Green Extension Time (g_e), s	0.7	0.0	0.0	1.5	1.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.94	
Max Out Probability	0.03	1.00	1.00	0.26	0.00		1.00	

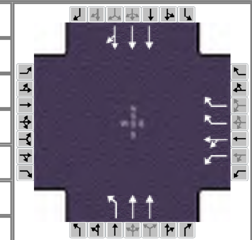
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	269	366		215	151		280	1409	129	97	1299	625
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1516		1681	1582		1681	1680	1496	1681	1765	1691
Queue Service Time (g_s), s	12.9	25.0		10.0	9.0		12.8	38.7	6.2	3.8	38.3	38.3
Cycle Queue Clearance Time (g_c), s	12.9	25.0		10.0	9.0		12.8	38.7	6.2	3.8	38.3	38.3
Green Ratio (*g/C*)	0.35	0.24		0.28	0.18		0.53	0.47	0.47	0.41	0.36	0.36
Capacity (*c*), veh/h	439	361		229	292		321	1568	698	175	1286	616
Volume-to-Capacity Ratio (*X*)	0.612	1.013		0.941	0.516		0.872	0.898	0.185	0.552	1.010	1.015
Available Capacity (c_a), veh/h	589	361		229	292		741	1568	698	175	1286	616
Back of Queue (*Q*), veh/ln (95th percentile)	9.0	20.6		11.6	6.5		11.7	18.6	6.1	2.5	11.8	10.9
Queue Storage Ratio (*RQ*) (95th percentile)	1.53	0.52		2.95	0.27		2.96	0.59	1.54	0.50	0.52	0.48
Uniform Delay (d_1), s/veh	27.0	40.0		34.4	38.6		32.1	20.1	19.8	25.7	17.2	14.5
Incremental Delay (d_2), s/veh	1.4	50.7		43.2	1.6		5.5	6.5	0.4	0.9	14.7	21.2
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	28.3	90.7		77.6	40.2		37.7	26.6	20.2	26.6	31.9	35.7
Level of Service (LOS)	C	F		E	D		D	C	C	C	F	F
Approach Delay, s/veh / LOS	64.3	E		62.2	E		27.9	C		32.8	C	
Intersection Delay, s/veh / LOS	37.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.5	A	1.1	A	2.0	A	1.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:52:03 PM

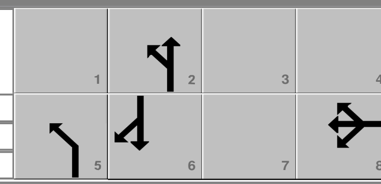
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise & I-229 SB ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				490	0	650	250	1010			1090	180

Signal Information										
Cycle, s	130.0	Reference Phase	2							
Offset, s	24	Reference Point	Begin	Green	15.2	48.5	52.3	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	3.5	3.5	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				9.0	1.0	4.0		8.3
Phase Duration, s				57.3	19.2	72.7		53.5
Change Period, ($Y+R_c$), s				5.0	4.0	5.0		5.0
Max Allow Headway (*MAH*), s				5.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				39.4	14.4			
Green Extension Time (g_e), s				12.9	1.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.01	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				576	0	765	256	1034			1248	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1773	1897	1536	1601	1716			1770	0
Queue Service Time (g_s), s				37.4	0.0	25.8	12.4	25.4			17.2	0.0
Cycle Queue Clearance Time (g_c), s				37.4	0.0	25.8	12.4	25.4			17.2	0.0
Green Ratio (*g/C*)				0.40	0.40	0.40	0.51	0.52			0.37	
Capacity (*c*), veh/h				713	763	1235	344	1787			1986	
Volume-to-Capacity Ratio (*X*)				0.808	0.000	0.619	0.743	0.578			0.628	0.000
Available Capacity (c_a), veh/h				1446	1547	2504	882	1787			1986	
Back of Queue (*Q*), veh/ln (95th percentile)				22.8	0.0	14.5	7.9	14.5			8.0	
Queue Storage Ratio (*RQ*) (95th percentile)				0.58	0.00	0.37	1.00	0.26			0.26	0.00
Uniform Delay (d_1), s/veh				34.4	0.0	30.9	22.0	19.2			16.0	
Incremental Delay (d_2), s/veh				3.2	0.0	0.7	2.9	1.2			1.1	0.0
Initial Queue Delay (d_3), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				37.6	0.0	31.7	24.9	20.5			17.1	
Level of Service (LOS)				D		C	C	C			B	

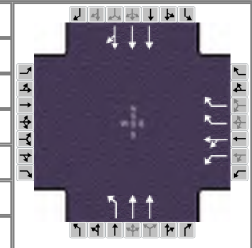
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		34.2	C	21.4	C	17.1	B
Intersection Delay, s/veh / LOS	24.4				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.1	C	2.1	B	1.9	A
Bicycle LOS Score / LOS			2.7	B	1.7	A	1.2	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:45:36 PM

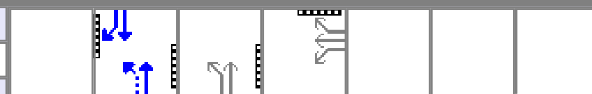
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise & I-229 SB ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_BestCase.xus				
Project Description	2035 NB PM				

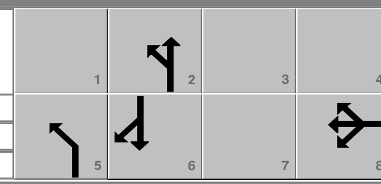


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				510	0	680	170	1010			1790	370

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	4	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	45.0	4.1	35.9	0.0	0.0	0.0
Yellow	3.5	4.0	3.5	0.0	0.0	0.0
Red	1.5	1.0	1.5	0.0	0.0	0.0



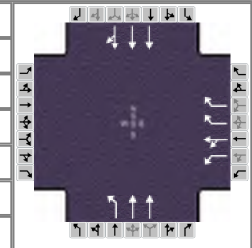
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				9.0	1.0	4.0		8.3
Phase Duration, s				40.9	9.1	59.1		50.0
Change Period, ($Y+R_c$), s				5.0	5.0	5.0		5.0
Max Allow Headway (MAH), s				4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				32.7	3.9			
Green Extension Time (g_e), s				3.1	0.2	0.0		0.0
Phase Call Probability				1.00	0.99			
Max Out Probability				0.74	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h				329	0	951	169	1003			1808	0
Adjusted Saturation Flow Rate (s), veh/h/ln				1635	1750	1467	1554	1676			1785	0
Queue Service Time (g_s), s				16.2	0.0	30.7	1.9	17.9			17.9	0.0
Cycle Queue Clearance Time (g_c), s				16.2	0.0	30.7	1.9	17.9			17.9	0.0
Green Ratio (g/C)				0.36	0.36	0.36	0.47	0.54			0.45	
Capacity (c), veh/h				587	628	1052	200	1814			2404	
Volume-to-Capacity Ratio (X)				0.561	0.000	0.903	0.843	0.553			0.752	0.000
Available Capacity (c_a), veh/h				638	682	1144	201	1814			2404	
Back of Queue (Q), veh/ln (95th percentile)				10.2	0.0	17.2	8.8	9.5			5.2	
Queue Storage Ratio (RQ) (95th percentile)				0.26	0.00	0.44	1.12	0.17			0.17	0.00
Uniform Delay (d_1), s/veh				25.7	0.0	30.4	41.1	12.7			8.0	
Incremental Delay (d_2), s/veh				0.9	0.0	9.6	23.9	1.1			0.7	0.0
Initial Queue Delay (d_3), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (d), s/veh				26.7	0.0	40.0	65.0	13.8			8.8	
Level of Service (LOS)				C		D	E	B			A	
Approach Delay, s/veh / LOS	0.0			36.6	D		21.1	C		8.8	A	
Intersection Delay, s/veh / LOS	20.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.4	C	2.1	B	2.0	A
Bicycle LOS Score / LOS			2.6	B	1.5	A	1.5	A

HCS 2010 Signalized Intersection Results Summary

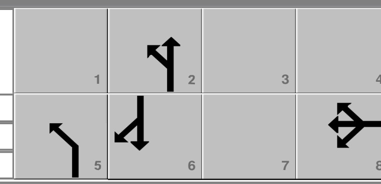
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise & I-229 SB ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				490	0	650	250	1010			1090	180

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	22	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	16.7	47.0	52.3	0.0	0.0	0.0
Yellow	3.0	3.5	3.5	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				9.0	1.0	4.0		8.3
Phase Duration, s				57.3	20.7	72.7		52.0
Change Period, (*Y+Rc*), s				5.0	4.0	5.0		5.0
Max Allow Headway (*MAH*), s				5.1	4.2	0.0		0.0
Queue Clearance Time (*gs*), s				39.4	16.2			
Green Extension Time (*ge*), s				12.9	1.1	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.01	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				576	0	765	289	1168			1260	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1773	1897	1536	1614	1736			1771	0
Queue Service Time (*gs*), s				37.4	0.0	25.8	14.2	30.1			17.9	0.0
Cycle Queue Clearance Time (*gc*), s				37.4	0.0	25.8	14.2	30.1			17.9	0.0
Green Ratio (*g/C*)				0.40	0.40	0.40	0.51	0.52			0.36	
Capacity (*c*), veh/h				713	763	1235	365	1809			1943	
Volume-to-Capacity Ratio (*X*)				0.808	0.000	0.619	0.793	0.646			0.649	0.000
Available Capacity (*ca*), veh/h				1446	1547	2504	880	1809			1943	
Back of Queue (*Q*), veh/ln (95th percentile)				22.8	0.0	14.5	8.9	16.9			7.8	
Queue Storage Ratio (*RQ*) (95th percentile)				0.58	0.00	0.37	1.12	0.31			0.25	0.00
Uniform Delay (*d1*), s/veh				34.4	0.0	30.9	22.2	20.3			16.4	
Incremental Delay (*d2*), s/veh				3.2	0.0	0.7	3.5	1.6			1.0	0.0
Initial Queue Delay (*d3*), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				37.6	0.0	31.7	25.6	21.9			17.4	
Level of Service (LOS)				D		C	C	C			B	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		34.2	C	22.6	C	17.4	B
Intersection Delay, s/veh / LOS	24.8				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.1	C	2.1	B	1.9	A
Bicycle LOS Score / LOS			2.7	B	1.7	A	1.2	A

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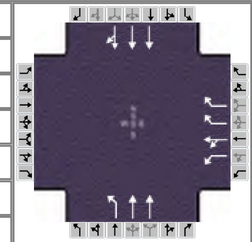
HCS 2010 Signalized Intersection Results Summary

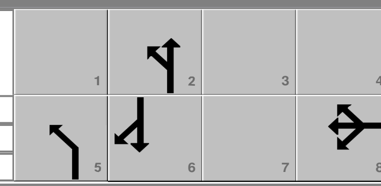
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise & I-229 SB ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				510	0	680	170	1010			1790	370

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	5	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	46.4	6.1	37.5	0.0	0.0	0.0
Yellow	3.5	4.0	3.5	0.0	0.0	0.0
Red	1.5	1.0	1.5	0.0	0.0	0.0



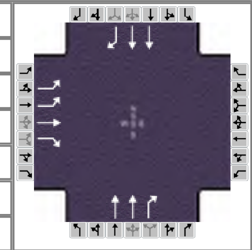
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				9.0	1.0	4.0		8.3
Phase Duration, s				42.5	11.1	62.5		51.4
Change Period, (*Y+Rc*), s				5.0	5.0	5.0		5.0
Max Allow Headway (*MAH*), s				4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				34.2	6.2			
Green Extension Time (g_e), s				3.3	0.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.68	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				329	0	951	183	1086			1903	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1640	1755	1471	1560	1692			1801	0
Queue Service Time (g_s), s				16.9	0.0	32.2	4.2	21.0			22.3	0.0
Cycle Queue Clearance Time (g_c), s				16.9	0.0	32.2	4.2	21.0			22.3	0.0
Green Ratio (*g/C*)				0.36	0.36	0.36	0.48	0.55			0.44	
Capacity (*c*), veh/h				586	627	1052	207	1852			2385	
Volume-to-Capacity Ratio (*X*)				0.561	0.000	0.904	0.881	0.586			0.798	0.000
Available Capacity (c_a), veh/h				640	685	1149	207	1852			2385	
Back of Queue (*Q*), veh/ln (95th percentile)				10.7	0.0	17.9	10.0	11.3			5.1	
Queue Storage Ratio (*RQ*) (95th percentile)				0.27	0.00	0.46	1.27	0.20			0.16	0.00
Uniform Delay (d_1), s/veh				27.1	0.0	32.0	43.7	14.0			9.5	
Incremental Delay (d_2), s/veh				0.9	0.0	9.6	29.6	1.2			0.3	0.0
Initial Queue Delay (d_3), s/veh				0.0	0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				28.0	0.0	41.6	73.3	15.2			9.8	
Level of Service (LOS)				C		D	E	B			A	
Approach Delay, s/veh / LOS	0.0			38.1		D	23.5		C	9.8		A
Intersection Delay, s/veh / LOS	21.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.4	C	2.1	B	2.0	A
Bicycle LOS Score / LOS			2.6	B	1.5	A	1.5	A

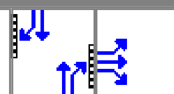
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise Ave & I-229 NB Off-	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_BestCase.xus				
Project Description	2035 NB AM				

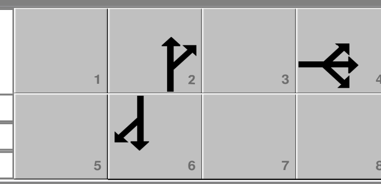


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	200	0	220					1060	570		980	600

Signal Information				
Cycle, s	130.0	Reference Phase	2	
Offset, s	105	Reference Point	End	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	



Green	103.0	17.0	0.0	0.0	0.0	0.0
Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Red	1.5	1.5	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				7.0		7.0
Phase Duration, s		22.0				108.0		108.0
Change Period, ($Y+R_c$), s		5.0				5.0		5.0
Max Allow Headway (MAH), s		4.1				0.0		0.0
Queue Clearance Time (g_s), s		11.4						
Green Extension Time (g_e), s		0.4				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		0.34						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12		6	16
Adjusted Flow Rate (v), veh/h	235	0	0					1054	0		1099	0
Adjusted Saturation Flow Rate (s), veh/h/ln	1538	1694	1442					1719	1403		1726	1403
Queue Service Time (g_s), s	9.4	0.0	0.0					14.5	0.0		4.1	0.0
Cycle Queue Clearance Time (g_c), s	9.4	0.0	0.0					14.5	0.0		4.1	0.0
Green Ratio (g/C)	0.13	0.13	0.13					0.79	0.79		0.79	0.79
Capacity (c), veh/h	402	222	189					2723	1112		2725	1112
Volume-to-Capacity Ratio (X)	0.585	0.000	0.000					0.387	0.000		0.403	0.000
Available Capacity (c_a), veh/h	402	222	189					2723	1112		2725	1112
Back of Queue (Q), veh/ln (95th percentile)	7.0	0.0	0.0					5.5	0.0		1.6	0.0
Queue Storage Ratio (RQ) (95th percentile)	0.18	0.00	0.00					0.10	0.00		0.03	0.00
Uniform Delay (d_1), s/veh	53.2	0.0	0.0					5.4	0.0		1.0	0.0
Incremental Delay (d_2), s/veh	6.1	0.0	0.0					0.0	0.0		0.3	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0					0.0	0.0		0.0	0.0
Control Delay (d), s/veh	59.3	0.0	0.0					5.4	0.0		1.3	0.0
Level of Service (LOS)	E							A			A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	59.3	E	0.0		5.4	A	1.3	A
Intersection Delay, s/veh / LOS	8.8				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.7	D	3.7	D	1.8	A	2.8	C
Bicycle LOS Score / LOS	0.9	A			1.5	A	1.4	A

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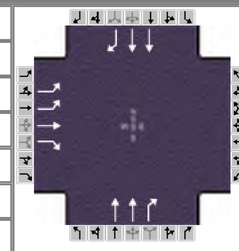
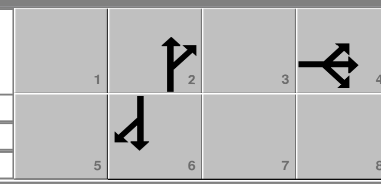
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & I-229 NB Off-	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	280	0	490					900	450		1320	980

Signal Information										
Cycle, s	100.0	Reference Phase	2							
Offset, s	5	Reference Point	Begin	Green	76.8	12.2	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	4.0	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	2.0	0.0	0.0	0.0	0.0



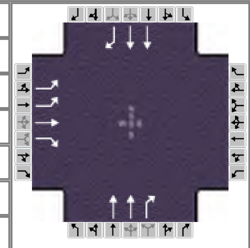
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				7.0		7.0
Phase Duration, s		18.2				81.8		81.8
Change Period, ($Y+R_c$), s		6.0				5.0		5.0
Max Allow Headway (*MAH*), s		4.1				0.0		0.0
Queue Clearance Time (g_s), s		11.5						
Green Extension Time (g_e), s		0.7				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		0.13						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12		6	16
Adjusted Flow Rate (*v*), veh/h	301	0	0					871	0		1285	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1537	1694	1441					1661	1403		1709	1403
Queue Service Time (g_s), s	9.5	0.0	0.0					1.0	0.0		18.8	0.0
Cycle Queue Clearance Time (g_c), s	9.5	0.0	0.0					1.0	0.0		18.8	0.0
Green Ratio (g/C)	0.12	0.12	0.12					0.77	0.77		0.52	0.52
Capacity (*c*), veh/h	377	207	177					2550	1077		1792	1077
Volume-to-Capacity Ratio (*X*)	0.800	0.000	0.000					0.342	0.000		0.717	0.000
Available Capacity (c_a), veh/h	584	322	274					2550	1077		1792	1077
Back of Queue (*Q*), veh/ln (95th percentile)	6.7	0.0	0.0					0.3	0.0		6.2	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.17	0.00	0.00					0.01	0.00		0.11	0.00
Uniform Delay (d_1), s/veh	42.7	0.0	0.0					0.3	0.0		4.0	0.0
Incremental Delay (d_2), s/veh	4.4	0.0	0.0					0.0	0.0		1.3	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0					0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	47.1	0.0	0.0					0.4	0.0		5.3	0.0
Level of Service (LOS)	D							A			A	
Approach Delay, s/veh / LOS	47.1		D	0.0			0.4		A	5.3		A
Intersection Delay, s/veh / LOS	8.7						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	D	4.3	E	1.8	A	3.2	C
Bicycle LOS Score / LOS	1.0	A			1.3	A	1.7	A

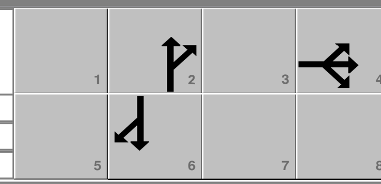
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise Ave & I-229 NB Off-	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	0	220					1060	570		980	600

Signal Information										
Cycle, s	130.0	Reference Phase	2							
Offset, s	104	Reference Point	End	Green	105.0	15.0	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.5	1.5	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				7.0		7.0
Phase Duration, s		20.0				110.0		110.0
Change Period, ($Y+R_c$), s		5.0				5.0		5.0
Max Allow Headway (*MAH*), s		4.1				0.0		0.0
Queue Clearance Time (g_s), s		11.5						
Green Extension Time (g_e), s		0.3				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		1.00						

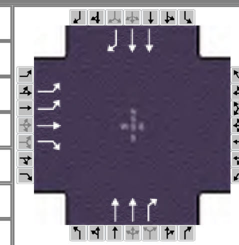
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12		6	16
Adjusted Flow Rate (*v*), veh/h	235	0	0					1222	0		1111	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1538	1694	1442					1745	1403		1727	1403
Queue Service Time (g_s), s	9.5	0.0	0.0					17.2	0.0		3.8	0.0
Cycle Queue Clearance Time (g_c), s	9.5	0.0	0.0					17.2	0.0		3.8	0.0
Green Ratio (g/C)	0.12	0.12	0.12					0.81	0.81		0.76	0.76
Capacity (*c*), veh/h	355	196	166					2819	1133		2639	1133
Volume-to-Capacity Ratio (*X*)	0.663	0.000	0.000					0.433	0.000		0.421	0.000
Available Capacity (c_a), veh/h	355	196	166					2819	1133		2639	1133
Back of Queue (*Q*), veh/ln (95th percentile)	7.4	0.0	0.0					7.3	0.0		1.5	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.19	0.00	0.00					0.13	0.00		0.03	0.00
Uniform Delay (d_1), s/veh	55.1	0.0	0.0					5.4	0.0		0.8	0.0
Incremental Delay (d_2), s/veh	9.4	0.0	0.0					0.1	0.0		0.3	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0					0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	64.5	0.0	0.0					5.5	0.0		1.1	0.0
Level of Service (LOS)	E							A			A	
Approach Delay, s/veh / LOS	64.5	E		0.0			5.5	A		1.1	A	
Intersection Delay, s/veh / LOS	9.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.7	D	3.7	D	1.8	A	2.8	C
Bicycle LOS Score / LOS	0.9	A			1.5	A	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:48:15 PM

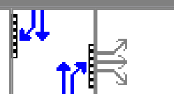
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & I-229 NB Off-	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_WorstCase.xus				
Project Description	2035 NB PM				

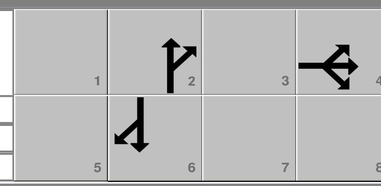


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	280	0	490					900	450		1320	980

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	5	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	81.3	12.7	0.0	0.0	0.0	0.0
Yellow	3.5	4.0	0.0	0.0	0.0	0.0
Red	1.5	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2		6
Case Number		9.0				7.0		7.0
Phase Duration, s		18.7				86.3		86.3
Change Period, ($Y+R_c$), s		6.0				5.0		5.0
Max Allow Headway (*MAH*), s		4.1				0.0		0.0
Queue Clearance Time (g_s), s		12.0						
Green Extension Time (g_e), s		0.7				0.0		0.0
Phase Call Probability		1.00						
Max Out Probability		0.17						

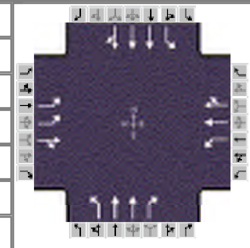
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12		6	16
Adjusted Flow Rate (*v*), veh/h	301	0	0					968	0		1378	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1539	1696	1443					1678	1403		1728	1403
Queue Service Time (g_s), s	10.0	0.0	0.0					0.6	0.0		22.9	0.0
Cycle Queue Clearance Time (g_c), s	10.0	0.0	0.0					0.6	0.0		22.9	0.0
Green Ratio (g/C)	0.12	0.12	0.12					0.77	0.77		0.52	0.52
Capacity (*c*), veh/h	372	205	175					2598	1087		1783	1087
Volume-to-Capacity Ratio (*X*)	0.809	0.000	0.000					0.372	0.000		0.773	0.000
Available Capacity (c_a), veh/h	557	307	261					2598	1087		1783	1087
Back of Queue (*Q*), veh/ln (95th percentile)	7.2	0.0	0.0					0.3	0.0		6.7	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.18	0.00	0.00					0.01	0.00		0.12	0.00
Uniform Delay (d_1), s/veh	45.0	0.0	0.0					0.1	0.0		4.2	0.0
Incremental Delay (d_2), s/veh	5.4	0.0	0.0					0.2	0.0		1.5	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0					0.0	0.0		0.0	0.0
Control Delay (*d*), s/veh	50.4	0.0	0.0					0.4	0.0		5.7	0.0
Level of Service (LOS)	D							A			A	
Approach Delay, s/veh / LOS	50.4	D		0.0			0.4	A		5.7	A	
Intersection Delay, s/veh / LOS	8.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	D	4.3	E	1.8	A	3.2	C
Bicycle LOS Score / LOS	1.0	A			1.3	A	1.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:52:03 PM

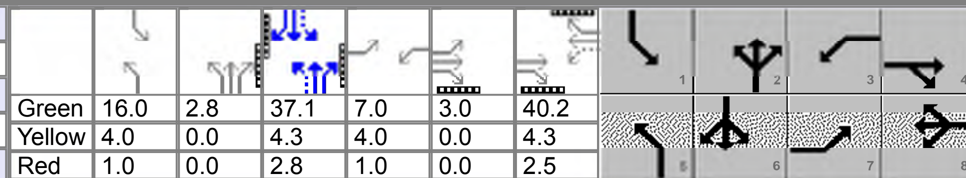
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise Ave & 69th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	240	250	50	120	780	390	250	1000	290	340	330	290

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	16.0	2.8	37.1	7.0	3.0	40.2
Yellow	4.0	0.0	4.3	4.0	0.0	4.3
Red	1.0	0.0	2.8	1.0	0.0	2.5

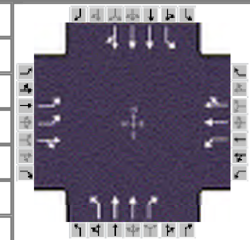
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	4.0	1.1	4.0	1.1	3.0	1.1	4.0
Phase Duration, s	15.0	50.0	12.0	47.0	23.8	47.0	21.0	44.2
Change Period, (Y+R_c), s	5.0	6.8	5.0	6.8	5.0	7.1	5.0	7.1
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	12.0	22.4	9.0	42.2	17.7		17.9	
Green Extension Time (g_e), s	0.0	6.2	0.0	0.0	1.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	0.99	1.00	1.00		1.00	
Max Out Probability	1.00	0.15	1.00	1.00	0.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	282	329		141	601	559	294	1176	167	384	373	209
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1731		1681	1765	1637	1681	1680	1496	1681	1765	1496
Queue Service Time (g_s), s	10.0	20.4		7.0	40.2	40.2	15.7	40.0	11.3	15.9	10.3	14.3
Cycle Queue Clearance Time (g_c), s	10.0	20.4		7.0	40.2	40.2	15.7	40.0	11.3	15.9	10.3	14.3
Green Ratio (g/C)	0.08	0.33		0.36	0.31	0.31	0.43	0.31	0.31	0.41	0.29	0.29
Capacity (c), veh/h	251	575		313	546	506	451	1033	460	261	1008	427
Volume-to-Capacity Ratio (X)	1.125	0.573		0.451	1.101	1.104	0.653	1.139	0.363	1.468	0.370	0.489
Available Capacity (c_a), veh/h	251	575		313	546	506	829	1033	460	262	1008	427
Back of Queue (Q), veh/ln (95th percentile)	12.3	13.5		5.6	38.5	36.5	10.5	38.3	7.8	34.9	7.6	9.0
Queue Storage Ratio (RQ) (95th percentile)	0.78	0.34		0.57	0.98	0.93	1.33	0.97	0.47	5.06	0.14	0.16
Uniform Delay (d_1), s/veh	60.0	35.8		31.6	44.9	44.9	26.6	45.0	35.1	36.9	33.6	34.9
Incremental Delay (d_2), s/veh	94.5	1.4		1.0	69.2	71.6	1.6	74.6	2.2	229.0	1.0	3.7
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	154.5	37.2		32.6	114.1	116.5	28.2	119.6	37.3	265.9	34.5	38.5
Level of Service (LOS)	F	D		C	F	F	C	F	D	F	C	D
Approach Delay, s/veh / LOS	91.3	F		106.3	F		94.8	F		127.4	F	
Intersection Delay, s/veh / LOS	104.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	C	3.1	C	2.7	B	2.9	C
Bicycle LOS Score / LOS	1.5	A	1.6	A	1.8	A	1.0	A

HCS 2010 Signalized Intersection Results Summary

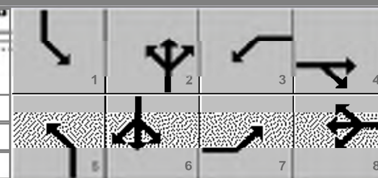
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 69th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	350	700	150	250	500	350	100	600	300	560	900	350

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.0	8.9	16.0	7.0	2.2	27.0
Yellow	4.0	4.0	4.3	4.0	4.0	4.3
Red	1.0	1.0	2.8	1.0	1.0	2.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	4.0	1.1	4.0	1.1	3.0	1.1	4.0
Phase Duration, s	19.2	41.0	12.0	33.8	10.0	23.1	23.9	37.0
Change Period, ($Y+R_c$), s	5.0	6.8	5.0	6.8	5.0	7.1	5.0	7.1
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	13.2	36.2	9.0	22.5	7.0		20.9	
Green Extension Time (g_e), s	1.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	0.95		1.00	
Max Out Probability	0.14	1.00	1.00	0.95	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	376	858		269	384	351	108	645	141	558	795	354
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1727		1681	1765	1602	1681	1680	1496	1681	1765	1564
Queue Service Time (g_s), s	11.2	34.2		7.0	20.3	20.5	5.0	16.0	8.7	18.9	17.2	17.3
Cycle Queue Clearance Time (g_c), s	11.2	34.2		7.0	20.3	20.5	5.0	16.0	8.7	18.9	17.2	17.3
Green Ratio (g/C)	0.14	0.34		0.34	0.27	0.27	0.21	0.16	0.16	0.37	0.30	0.30
Capacity (c), veh/h	462	590		190	477	433	215	538	240	390	1055	468
Volume-to-Capacity Ratio (X)	0.815	1.453		1.417	0.806	0.810	0.500	1.199	0.588	1.432	0.753	0.757
Available Capacity (c_a), veh/h	685	590		190	477	433	215	538	240	392	1055	468
Back of Queue (Q), veh/ln (95th percentile)	8.2	73.5		23.1	14.7	13.8	4.0	22.3	6.8	40.3	8.2	8.1
Queue Storage Ratio (RQ) (95th percentile)	0.52	1.87		2.35	0.37	0.35	0.51	0.57	0.41	5.85	0.15	0.15
Uniform Delay (d_1), s/veh	41.7	32.9		31.1	34.0	34.1	33.8	42.0	38.9	22.8	19.4	19.4
Incremental Delay (d_2), s/veh	4.7	213.3		215.9	9.8	11.0	1.8	106.4	10.2	203.5	3.2	7.1
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	46.4	246.2		246.9	43.8	45.1	35.5	148.4	49.1	226.3	22.5	26.5
Level of Service (LOS)	D	F		F	D	D	D	F	D	F	C	C

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	185.3	F	98.6	F	119.2	F	90.0	F
Intersection Delay, s/veh / LOS	121.5				F			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	D	3.1	C	2.7	B	2.9	C
Bicycle LOS Score / LOS	2.5	B	1.3	A	1.2	A	1.5	A

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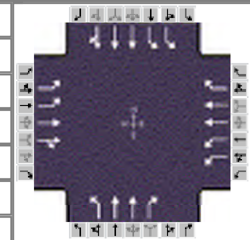
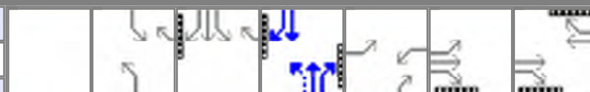
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Louise Ave & 69th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Louise_AM_WorstCase.xus				
Project Description	2035 NB AM				

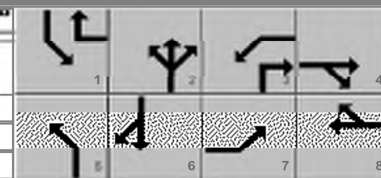


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	240	250	50	120	780	390	250	1000	290	340	330	290

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.0	7.4	43.5	8.0	3.0	34.2
Yellow	4.0	4.0	4.3	4.0	0.0	4.3
Red	1.0	1.0	2.8	1.0	0.0	2.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	4.0	2.0	3.0	1.1	3.0	2.0	4.0
Phase Duration, s	16.0	44.0	13.0	41.0	10.0	50.6	22.4	63.0
Change Period, (Y+R_c), s	5.0	6.8	5.0	6.8	5.0	7.1	5.0	7.1
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	13.0	11.9	7.5	36.2	7.0		17.2	
Green Extension Time (g_e), s	0.0	6.9	0.5	0.0	0.0	0.0	0.7	0.0
Phase Call Probability	1.00	1.00	0.99	1.00	1.00		1.00	
Max Out Probability	1.00	0.07	0.00	1.00	1.00		0.67	

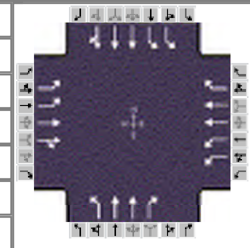
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	282	166	163	141	918	242	294	1176	167	388	376	211
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1765	1698	1632	1680	1496	1681	1680	1496	1632	1765	1496
Queue Service Time (g_s), s	11.0	9.7	9.9	5.5	34.2	15.2	5.0	43.9	9.8	15.2	7.2	10.1
Cycle Queue Clearance Time (g_c), s	11.0	9.7	9.9	5.5	34.2	15.2	5.0	43.9	9.8	15.2	7.2	10.1
Green Ratio (g/C)	0.08	0.29	0.29	0.06	0.26	0.39	0.38	0.33	0.40	0.13	0.43	0.43
Capacity (c), veh/h	276	504	485	202	884	589	399	1135	598	426	1518	643
Volume-to-Capacity Ratio (X)	1.022	0.330	0.336	0.699	1.038	0.412	0.737	1.036	0.279	0.910	0.248	0.328
Available Capacity (c_a), veh/h	276	504	485	1004	884	589	399	1135	598	552	1518	643
Back of Queue (Q), veh/ln (95th percentile)	11.1	7.5	7.4	4.3	26.7	9.3	10.8	32.1	6.6	10.8	5.2	6.2
Queue Storage Ratio (RQ) (95th percentile)	0.71	0.19	0.19	0.43	0.68	2.35	1.37	0.82	0.39	1.57	0.09	0.11
Uniform Delay (d_1), s/veh	59.5	36.6	36.7	59.8	47.9	28.5	35.0	43.0	26.4	53.1	18.4	19.0
Incremental Delay (d_2), s/veh	60.0	0.4	0.4	4.3	40.6	0.5	7.0	36.5	1.2	15.1	0.4	1.2
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	119.5	37.0	37.1	64.1	88.5	29.0	42.0	79.6	27.5	68.2	18.7	20.2
Level of Service (LOS)	F	D	D	E	F	C	D	F	C	E	B	C
Approach Delay, s/veh / LOS	75.1	E		74.8	E		67.5	E		38.7	D	
Intersection Delay, s/veh / LOS	64.4						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	C	3.2	C	3.3	C	3.0	C
Bicycle LOS Score / LOS	1.0	A	1.6	A	1.8	A	1.0	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:23:08 AM

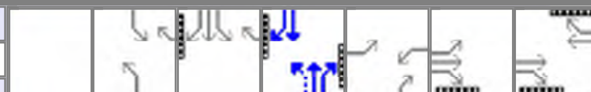
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Louise Ave & 69th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Louise_PM_WorstCase.xus				
Project Description	2035 NB PM				

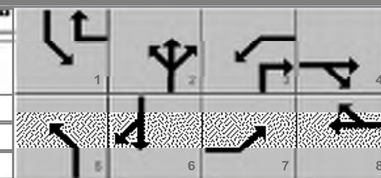


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	350	700	150	250	500	350	100	600	300	560	900	350

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.8	10.3	21.4	11.2	3.7	24.7
Yellow	4.0	4.0	4.3	4.0	0.0	4.3
Red	1.0	1.0	2.8	1.0	0.0	2.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	4.0	2.0	3.0	1.1	3.0	2.0	4.0
Phase Duration, s	19.9	35.2	16.2	31.5	9.8	28.5	25.1	43.8
Change Period, (Y+R_c), s	5.0	6.8	5.0	6.8	5.0	7.1	5.0	7.1
Max Allow Headway (MAH), s	4.1	4.0	4.1	4.0	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	13.7	27.3	10.4	17.3	7.0		20.8	
Green Extension Time (g_e), s	1.2	1.1	0.8	4.1	0.0	0.0	0.3	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	0.96		1.00	
Max Out Probability	0.02	1.00	0.01	0.65	1.00		1.00	

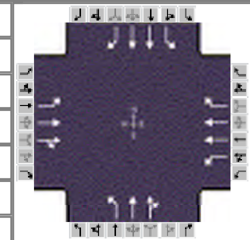
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	376	438	420	269	538	198	108	645	141	588	838	373
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1765	1688	1632	1680	1496	1681	1680	1496	1632	1765	1564
Queue Service Time (g_s), s	11.7	25.3	25.3	8.4	15.3	9.3	5.0	19.6	7.4	18.8	15.3	15.4
Cycle Queue Clearance Time (g_c), s	11.7	25.3	25.3	8.4	15.3	9.3	5.0	19.6	7.4	18.8	15.3	15.4
Green Ratio (g/C)	0.14	0.27	0.27	0.11	0.24	0.42	0.26	0.20	0.31	0.19	0.35	0.35
Capacity (c), veh/h	464	477	456	348	788	623	238	718	479	594	1228	544
Volume-to-Capacity Ratio (X)	0.811	0.919	0.920	0.773	0.682	0.318	0.451	0.899	0.294	0.990	0.683	0.685
Available Capacity (c_a), veh/h	777	488	466	653	809	632	238	718	479	675	1228	544
Back of Queue (Q), veh/ln (95th percentile)	8.4	19.4	18.9	6.3	10.5	5.7	3.9	14.5	5.0	10.5	6.6	6.4
Queue Storage Ratio (RQ) (95th percentile)	0.54	0.49	0.48	0.64	0.27	1.45	0.50	0.37	0.30	1.53	0.12	0.12
Uniform Delay (d_1), s/veh	43.7	37.2	37.2	45.7	36.6	20.6	30.7	40.2	26.8	33.3	14.0	14.1
Incremental Delay (d_2), s/veh	3.5	22.4	23.2	3.7	2.3	0.3	1.3	16.4	1.6	22.1	1.7	3.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	47.1	59.6	60.4	49.4	38.9	20.9	32.1	56.5	28.3	55.5	15.7	17.9
Level of Service (LOS)	D	E	E	D	D	C	C	E	C	E	B	B
Approach Delay, s/veh / LOS	56.1	E		38.2	D		49.2	D		29.2	C	
Intersection Delay, s/veh / LOS	41.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.5	D	3.2	C	3.3	C	3.0	C
Bicycle LOS Score / LOS	1.5	A	1.3	A	1.2	A	1.5	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:25:07 AM

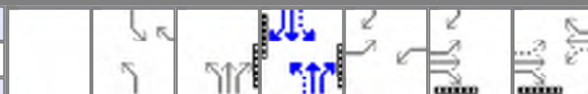
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Western Ave & 49th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Western_AM_BestCase.xus				
Project Description	2035 NB AM				

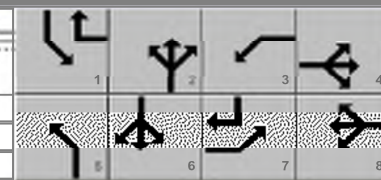


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	260	270	240	140	420	150	550	1150	210	100	500	240

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	53	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.2	23.1	24.8	7.0	6.0	20.9
Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Red	2.0	2.0	2.0	2.0	0.0	2.0



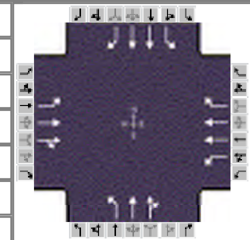
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	3.0
Phase Duration, s	19.0	32.9	13.0	26.9	43.3	59.9	14.2	30.8
Change Period, ($Y+R_c$), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.6	3.1	3.6	4.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	15.0	18.8	9.0	18.7	38.0		8.3	
Green Extension Time (g_e), s	0.0	3.1	0.0	2.2	0.7	0.0	0.1	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.98	
Max Out Probability	1.00	0.14	1.00	0.53	1.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	306	267	241	165	494	176	634	798	771	118	588	131
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1800	1576	1714	1714	1525	1681	1765	1670	1714	1680	1496
Queue Service Time (g_s), s	13.0	16.2	16.8	7.0	16.7	11.9	36.0	54.0	54.0	6.3	19.9	7.7
Cycle Queue Clearance Time (g_c), s	13.0	16.2	16.8	7.0	16.7	11.9	36.0	54.0	54.0	6.3	19.9	7.7
Green Ratio (g/C)	0.30	0.22	0.22	0.23	0.17	0.24	0.55	0.45	0.45	0.29	0.21	0.32
Capacity (c), veh/h	269	403	353	221	597	368	616	795	752	176	732	488
Volume-to-Capacity Ratio (X)	1.137	0.663	0.682	0.745	0.828	0.479	1.031	1.004	1.025	0.669	0.804	0.268
Available Capacity (c_a), veh/h	269	465	407	221	714	420	673	795	752	334	732	488
Back of Queue (Q), veh/ln (95th percentile)	15.0	12.0	11.1	4.1	12.0	7.9	22.0	29.4	26.9	4.8	14.1	5.3
Queue Storage Ratio (RQ) (95th percentile)	1.53	0.30	0.28	0.41	0.30	0.79	2.48	0.46	0.42	0.48	0.36	0.60
Uniform Delay (d_1), s/veh	39.9	42.4	42.6	43.7	47.8	39.1	22.9	26.5	21.7	35.8	44.5	29.9
Incremental Delay (d_2), s/veh	97.0	2.9	3.8	11.4	5.9	0.4	30.1	21.1	27.2	1.6	9.1	1.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	136.9	45.3	46.5	55.1	53.7	39.4	53.0	47.6	48.9	37.4	53.6	31.2
Level of Service (LOS)	F	D	D	E	D	D	F	F	F	D	D	C
Approach Delay, s/veh / LOS	80.1	F		51.0	D		49.6	D		47.8	D	
Intersection Delay, s/veh / LOS	54.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.2	C	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.2	A	1.2	A	2.3	B	1.2	A

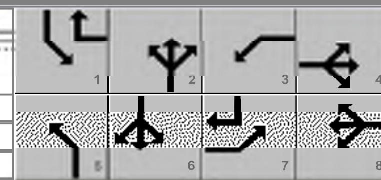
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Western_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240	400	480	330	550	100	410	800	120	110	920	340

Signal Information										
Cycle, s	100.0	Reference Phase	2							
Offset, s	27	Reference Point	Begin	Green	17.7	8.7	6.2	12.9	1.0	23.5
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	2.0	0.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	3.0	1.2	4.0	1.3	3.0
Phase Duration, s	18.9	29.5	19.9	30.5	23.7	38.5	12.2	26.9
Change Period, (Y+R_c), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (*MAH*), s	3.1	3.7	3.1	3.7	4.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	13.5	26.0	15.9	17.6	19.5		3.8	
Green Extension Time (g_e), s	0.0	0.0	0.0	3.1	0.0	0.0	2.7	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.96	
Max Out Probability	1.00	1.00	1.00	0.69	1.00		0.20	

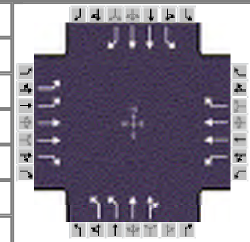
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	258	430	433	355	591	108	438	503	479	118	989	218
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1800	1525	1714	1714	1525	1681	1765	1684	1714	1680	1496
Queue Service Time (g_s), s	11.5	23.9	24.0	13.9	15.6	5.2	17.5	27.7	27.8	1.8	20.6	11.4
Cycle Queue Clearance Time (g_c), s	11.5	23.9	24.0	13.9	15.6	5.2	17.5	27.7	27.8	1.8	20.6	11.4
Green Ratio (*g/C*)	0.37	0.23	0.23	0.38	0.24	0.31	0.28	0.32	0.32	0.13	0.21	0.34
Capacity (*c*), veh/h	352	432	366	311	857	475	366	564	538	188	692	501
Volume-to-Capacity Ratio (*X*)	0.734	0.997	1.185	1.142	0.690	0.226	1.195	0.891	0.891	0.629	1.429	0.436
Available Capacity (c_a), veh/h	354	432	366	312	857	475	366	564	538	306	692	501
Back of Queue (*Q*), veh/ln (95th percentile)	8.7	21.7	29.4	20.9	10.8	2.2	17.5	19.9	19.2	5.1	42.7	7.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.89	0.54	0.73	2.09	0.27	0.22	1.98	0.31	0.30	0.51	1.08	0.87
Uniform Delay (d_1), s/veh	25.4	38.0	38.0	27.0	34.0	6.8	36.9	38.6	38.8	44.2	39.7	25.9
Incremental Delay (d_2), s/veh	6.7	42.4	107.6	95.0	2.0	0.1	104.9	13.9	14.5	1.3	201.5	2.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	32.1	80.4	145.6	122.0	36.0	6.9	141.8	52.5	53.3	45.5	241.2	28.7
Level of Service (LOS)	C	F	F	F	D	A	F	D	D	D	F	C
Approach Delay, s/veh / LOS	94.5	F		62.0	E		80.3	F		188.8	F	
Intersection Delay, s/veh / LOS	108.8						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	3.2	C	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.4	A	1.4	A	1.7	A	1.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:29:01 AM

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Western Ave & 49th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Western_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	260	270	240	140	420	150	550	1150	210	100	500	240

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	53	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.8	13.1	34.9	7.0	6.0	21.2
Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Red	2.0	2.0	2.0	2.0	0.0	2.0

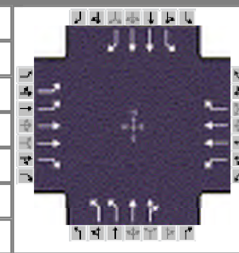
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	1.1	3.0	2.0	4.0	1.1	3.0
Phase Duration, s	19.0	33.2	13.0	27.2	32.9	60.0	13.8	40.9
Change Period, (Y+R_c), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (MAH), s	3.1	3.6	3.1	3.6	4.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	13.1	11.7	9.0	19.0	24.3		7.8	
Green Extension Time (g_e), s	0.0	3.6	0.0	2.2	2.5	0.0	0.1	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.98	
Max Out Probability	1.00	0.02	1.00	0.56	0.02		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	306	318	191	165	494	176	634	798	771	118	588	131
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1680	1496	1681	1680	1496	1632	1765	1670	1681	1680	1496
Queue Service Time (g_s), s	11.1	9.7	9.6	7.0	17.0	12.2	22.3	54.0	54.0	5.8	18.1	6.9
Cycle Queue Clearance Time (g_c), s	11.1	9.7	9.6	7.0	17.0	12.2	22.3	54.0	54.0	5.8	18.1	6.9
Green Ratio (g/C)	0.11	0.23	0.45	0.24	0.18	0.24	0.22	0.45	0.45	0.36	0.29	0.40
Capacity (c), veh/h	354	762	674	273	594	361	730	794	752	169	978	597
Volume-to-Capacity Ratio (X)	0.865	0.417	0.283	0.603	0.832	0.489	0.869	1.005	1.025	0.694	0.601	0.219
Available Capacity (c_a), veh/h	354	868	721	273	700	408	1082	794	752	324	978	597
Back of Queue (Q), veh/ln (95th percentile)	9.2	7.2	6.0	2.6	12.1	7.9	12.0	29.4	26.9	4.3	12.2	4.6
Queue Storage Ratio (RQ) (95th percentile)	0.94	0.18	0.15	0.26	0.31	0.81	1.35	0.46	0.42	0.44	0.31	0.52
Uniform Delay (d_1), s/veh	52.6	39.6	20.8	41.0	47.7	39.1	43.0	26.5	21.7	31.9	36.5	23.7
Incremental Delay (d_2), s/veh	18.8	0.4	0.2	2.7	6.3	0.4	2.2	21.2	27.4	1.9	2.7	0.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	71.4	40.0	21.0	43.7	54.0	39.5	45.2	47.7	49.1	33.8	39.3	24.6
Level of Service (LOS)	E	D	C	D	D	D	D	F	F	C	D	C
Approach Delay, s/veh / LOS	47.3		D	48.9		D	47.5		D	36.2		D
Intersection Delay, s/veh / LOS	45.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.2	C	2.9	C	3.2	C
Bicycle LOS Score / LOS	1.2	A	1.2	A	2.3	B	1.2	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Western_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	240	400	480	330	550	100	410	800	120	110	920	340

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	27	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	15.7	10.7	6.1	9.9	4.1	23.5
Yellow	4.0	4.0	4.0	4.0	0.0	4.0
Red	2.0	2.0	2.0	2.0	0.0	2.0

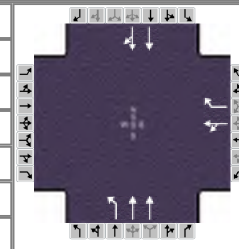
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	1.1	3.0	2.0	4.0	1.3	3.0
Phase Duration, s	15.9	29.5	20.0	33.5	21.7	38.4	12.1	28.8
Change Period, (Y+R_c), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (MAH), s	3.1	3.7	3.1	3.7	4.1	0.0	3.1	0.0
Queue Clearance Time (g_s), s	9.7	26.0	16.0	17.4	15.2		3.8	
Green Extension Time (g_e), s	0.2	0.0	0.0	4.1	0.5	0.0	2.7	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.96	
Max Out Probability	0.90	1.00	1.00	0.42	1.00		0.20	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	258	430	433	355	591	108	438	503	479	118	989	218
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1680	1496	1681	1680	1496	1632	1765	1684	1681	1680	1496
Queue Service Time (g_s), s	7.7	11.2	24.0	14.0	15.4	5.1	13.2	27.8	27.8	1.8	22.3	11.6
Cycle Queue Clearance Time (g_c), s	7.7	11.2	24.0	14.0	15.4	5.1	13.2	27.8	27.8	1.8	22.3	11.6
Green Ratio (g/C)	0.10	0.23	0.39	0.38	0.28	0.34	0.16	0.32	0.32	0.14	0.23	0.33
Capacity (c), veh/h	324	806	594	395	944	511	513	564	538	185	748	481
Volume-to-Capacity Ratio (X)	0.797	0.534	0.730	0.898	0.626	0.211	0.854	0.892	0.892	0.640	1.322	0.453
Available Capacity (c_a), veh/h	429	806	594	397	944	511	570	564	538	302	748	481
Back of Queue (Q), veh/ln (95th percentile)	6.0	8.0	14.0	13.5	10.3	2.0	9.4	19.9	19.3	5.1	38.0	7.9
Queue Storage Ratio (RQ) (95th percentile)	0.61	0.20	0.36	1.38	0.26	0.20	1.06	0.31	0.30	0.52	0.97	0.89
Uniform Delay (d_1), s/veh	44.1	33.1	25.6	27.6	31.4	6.8	44.0	39.0	39.3	44.3	38.9	26.9
Incremental Delay (d_2), s/veh	5.5	0.7	4.6	21.9	1.0	0.1	7.9	13.9	14.4	1.4	154.4	3.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	49.5	33.8	30.2	49.5	32.4	6.9	51.9	52.9	53.7	45.6	193.2	30.0
Level of Service (LOS)	D	C	C	D	C	A	D	D	D	D	F	C
Approach Delay, s/veh / LOS	36.0	D		35.5	D		52.9	D		153.2	F	
Intersection Delay, s/veh / LOS	72.3						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.1	C	3.0	C	3.2	C
Bicycle LOS Score / LOS	1.4	A	1.4	A	1.7	A	1.6	A

HCS 2010 Signalized Intersection Results Summary

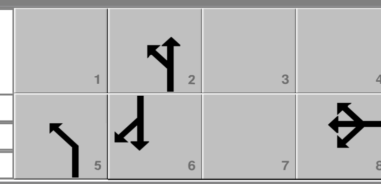
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Western Ave & I-229 SB ra	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Western_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				320	0	550	110	1360			760	120

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	24	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.3	42.5	51.3	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



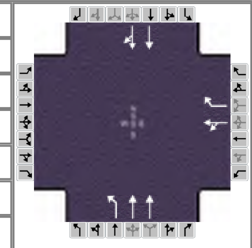
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				11.0	1.0	4.0		8.3
Phase Duration, s				57.3	14.3	62.7		48.5
Change Period, (*Y+R*c), s				6.0	6.0	6.0		6.0
Max Allow Headway (*MAH*), s				4.1	4.2	0.0		0.0
Queue Clearance Time (*g*s), s				46.9	8.0			
Green Extension Time (*g*e), s				4.4	0.4	0.0		0.0
Phase Call Probability				1.00	0.98			
Max Out Probability				0.04	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h					376	647	126	1556			522	513
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1673	1637	1549	1780			1791	1758
Queue Service Time (*g*s), s					20.0	44.9	6.0	45.2			40.7	32.9
Cycle Queue Clearance Time (*g*c), s					20.0	44.9	6.0	45.2			40.7	32.9
Green Ratio (*g/C*)					0.43	0.43	0.44	0.47			0.35	0.35
Capacity (*c*), veh/h					715	700	175	1682			634	622
Volume-to-Capacity Ratio (*X*)					0.526	0.925	0.721	0.925			0.823	0.825
Available Capacity (*c*a), veh/h					962	941	426	1682			634	622
Back of Queue (*Q*), veh/ln (95th percentile)					12.3	26.4	3.2	16.7			19.9	20.6
Queue Storage Ratio (*RQ*) (95th percentile)					0.31	2.68	0.27	0.61			0.31	0.32
Uniform Delay (*d*1), s/veh					25.4	32.5	26.8	17.3			37.0	40.5
Incremental Delay (*d*2), s/veh					0.6	11.9	1.4	3.1			6.7	6.9
Initial Queue Delay (*d*3), s/veh					0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh					26.0	44.4	28.2	20.3			43.8	47.4
Level of Service (LOS)					C	D	C	C			D	D
Approach Delay, s/veh / LOS	0.0			37.6	D		20.9	C		45.6	D	
Intersection Delay, s/veh / LOS	32.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	1.7	A	1.9	A
Bicycle LOS Score / LOS			2.2	B	1.9	A	1.3	A

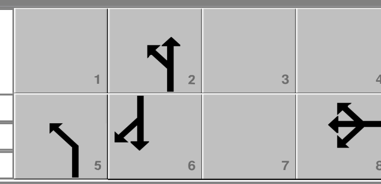
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & I-229 SB ra	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Western_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				350	0	460	170	870			1480	250

Signal Information										
Cycle, s	100.0	Reference Phase	2							
Offset, s	58	Reference Point	Begin	Green	8.6	43.4	30.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				11.0	1.0	4.0		8.3
Phase Duration, s				36.0	14.6	64.0		49.4
Change Period, (*Y+Rc*), s				6.0	6.0	6.0		6.0
Max Allow Headway (*MAH*), s				4.1	4.2	0.0		0.0
Queue Clearance Time (*gs*), s				32.0	8.6			
Green Extension Time (*ge*), s				0.0	0.1	0.0		0.0
Phase Call Probability				1.00	0.99			
Max Out Probability				1.00	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h					376	495	183	935			701	733
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1649	1614	1558	1669			1706	1786
Queue Service Time (*gs*), s					20.7	30.0	6.6	18.3			66.8	37.5
Cycle Queue Clearance Time (*gc*), s					20.7	30.0	6.6	18.3			66.8	37.5
Green Ratio (*g/C*)					0.30	0.30	0.54	0.58			0.43	0.43
Capacity (*c*), veh/h					495	484	206	1936			740	775
Volume-to-Capacity Ratio (*X*)					0.761	1.021	0.885	0.483			0.947	0.947
Available Capacity (*ca*), veh/h					495	484	243	1936			740	775
Back of Queue (*Q*), veh/ln (95th percentile)					13.6	24.6	4.4	9.8			14.5	12.3
Queue Storage Ratio (*RQ*) (95th percentile)					0.35	2.49	0.37	0.36			0.23	0.19
Uniform Delay (d_1), s/veh					31.7	35.0	19.9	14.9			20.5	16.8
Incremental Delay (d_2), s/veh					6.8	46.4	14.4	0.4			3.4	3.3
Initial Queue Delay (d_3), s/veh					0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh					38.5	81.4	34.3	15.3			24.0	20.1
Level of Service (LOS)					D	F	C	B			C	C

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		62.9	E	18.4	B	22.0	C
Intersection Delay, s/veh / LOS	31.2				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.7	B	1.7	A	1.9	A
Bicycle LOS Score / LOS			1.9	A	1.4	A	2.0	B

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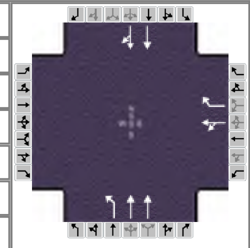
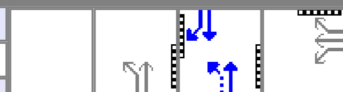
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Western Ave & I-229 SB ra	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Western_AM_WorstCase.xus				
Project Description	2035 NB AM				

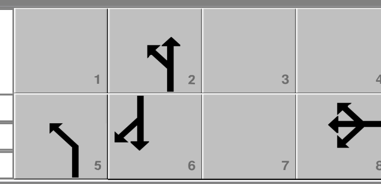


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				320	0	550	110	1360			760	120

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	24	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.3	42.5	51.3	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				11.0	1.0	4.0		8.3
Phase Duration, s				57.3	14.3	62.7		48.5
Change Period, ($Y+R_c$), s				6.0	6.0	6.0		6.0
Max Allow Headway (MAH), s				4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				46.9	8.0			
Green Extension Time (g_e), s				4.4	0.4	0.0		0.0
Phase Call Probability				1.00	0.98			
Max Out Probability				0.04	0.00			

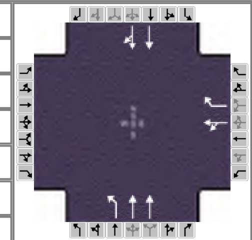
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h					376	647	126	1556			522	513
Adjusted Saturation Flow Rate (s), veh/h/ln					1673	1637	1549	1780			1791	1758
Queue Service Time (g_s), s					20.0	44.9	6.0	45.2			40.7	33.2
Cycle Queue Clearance Time (g_c), s					20.0	44.9	6.0	45.2			40.7	33.2
Green Ratio (g/C)					0.43	0.43	0.44	0.47			0.35	0.35
Capacity (c), veh/h					715	700	175	1682			634	622
Volume-to-Capacity Ratio (X)					0.526	0.925	0.721	0.925			0.823	0.825
Available Capacity (c_a), veh/h					962	941	426	1682			634	622
Back of Queue (Q), veh/ln (95th percentile)					12.3	26.4	3.2	16.7			22.3	22.7
Queue Storage Ratio (RQ) (95th percentile)					0.31	2.68	0.27	0.61			0.35	0.36
Uniform Delay (d_1), s/veh					25.4	32.5	26.8	17.3			39.3	42.3
Incremental Delay (d_2), s/veh					0.6	11.9	1.4	3.1			9.8	10.0
Initial Queue Delay (d_3), s/veh					0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (d), s/veh					26.0	44.4	28.2	20.4			49.1	52.3
Level of Service (LOS)					C	D	C	C			D	D

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		37.6	D	20.9	C	50.7	D
Intersection Delay, s/veh / LOS	33.7				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	1.7	A	1.9	A
Bicycle LOS Score / LOS			2.2	B	1.9	A	1.3	A

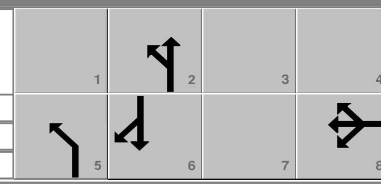
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & I-229 SB ra	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Western_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				350	0	460	170	870			1480	250

Signal Information										
Cycle, s	100.0	Reference Phase	2							
Offset, s	58	Reference Point	Begin	Green	8.6	43.4	30.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				11.0	1.0	4.0		8.3
Phase Duration, s				36.0	14.6	64.0		49.4
Change Period, (Y+R_c), s				6.0	6.0	6.0		6.0
Max Allow Headway (*MAH*), s				4.1	4.2	0.0		0.0
Queue Clearance Time (g_s), s				32.0	8.5			
Green Extension Time (g_e), s				0.0	0.1	0.0		0.0
Phase Call Probability				1.00	0.99			
Max Out Probability				1.00	1.00			

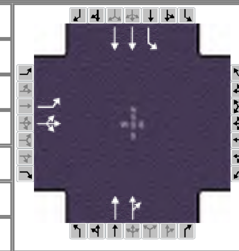
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h					376	495	183	935			781	815
Adjusted Saturation Flow Rate (*s*), veh/h/ln					1649	1614	1558	1669			1735	1806
Queue Service Time (g_s), s					20.7	30.0	6.5	19.6			66.8	43.4
Cycle Queue Clearance Time (g_c), s					20.7	30.0	6.5	19.6			66.8	43.4
Green Ratio (*g/C*)					0.30	0.30	0.54	0.57			0.43	0.43
Capacity (*c*), veh/h					495	484	206	1887			753	784
Volume-to-Capacity Ratio (*X*)					0.761	1.021	0.886	0.496			1.038	1.040
Available Capacity (c_a), veh/h					495	484	243	1887			753	784
Back of Queue (*Q*), veh/ln (95th percentile)					13.6	24.6	3.9	10.4			21.5	19.9
Queue Storage Ratio (*RQ*) (95th percentile)					0.35	2.49	0.33	0.38			0.34	0.31
Uniform Delay (d_1), s/veh					31.7	35.0	19.3	16.5			22.3	18.7
Incremental Delay (d_2), s/veh					6.8	46.4	12.4	0.3			21.6	22.4
Initial Queue Delay (d_3), s/veh					0.0	0.0	0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh					38.5	81.4	31.7	16.9			43.9	41.0
Level of Service (LOS)					D	F	C	B			F	F
Approach Delay, s/veh / LOS	0.0			62.9	E		19.3	B		42.4	D	
Intersection Delay, s/veh / LOS	40.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.7	B	1.7	A	1.9	A
Bicycle LOS Score / LOS			1.9	A	1.4	A	2.0	B

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:00:25 PM

HCS 2010 Signalized Intersection Results Summary

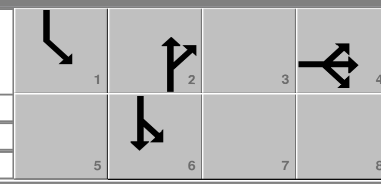
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Western Ave & I-229 NB ra	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Western_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	290	0	170					1180	410	190	890	

Signal Information			
Cycle, s	120.0	Reference Phase	6
Offset, s	15	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	14.9	63.3	24.9	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.8	1.8	1.9	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		30.4				69.0	20.6	89.6
Change Period, ($Y+R_c$), s		5.5				5.7	5.7	5.7
Max Allow Headway (MAH), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		22.8					14.0	
Green Extension Time (g_e), s		2.1				0.0	0.9	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.00					0.00	

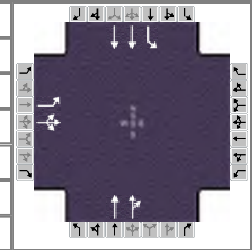
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	256	256						909	901	224	1047	
Adjusted Saturation Flow Rate (s), veh/h/ln	1628	1628						1909	1850	1582	1705	
Queue Service Time (g_s), s	17.7	17.7						120.0	49.4	12.0	15.6	
Cycle Queue Clearance Time (g_c), s	17.7	17.7						120.0	49.4	12.0	15.6	
Green Ratio (g/C)	0.21	0.21						0.53	0.53	0.67	0.70	
Capacity (c), veh/h	338	338						1007	975	256	2383	
Volume-to-Capacity Ratio (X)	0.756	0.756						0.903	0.924	0.872	0.439	
Available Capacity (c_a), veh/h	1025	1025						1007	975	928	2383	
Back of Queue (Q), veh/ln (95th percentile)	11.8	11.8						20.4	19.1	10.3	8.0	
Queue Storage Ratio (RQ) (95th percentile)	1.00	1.00						0.69	0.65	0.88	0.29	
Uniform Delay (d_1), s/veh	44.7	44.7						16.9	15.5	39.8	7.5	
Incremental Delay (d_2), s/veh	3.5	3.5						3.9	5.0	5.6	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	48.1	48.1						20.8	20.5	45.4	7.9	
Level of Service (LOS)	D	D						C	C	D	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	52.2	D	0.0		20.6	C	14.5	B
Intersection Delay, s/veh / LOS	23.2				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.4	A			2.0	B	1.5	A

HCS 2010 Signalized Intersection Results Summary

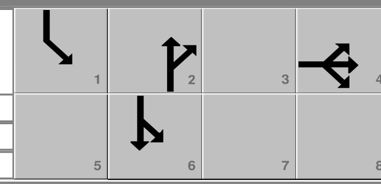
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & I-229 NB ra	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Western_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	150	0	330					890	310	500	1330	

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	85	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	22.0	41.6	19.5	0.0	0.0	0.0
Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Red	1.8	1.8	1.9	0.0	0.0	0.0



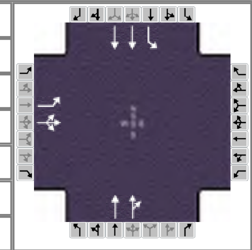
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		25.0				47.3	27.7	75.0
Change Period, ($Y+R_c$), s		5.5				5.7	5.7	5.7
Max Allow Headway (MAH), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		21.5					21.9	
Green Extension Time (g_e), s		0.0				0.0	0.5	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	161	161						644	646	438	1165	
Adjusted Saturation Flow Rate (s), veh/h/ln	1586	1586						1741	1740	1633	1695	
Queue Service Time (g_s), s	9.1	9.1						35.5	31.1	19.9	8.5	
Cycle Queue Clearance Time (g_c), s	9.1	9.1						35.5	31.1	19.9	8.5	
Green Ratio (g/C)	0.20	0.20						0.42	0.42	0.66	0.69	
Capacity (c), veh/h	309	309						732	731	453	2349	
Volume-to-Capacity Ratio (X)	0.522	0.522						0.881	0.883	0.967	0.496	
Available Capacity (c_a), veh/h	309	309						732	731	498	2349	
Back of Queue (Q), veh/ln (95th percentile)	6.4	6.4						19.3	15.2	12.4	3.0	
Queue Storage Ratio (RQ) (95th percentile)	0.54	0.54						0.65	0.52	1.05	0.11	
Uniform Delay (d_1), s/veh	36.1	36.1						22.8	16.7	21.0	2.8	
Incremental Delay (d_2), s/veh	1.6	1.6						11.1	11.3	14.6	0.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	37.6	37.6						34.0	28.0	35.6	3.0	
Level of Service (LOS)	D	D						C	C	D	A	
Approach Delay, s/veh / LOS	113.0	F		0.0			31.0	C		11.9	B	
Intersection Delay, s/veh / LOS	34.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.3	A			1.6	A	2.1	B

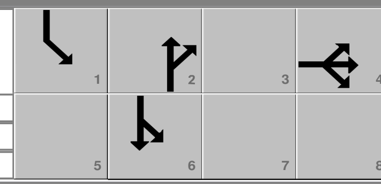
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Western Ave & I-229 NB ra	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Western_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	290	0	170					1180	410	190	890	

Signal Information										
Cycle, s	120.0	Reference Phase	6							
Offset, s	15	Reference Point	Begin	Green	14.9	63.3	24.9	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.8	1.8	1.9	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		30.4				69.0	20.6	89.6
Change Period, ($Y+R_c$), s		5.5				5.7	5.7	5.7
Max Allow Headway (MAH), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		22.8					14.0	
Green Extension Time (g_e), s		2.1				0.0	0.9	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.00					0.00	

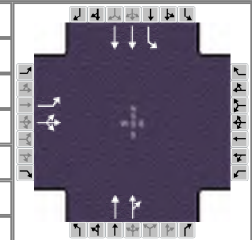
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	256	256						909	901	224	1047	
Adjusted Saturation Flow Rate (s), veh/h/ln	1628	1628						1909	1850	1582	1705	
Queue Service Time (g_s), s	17.7	17.7						120.0	49.3	12.0	14.6	
Cycle Queue Clearance Time (g_c), s	17.7	17.7						120.0	49.3	12.0	14.6	
Green Ratio (g/C)	0.21	0.21						0.53	0.53	0.67	0.70	
Capacity (c), veh/h	338	338						1007	976	256	2383	
Volume-to-Capacity Ratio (X)	0.756	0.756						0.902	0.924	0.873	0.439	
Available Capacity (c_a), veh/h	1025	1025						1007	976	928	2383	
Back of Queue (Q), veh/ln (95th percentile)	11.8	11.8						20.4	19.1	10.2	7.3	
Queue Storage Ratio (RQ) (95th percentile)	1.00	1.00						0.69	0.65	0.87	0.27	
Uniform Delay (d_1), s/veh	44.7	44.7						16.9	15.5	39.1	6.8	
Incremental Delay (d_2), s/veh	3.5	3.5						3.8	4.9	5.7	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	48.1	48.1						20.7	20.4	44.8	7.2	
Level of Service (LOS)	D	D						C	C	D	A	
Approach Delay, s/veh / LOS	52.2	D		0.0			20.5	C		13.8	B	
Intersection Delay, s/veh / LOS	22.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.4	A			2.0	B	1.5	A

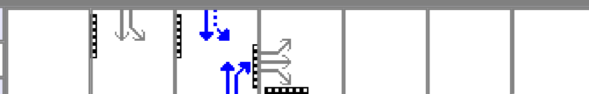
 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 2:57:15 PM

HCS 2010 Signalized Intersection Results Summary

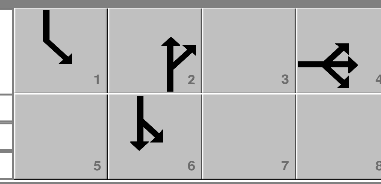
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & I-229 NB ra	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Western_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	0	330					890	310	500	1330	



Signal Information									
Cycle, s	100.0	Reference Phase	6	Green	23.7	39.9	19.5	0.0	0.0	0.0
Offset, s	85	Reference Point	Begin	Yellow	3.9	3.9	3.6	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Red	1.8	1.8	1.9	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On							



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		25.0				45.6	29.4	75.0
Change Period, (Y+R_c), s		5.5				5.7	5.7	5.7
Max Allow Headway (*MAH*), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		21.5					23.5	
Green Extension Time (g_e), s		0.0				0.0	0.2	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		1.00					1.00	

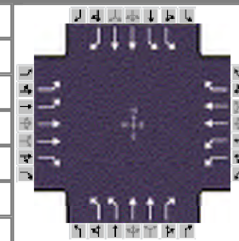
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	121	121						644	646	462	1228	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1574	1574						1741	1740	1640	1702	
Queue Service Time (g_s), s	6.7	6.7						35.5	33.2	21.5	9.0	
Cycle Queue Clearance Time (g_c), s	6.7	6.7						35.5	33.2	21.5	9.0	
Green Ratio (*g/C*)	0.20	0.20						0.40	0.40	0.66	0.69	
Capacity (*c*), veh/h	307	307						695	694	480	2359	
Volume-to-Capacity Ratio (*X*)	0.394	0.394						0.927	0.930	0.962	0.521	
Available Capacity (c_a), veh/h	307	307						695	694	490	2359	
Back of Queue (*Q*), veh/ln (95th percentile)	4.6	4.6						20.6	16.5	10.6	2.7	
Queue Storage Ratio (*RQ*) (95th percentile)	0.39	0.39						0.70	0.56	0.90	0.10	
Uniform Delay (d_1), s/veh	35.1	35.1						23.7	17.4	20.2	2.7	
Incremental Delay (d_2), s/veh	0.8	0.8						16.3	16.6	8.2	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	35.9	35.9						39.9	34.0	28.4	2.9	
Level of Service (LOS)	D	D						D	C	C	A	
Approach Delay, s/veh / LOS	164.2	F		0.0			37.0	D		9.8	A	
Intersection Delay, s/veh / LOS	42.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.3	A			1.6	A	2.1	B

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:00:25 PM

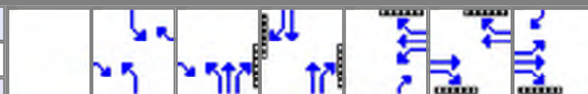
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Western Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Western_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	310	480	210	150	600	300	350	980	300	180	480	400

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.1	8.1	24.1	15.1	8.1	17.1
Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Red	2.0	2.0	2.0	2.0	2.0	2.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	23.0	37.0	21.0	35.0	32.0	44.0	18.0	30.0
Change Period, (Y+R_c), s	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Max Allow Headway (*MAH*), s	4.1	4.1	4.1	4.1	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	15.4	20.5	8.3	26.6	15.9		10.0	
Green Extension Time (g_e), s	0.9	3.7	0.3	1.2	1.3	0.0	0.2	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	0.29	0.10	1.00	0.05		1.00	

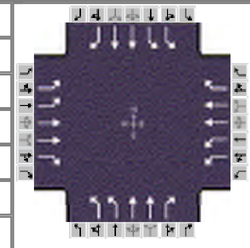
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	365	565	198	176	706	306	412	1153	353	212	565	264
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1586	1640	1475	1554	1659	1501	1594	1720	1512	1560	1640	1462
Queue Service Time (g_s), s	13.4	18.5	9.7	6.3	24.6	20.2	13.9	38.1	20.3	8.0	19.3	16.5
Cycle Queue Clearance Time (g_c), s	13.4	18.5	9.7	6.3	24.6	20.2	13.9	38.1	20.3	8.0	19.3	16.5
Green Ratio (*g/C*)	0.14	0.26	0.48	0.13	0.24	0.34	0.22	0.32	0.44	0.10	0.20	0.34
Capacity (*c*), veh/h	452	850	703	391	804	515	693	1092	670	315	659	502
Volume-to-Capacity Ratio (*X*)	0.807	0.664	0.281	0.451	0.877	0.594	0.594	1.055	0.526	0.673	0.857	0.525
Available Capacity (c_a), veh/h	452	850	703	391	804	515	693	1092	670	315	659	502
Back of Queue (*Q*), veh/ln (95th percentile)	10.2	12.3	6.1	4.7	16.8	10.8	9.7	31.1	12.2	6.6	12.3	5.1
Queue Storage Ratio (*RQ*) (95th percentile)	1.03	0.31	0.61	0.48	0.43	1.08	0.99	0.79	2.03	0.67	0.42	0.86
Uniform Delay (d_1), s/veh	49.9	39.8	19.0	48.6	43.7	2.3	42.2	41.0	24.3	55.1	39.0	5.1
Incremental Delay (d_2), s/veh	14.3	4.1	1.0	3.7	13.0	5.0	3.7	43.1	2.9	9.8	12.2	3.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	64.2	43.9	20.0	52.3	56.7	7.3	45.9	84.1	27.2	64.9	51.1	8.5
Level of Service (LOS)	E	D	B	D	E	A	D	F	C	E	D	A
Approach Delay, s/veh / LOS	46.2	D		43.3	D		65.4	E		43.1	D	
Intersection Delay, s/veh / LOS	51.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.3	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.4	A	1.5	A	2.1	B	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:26:30 AM

HCS 2010 Signalized Intersection Results Summary

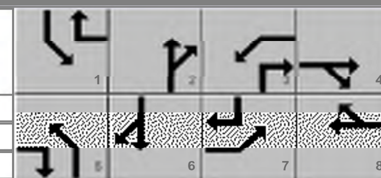
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & 57th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Western_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	330	840	300	300	520	220	400	650	150	330	960	370

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	88	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	11.1	10.1	15.1	9.1	2.1	17.1
Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Red	2.0	2.0	2.0	2.0	2.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	23.0	31.0	15.0	23.0	21.0	37.0	17.0	33.0
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Max Allow Headway (MAH), s	4.1	4.1	4.1	4.1	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	12.1	27.1	11.1	18.5	14.9		10.6	
Green Extension Time (g_e), s	3.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	0.89	1.00	1.00	1.00	1.00		1.00	

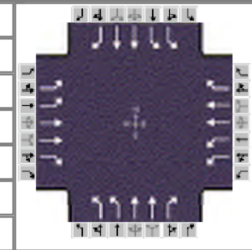
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	355	903	272	323	559	201	430	699	115	285	829	186
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1680	1525	1632	1680	1525	1632	1680	1525	1632	1680	1496
Queue Service Time (g_s), s	10.1	25.1	13.0	9.1	16.5	10.9	12.9	18.1	4.9	8.6	23.6	7.7
Cycle Queue Clearance Time (g_c), s	10.1	25.1	13.0	9.1	16.5	10.9	12.9	18.1	4.9	8.6	23.6	7.7
Green Ratio (g/C)	0.17	0.25	0.40	0.09	0.17	0.28	0.15	0.31	0.40	0.11	0.27	0.44
Capacity (c), veh/h	558	843	613	297	575	430	493	1045	613	362	911	661
Volume-to-Capacity Ratio (X)	0.636	1.071	0.444	1.086	0.973	0.467	0.873	0.669	0.188	0.786	0.910	0.282
Available Capacity (c_a), veh/h	558	843	613	297	575	430	493	1045	613	362	911	661
Back of Queue (Q), veh/ln (95th percentile)	7.8	23.3	4.9	11.3	14.1	6.8	10.5	12.1	3.2	7.0	14.5	4.7
Queue Storage Ratio (RQ) (95th percentile)	0.79	0.59	0.49	1.15	0.36	0.68	1.07	0.31	0.54	0.71	0.49	0.80
Uniform Delay (d_1), s/veh	38.6	37.5	8.5	45.5	41.2	1.3	41.5	30.0	19.3	46.1	32.0	16.7
Incremental Delay (d_2), s/veh	5.4	51.8	2.3	77.1	31.5	3.6	18.8	3.4	0.7	11.6	11.1	0.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	44.0	89.3	10.9	122.6	72.7	4.9	60.4	33.4	20.0	57.6	43.1	17.5
Level of Service (LOS)	D	F	B	F	E	A	E	C	C	E	D	B
Approach Delay, s/veh / LOS	64.8	E		75.0	E		41.5	D		42.6	D	
Intersection Delay, s/veh / LOS	55.7						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.3	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.7	A	1.4	A	1.5	A	1.8	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:29:01 AM

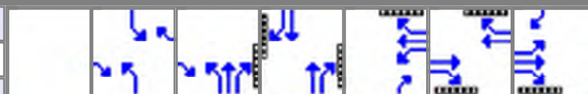
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Western Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Western_AM_WorstCase.xus				
Project Description	2035 NB AM				

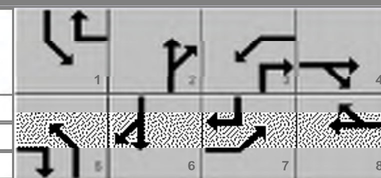


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	310	480	210	150	600	300	350	980	300	180	480	400

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.1	8.1	24.1	15.1	8.1	17.1
Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Red	2.0	2.0	2.0	2.0	2.0	2.0



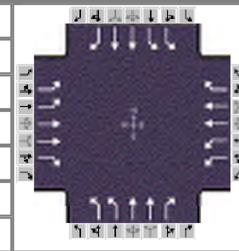
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	23.0	37.0	21.0	35.0	32.0	44.0	18.0	30.0
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Max Allow Headway (MAH), s	4.1	4.1	4.1	4.1	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	15.4	20.5	8.3	26.6	15.9		10.0	
Green Extension Time (g_e), s	0.9	3.7	0.3	1.2	1.3	0.0	0.2	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	0.29	0.10	1.00	0.05		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	365	565	198	176	706	306	412	1153	353	212	565	264
Adjusted Saturation Flow Rate (s), veh/h/ln	1586	1640	1447	1554	1659	1471	1594	1720	1482	1560	1640	1462
Queue Service Time (g_s), s	13.4	18.5	9.9	6.3	24.6	20.7	13.9	38.1	20.9	8.0	19.4	16.6
Cycle Queue Clearance Time (g_c), s	13.4	18.5	9.9	6.3	24.6	20.7	13.9	38.1	20.9	8.0	19.4	16.6
Green Ratio (g/C)	0.14	0.26	0.48	0.13	0.24	0.34	0.22	0.32	0.44	0.10	0.20	0.34
Capacity (c), veh/h	452	850	690	391	804	505	693	1092	657	315	659	502
Volume-to-Capacity Ratio (X)	0.807	0.664	0.287	0.451	0.877	0.605	0.594	1.055	0.537	0.673	0.857	0.525
Available Capacity (c_a), veh/h	452	850	690	391	804	505	693	1092	657	315	659	502
Back of Queue (Q), veh/ln (95th percentile)	10.2	12.3	6.2	4.7	16.8	10.8	9.7	31.1	12.3	6.6	12.4	5.2
Queue Storage Ratio (RQ) (95th percentile)	1.03	0.31	0.63	0.48	0.43	1.10	0.99	0.79	2.08	0.67	0.42	0.88
Uniform Delay (d_1), s/veh	49.9	39.8	19.0	48.6	43.7	2.3	42.2	41.0	24.4	55.1	39.6	5.2
Incremental Delay (d_2), s/veh	14.3	4.1	1.0	3.7	13.0	5.3	3.7	43.1	3.1	9.8	12.2	3.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	64.2	43.9	20.1	52.3	56.7	7.6	45.9	84.1	27.5	64.9	51.8	8.7
Level of Service (LOS)	E	D	C	D	E	A	D	F	C	E	D	A
Approach Delay, s/veh / LOS	46.3	D		43.4	D		65.5	E		43.5	D	
Intersection Delay, s/veh / LOS	52.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.3	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.4	A	1.5	A	2.1	B	1.3	A

HCS 2010 Signalized Intersection Results Summary

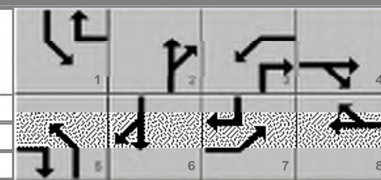
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Western Ave & 57th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Western_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	330	840	300	300	520	220	400	650	150	330	960	370

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	88	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	11.1	10.1	15.1	9.1	2.1	17.1
Yellow	3.9	3.9	3.9	3.9	3.9	3.9
Red	2.0	2.0	2.0	2.0	2.0	2.0



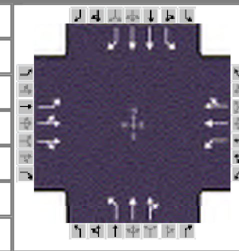
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	23.0	31.0	15.0	23.0	21.0	37.0	17.0	33.0
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Max Allow Headway (MAH), s	4.1	4.1	4.1	4.1	4.1	0.0	4.1	0.0
Queue Clearance Time (g_s), s	12.1	27.1	11.1	18.5	14.9		11.1	
Green Extension Time (g_e), s	3.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	0.89	1.00	1.00	1.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	355	903	272	323	559	201	430	699	115	299	869	196
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1680	1496	1632	1680	1496	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	10.1	25.1	13.3	9.1	16.5	11.2	12.9	18.1	5.0	9.1	25.3	8.1
Cycle Queue Clearance Time (g_c), s	10.1	25.1	13.3	9.1	16.5	11.2	12.9	18.1	5.0	9.1	25.3	8.1
Green Ratio (g/C)	0.17	0.25	0.40	0.09	0.17	0.28	0.15	0.31	0.40	0.11	0.27	0.44
Capacity (c), veh/h	558	843	601	297	575	422	493	1045	601	362	911	661
Volume-to-Capacity Ratio (X)	0.636	1.071	0.453	1.086	0.973	0.477	0.873	0.669	0.191	0.825	0.955	0.296
Available Capacity (c_a), veh/h	558	843	601	297	575	422	493	1045	601	362	911	661
Back of Queue (Q), veh/ln (95th percentile)	7.8	23.3	5.0	11.3	14.1	6.9	10.5	12.1	3.2	7.4	15.9	5.0
Queue Storage Ratio (RQ) (95th percentile)	0.79	0.59	0.50	1.15	0.36	0.70	1.07	0.31	0.55	0.75	0.54	0.84
Uniform Delay (d_1), s/veh	38.6	37.5	8.6	45.5	41.2	1.3	41.5	30.0	19.4	46.4	32.6	16.8
Incremental Delay (d_2), s/veh	5.4	51.8	2.5	77.1	31.5	3.8	18.8	3.4	0.7	13.8	16.1	0.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	44.0	89.3	11.0	122.6	72.7	5.1	60.4	33.4	20.1	60.2	48.7	17.6
Level of Service (LOS)	D	F	B	F	E	A	E	C	C	E	D	B
Approach Delay, s/veh / LOS	64.8	E		75.0	E		41.5	D		46.7	D	
Intersection Delay, s/veh / LOS	56.7						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.3	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.7	A	1.4	A	1.5	A	1.8	A

HCS 2010 Signalized Intersection Results Summary

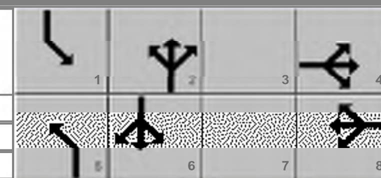
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Minnesota Ave & 41st St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Minnesota_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	350	180	110	200	220	70	150	1360	100	80	710	230

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	114	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.1	55.2	5.9	24.4	29.2	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	2.3	2.3	1.0	2.1	2.5	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		10.0		10.0	1.3	4.0	1.2	3.0
Phase Duration, s		35.3		30.1	10.5	71.6	13.0	74.1
Change Period, (*Y+R*c), s		6.1		5.7	5.9	5.9	5.9	5.9
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s		29.3		22.5	2.0		7.1	
Green Extension Time (g_e), s		0.5		1.9	2.1	0.0	0.1	0.0
Phase Call Probability		1.00		1.00	1.00		0.98	
Max Out Probability		1.00		0.01	1.00		0.99	

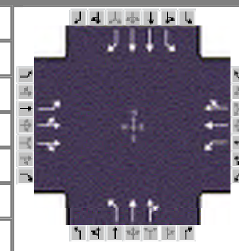
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	309	249	140	235	163	157	153	745	734	94	835	222
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1730	1611	1681	1765	1649	1664	1748	1711	1664	1664	1481
Queue Service Time (g_s), s	27.3	20.4	11.5	20.5	12.8	13.2	0.0	61.7	62.3	5.1	22.2	11.1
Cycle Queue Clearance Time (g_c), s	27.3	20.4	11.5	20.5	12.8	13.2	0.0	61.7	62.3	5.1	22.2	11.1
Green Ratio (*g/C*)	0.19	0.19	0.19	0.16	0.16	0.16	0.39	0.44	0.44	0.43	0.45	0.45
Capacity (*c*), veh/h	320	330	307	273	287	268	263	773	757	127	1516	675
Volume-to-Capacity Ratio (*X*)	0.964	0.756	0.455	0.861	0.568	0.586	0.584	0.964	0.969	0.742	0.551	0.330
Available Capacity (c_a), veh/h	345	355	331	452	474	443	269	773	757	188	1516	675
Back of Queue (*Q*), veh/ln (95th percentile)	21.4	14.9	8.4	14.5	9.9	9.6	8.2	35.1	34.7	4.2	12.8	6.8
Queue Storage Ratio (*RQ*) (95th percentile)	3.62	0.38	0.21	2.10	0.25	0.24	1.69	0.64	0.63	1.08	0.33	1.75
Uniform Delay (d_1), s/veh	60.2	57.4	53.8	61.2	58.0	58.1	46.8	36.2	35.5	36.2	20.4	18.2
Incremental Delay (d_2), s/veh	37.8	8.4	1.1	8.9	1.8	2.0	1.6	16.2	17.3	8.3	1.4	1.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	98.0	65.8	54.9	70.1	59.7	60.2	48.4	52.4	52.9	44.5	21.8	19.5
Level of Service (LOS)	F	E	D	E	E	E	D	D	D	D	C	B
Approach Delay, s/veh / LOS	77.9	E		64.2	E		52.2	D		23.2	C	
Intersection Delay, s/veh / LOS	50.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.1	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	0.9	A	2.0	B	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:31:57 AM

HCS 2010 Signalized Intersection Results Summary

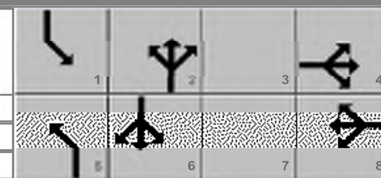
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & 41st St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Minnesota_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400	250	280	320	290	60	280	840	180	60	1150	390

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	130	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	20.7	27.0	12.2	25.9	31.1	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	1.0	2.3	2.3	2.1	2.4	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2	1	6
Case Number		10.0		10.0	1.2	4.0	1.3	3.0
Phase Duration, s		37.1		31.6	25.3	58.2	18.1	51.0
Change Period, (Y+R_c), s		6.0		5.7	4.6	5.9	5.9	5.9
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s		30.1		25.5	21.1		2.0	
Green Extension Time (g_e), s		4.0		2.8	1.2	0.0	11.1	0.0
Phase Call Probability		1.00		1.00	1.00		0.93	
Max Out Probability		0.00		0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	344	352	234	344	184	178	301	543	516	65	1237	373
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1744	1498	1681	1765	1679	1664	1748	1657	1664	1664	1481
Queue Service Time (g_s), s	28.1	28.1	21.7	23.5	14.1	14.4	19.1	40.0	40.5	0.0	52.1	28.7
Cycle Queue Clearance Time (g_c), s	28.1	28.1	21.7	23.5	14.1	14.4	19.1	40.0	40.5	0.0	52.1	28.7
Green Ratio (*g/C*)	0.21	0.21	0.21	0.18	0.18	0.18	0.39	0.36	0.36	0.30	0.31	0.31
Capacity (*c*), veh/h	325	337	290	273	286	272	282	695	659	275	1196	532
Volume-to-Capacity Ratio (*X*)	1.058	1.043	0.808	1.262	0.642	0.655	1.069	0.783	0.783	0.235	1.034	0.701
Available Capacity (c_a), veh/h	937	972	835	1135	1192	1134	776	695	659	1352	1196	532
Back of Queue (*Q*), veh/ln (95th percentile)	22.7	22.7	13.5	29.7	10.7	10.5	16.9	25.2	24.6	3.6	34.6	16.1
Queue Storage Ratio (*RQ*) (95th percentile)	3.85	0.58	0.34	4.32	0.27	0.27	3.47	0.46	0.45	0.91	0.88	4.12
Uniform Delay (d_1), s/veh	58.5	58.5	55.9	60.7	56.8	56.9	41.9	40.2	42.0	45.4	37.8	31.7
Incremental Delay (d_2), s/veh	40.3	34.8	5.3	124.3	2.4	2.7	43.7	7.2	7.5	0.4	35.3	7.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	98.8	93.3	61.2	185.0	59.2	59.6	85.6	47.4	49.5	45.9	73.0	39.2
Level of Service (LOS)	F	F	E	F	E	E	F	D	D	D	F	D
Approach Delay, s/veh / LOS	87.3	F		120.6	F		56.6	E		64.4	E	
Intersection Delay, s/veh / LOS	75.2						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.1	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.3	A	1.1	A	1.6	A	1.9	A

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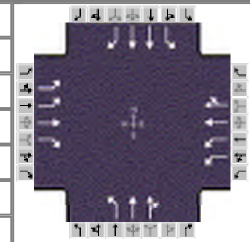
HCS 2010 Signalized Intersection Results Summary

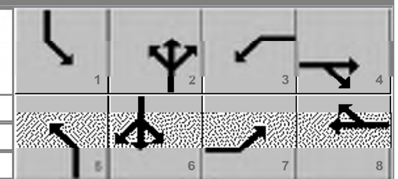
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Minnesota Ave & 41st St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Minnesota_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	350	180	110	200	220	70	150	1360	100	80	710	230

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	118	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	6.2	55.4	5.4	11.8	4.1	21.5
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	2.3	2.3	1.0	1.0	0.0	1.0



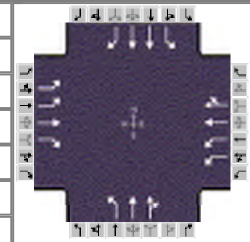
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	4.0	1.3	4.0	1.2	3.0
Phase Duration, s	26.1	30.2	16.4	20.5	10.0	71.3	12.1	73.4
Change Period, (*Y+Rc*), s	6.1	6.1	4.6	5.7	5.9	5.9	5.9	5.9
Max Allow Headway (*MAH*), s	3.6	3.6	3.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	17.9	16.4	11.2	14.1	2.0		6.0	
Green Extension Time (g_e), s	2.1	2.1	0.6	0.7	1.6	0.0	0.3	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.97	
Max Out Probability	0.00	0.00	0.00	0.20	1.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	412	212	74	235	163	157	157	762	751	94	835	222
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1632	1765	1496	1632	1765	1649	1664	1748	1711	1664	1664	1481
Queue Service Time (g_s), s	15.9	14.4	5.5	9.2	11.7	12.1	0.0	47.9	48.1	4.0	15.2	7.6
Cycle Queue Clearance Time (g_c), s	15.9	14.4	5.5	9.2	11.7	12.1	0.0	47.9	48.1	4.0	15.2	7.6
Green Ratio (*g/C*)	0.15	0.19	0.19	0.09	0.11	0.11	0.44	0.50	0.50	0.49	0.52	0.52
Capacity (*c*), veh/h	503	327	277	296	201	188	308	879	861	151	1723	767
Volume-to-Capacity Ratio (*X*)	0.819	0.647	0.267	0.794	0.812	0.837	0.509	0.867	0.872	0.622	0.485	0.290
Available Capacity (c_a), veh/h	1165	685	580	1416	289	270	312	879	861	654	1723	767
Back of Queue (*Q*), veh/ln (95th percentile)	10.8	10.8	3.6	7.0	9.8	9.7	6.4	24.5	23.9	3.1	8.5	4.5
Queue Storage Ratio (*RQ*) (95th percentile)	1.83	0.27	0.92	1.01	0.25	0.25	1.32	0.45	0.44	0.78	0.22	1.15
Uniform Delay (d_1), s/veh	53.2	49.0	3.4	57.9	56.2	56.4	32.3	23.7	23.0	29.6	12.1	10.9
Incremental Delay (d_2), s/veh	1.3	2.2	0.5	1.8	10.9	14.1	0.6	5.6	6.0	4.1	1.0	1.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	54.5	51.2	3.9	59.7	67.1	70.6	32.9	29.3	29.0	33.7	13.0	11.8
Level of Service (LOS)	D	D	A	E	E	E	C	C	C	C	B	B
Approach Delay, s/veh / LOS	48.1		D	65.0		E	29.5		C	14.5		B
Intersection Delay, s/veh / LOS	33.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	2.6	B	3.1	C
Bicycle LOS Score / LOS	1.6	A	0.9	A	2.0	B	1.4	A

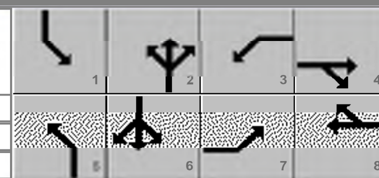
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & 41st St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Minnesota_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	400	250	280	320	290	60	280	840	180	60	1150	390

Signal Information										
Cycle, s	145.0	Reference Phase	2							
Offset, s	130	Reference Point	Begin	Green	22.3	37.8	12.2	18.3	0.7	28.1
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.3	2.3	1.0	0.0	1.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	2.0	4.0	1.2	4.0	1.3	3.0
Phase Duration, s	32.7	33.4	22.9	23.6	26.9	70.6	18.1	61.8
Change Period, ($Y+R_c$), s	6.0	6.0	4.6	5.7	4.6	5.9	5.9	5.9
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.1	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	20.0	23.6	17.0	17.2	22.7		2.0	
Green Extension Time (g_e), s	4.3	4.3	1.6	1.3	1.2	0.0	11.1	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		0.93	
Max Out Probability	0.00	0.00	0.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	430	269	231	344	184	178	301	543	516	65	1237	373
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1632	1765	1496	1632	1765	1679	1664	1748	1657	1664	1664	1481
Queue Service Time (g_s), s	18.0	21.2	21.6	15.0	14.9	15.2	20.7	37.5	38.3	0.0	49.6	25.5
Cycle Queue Clearance Time (g_c), s	18.0	21.2	21.6	15.0	14.9	15.2	20.7	37.5	38.3	0.0	49.6	25.5
Green Ratio (*g/C*)	0.18	0.19	0.19	0.13	0.12	0.12	0.44	0.45	0.45	0.35	0.39	0.39
Capacity (*c*), veh/h	597	328	278	406	211	201	301	788	747	297	1336	595
Volume-to-Capacity Ratio (*X*)	0.720	0.820	0.832	0.848	0.872	0.889	0.999	0.690	0.690	0.217	0.925	0.627
Available Capacity (c_a), veh/h	1934	1042	883	2229	1192	1134	847	788	747	1374	1336	595
Back of Queue (*Q*), veh/ln (95th percentile)	12.1	15.1	13.5	10.7	11.7	11.6	18.6	23.4	23.1	3.3	27.9	19.4
Queue Storage Ratio (*RQ*) (95th percentile)	2.05	0.38	3.43	1.55	0.30	0.29	3.81	0.43	0.42	0.86	0.71	4.97
Uniform Delay (d_1), s/veh	55.8	56.7	56.9	62.2	62.7	62.9	45.2	35.5	37.6	40.5	31.7	51.6
Incremental Delay (d_2), s/veh	1.7	5.1	6.4	5.0	10.6	12.4	21.6	4.1	4.3	0.4	12.2	4.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	57.4	61.8	63.3	67.1	73.4	75.3	66.8	39.5	41.9	40.8	43.9	56.5
Level of Service (LOS)	E	E	E	E	E	E	E	D	D	D	D	E
Approach Delay, s/veh / LOS	60.1	E		70.8	E		46.5	D		46.6	D	
Intersection Delay, s/veh / LOS	52.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	2.6	B	3.0	C
Bicycle LOS Score / LOS	2.0	B	1.1	A	1.6	A	1.9	A

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TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & 49th St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 49th St
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	550	1670			760	300
Peak-Hour Factor, PHF	0.85	0.85			0.85	0.85
Hourly Flow Rate, HFR	647	1964			894	352
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				150		230
Peak Hour Factor, PHF				0.85		0.85
Hourly Flow Rate, HFR				176		270
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	647					176		270
C(m) (vph)	597							651
v/c	1.08							0.41
95% queue length	19.01							2.04
Control Delay	87.3							14.4
LOS	F							B
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 11/13/2013
Analysis Time Period: AM Peak
Intersection: Minnesota Ave & 49th St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 49th St
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	550	1670			760	300
Peak-Hour Factor, PHF	0.85	0.85			0.85	0.85
Peak-15 Minute Volume	162	491			224	88
Hourly Flow Rate, HFR	647	1964			894	352
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				150		230
Peak Hour Factor, PHF				0.85		0.85
Peak-15 Minute Volume				44		68
Hourly Flow Rate, HFR				176		270
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	225
	Through	1960	1800	4	84	116	30	225
S5	Left-Turn	0	1800	3	0	116	30	1170
	Through	710	1800	4	46	116	30	1170

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage	4.2					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	1960	0	710	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	84	0	46	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.966	0.000	0.529	0.000
g(q1)	2.2	0.0	10.8	0.0
g(q2)	5.8	0.0	3.8	0.0
g(q)	7.9	0.0	14.6	0.0

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	5.102		26.531	
Smoothing Factor, F	0.431		0.127	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3559	0	3106	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	82.6	0.0	13.9	0.0
Proportion time blocked, p	0.712		0.120	

Computation 3-Platoon Event Periods	Result
p(2)	0.712
p(5)	0.120
p(dom)	0.712
p(subo)	0.120
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.880		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.228	0.880	0.288
p(11)			
p(12)	0.880		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1246					3346		623
s	3000					3000		3000
Px	0.880					0.228		0.880
V c,u,x	1006					4516		298
C r,x	678					1		740
C plat,x	597					0		651

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					1070	2276		
s					3000	3000		
P(x)					0.880	0.288		
V(c,u,x)					806	489		
C(r,x)					400	582		
C(plat,x)					352	168		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		623
Potential Capacity		651
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		651
Probability of Queue free St.	1.00	0.59

Step 2: LT from Major St.	4	1
Conflicting Flows		1246
Potential Capacity		597
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		597
Probability of Queue free St.	1.00	0.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		3346
Potential Capacity		0
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	
Maj. L, Min T Adj. Imp Factor.	0.00	
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	3	350
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	1.00
Movement Capacity	0	350
Probability of Queue free St.		1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	282	3
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.00
Movement Capacity	282	0

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		1070
Potential Capacity	2	352
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	1.00
Movement Capacity	0	352

Part 2 - Second Stage		
Conflicting Flows		2276
Potential Capacity	810	168
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.59	
Movement Capacity	474	

Part 3 - Single Stage		
Conflicting Flows		3346
Potential Capacity		0
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	
Maj. L, Min T Adj. Imp Factor.	0.00	
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		0

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				176		270
Movement Capacity (vph)						651
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						651
Volume				176		270
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	647					176		270
C(m) (vph)	597							651
v/c	1.08							0.41
95% queue length	19.01							2.04
Control Delay	87.3							14.4
LOS	F							B
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	87.3	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/09/2014
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & 49th St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 49th St
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	500	920			1750	260
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Hourly Flow Rate, HFR	537	989			1881	279
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				450		250
Peak Hour Factor, PHF				0.93		0.93
Hourly Flow Rate, HFR				483		268
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	537					483		268
C(m) (vph)	234							555
v/c	2.29							0.48
95% queue length	42.60							2.61
Control Delay	629.2							17.4
LOS	F							C
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/09/2014
Analysis Time Period: PM Peak
Intersection: Minnesota Ave & 49th St
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - Minnesota Corridor
East/West Street: 49th St
North/South Street: Minnesota Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	500	920			1750	260
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Peak-15 Minute Volume	134	247			470	70
Hourly Flow Rate, HFR	537	989			1881	279
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				450		250
Peak Hour Factor, PHF				0.93		0.93
Peak-15 Minute Volume				121		67
Hourly Flow Rate, HFR				483		268
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?						No
Lanes				1	1	
Configuration				L	R	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	128	30	225
	Through	1230	1800	4	96	128	30	225
S5	Left-Turn	0	1800	3	0	128	30	1170
	Through	1150	1800	4	45	128	30	1170

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage	4.2					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	1230	0	1150	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	96	0	45	0
Cycle Length, C (sec)	128	128	128	128
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	1.000	0.000	0.469	0.000
g(q1)	0.0	0.0	21.7	0.0
g(q2)	0.0	0.0	16.1	0.0
g(q)	0.0	0.0	37.8	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	5.102		26.531	
Smoothing Factor, F	0.431		0.127	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	0	0	3579	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	39.0	0.0
Proportion time blocked, p	0.000		0.305	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.305
p(dom)	0.305
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.695		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.695	0.695	1.000
p(11)			
p(12)	0.695		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	2160					3588		1080
s	3000					3000		3000
Px	0.695					0.695		0.695
V c,u,x	1792					3846		238
C r,x	337					3		799
C plat,x	234					2		555

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					2020	1568		
s					3000	3000		
P(x)					0.695	1.000		
V(c,u,x)					1590	1568		
C(r,x)					153	157		
C(plat,x)					106	157		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		1080
Potential Capacity		555
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		555
Probability of Queue free St.	1.00	0.52

Step 2: LT from Major St.	4	1
Conflicting Flows		2160
Potential Capacity		234
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		234
Probability of Queue free St.	1.00	0.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		3588
Potential Capacity		2
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	
Maj. L, Min T Adj. Imp Factor.	0.00	
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	98	117
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	1.00
Movement Capacity	0	117
Probability of Queue free St.		1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	93	98
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.00
Movement Capacity	93	0

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		2020
Potential Capacity	86	106
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	1.00
Movement Capacity	0	106

Part 2 - Second Stage		
Conflicting Flows		1568
Potential Capacity	687	157
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.52	
Movement Capacity	355	

Part 3 - Single Stage		
Conflicting Flows		3588
Potential Capacity		2
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	
Maj. L, Min T Adj. Imp Factor.	0.00	
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		0

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				483		268
Movement Capacity (vph)						555
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						555
Volume				483		268
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

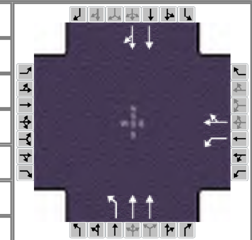
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	537					483		268
C(m) (vph)	234							555
v/c	2.29							0.48
95% queue length	42.60							2.61
Control Delay	629.2							17.4
LOS	F							C
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	629.2	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

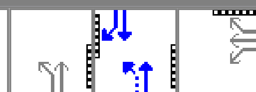
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Minnesota Ave & I-229 SB	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Minnesota_AM_BestCase.xus				
Project Description	2035 NB AM				

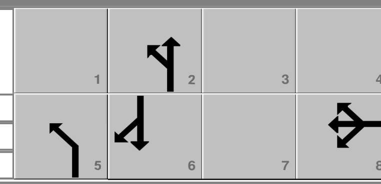


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				210	0	260	120	1960			690	300

Signal Information				
Cycle, s	150.0	Reference Phase	2
Offset, s	7	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.3	93.4	34.3	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	2.2	1.7	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				10.0	1.0	4.0		8.3
Phase Duration, s				40.0	10.9	110.0		99.2
Change Period, (Y+R_c), s				5.7	4.6	5.8		5.8
Max Allow Headway (MAH), s				4.2	4.1	0.0		0.0
Queue Clearance Time (g_s), s				32.0	5.9			
Green Extension Time (g_e), s				2.2	0.4	0.0		0.0
Phase Call Probability				1.00	0.99			
Max Out Probability				0.00	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h				247	306		118	1926			600	565
Adjusted Saturation Flow Rate (s), veh/h/ln				1663	1486		1605	1800			1770	1648
Queue Service Time (g_s), s				20.2	30.0		3.9	38.0			70.2	23.2
Cycle Queue Clearance Time (g_c), s				20.2	30.0		3.9	38.0			70.2	23.2
Green Ratio (g/C)				0.23	0.23		0.68	0.69			0.62	0.62
Capacity (c), veh/h				380	339		185	2502			1101	1026
Volume-to-Capacity Ratio (X)				0.651	0.901		0.637	0.770			0.545	0.551
Available Capacity (c_a), veh/h				1245	1112		1021	2502			1101	1026
Back of Queue (Q), veh/ln (95th percentile)				13.4	17.6		3.4	9.9			15.5	11.9
Queue Storage Ratio (RQ) (95th percentile)				2.74	0.45		0.70	0.36			0.28	0.22
Uniform Delay (d_1), s/veh				52.4	56.2		31.5	7.2			14.1	10.8
Incremental Delay (d_2), s/veh				1.9	8.8		0.3	0.2			1.5	1.6
Initial Queue Delay (d_3), s/veh				0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (d), s/veh				54.3	65.0		31.8	7.4			15.6	12.4
Level of Service (LOS)				D	E		C	A			B	B

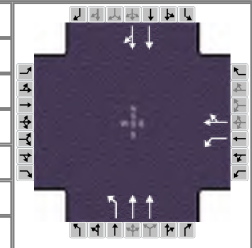
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		60.2	E	8.8	A	14.0	B
Intersection Delay, s/veh / LOS	18.0				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	1.7	A	1.9	A
Bicycle LOS Score / LOS			1.4	A	2.5	B	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:07:38 PM

HCS 2010 Signalized Intersection Results Summary

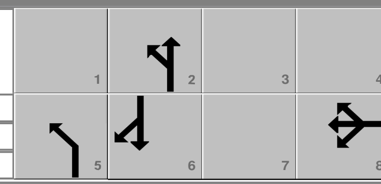
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & I-229 SB	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Minnesota_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				290	0	190	130	1230			1490	510

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	35	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	92.4	6.4	30.1	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	2.2	1.0	1.7	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				10.0	1.0	4.0		8.3
Phase Duration, s				35.8	11.0	109.2		98.2
Change Period, (*Y+Rc*), s				5.7	5.8	5.8		5.8
Max Allow Headway (*MAH*), s				4.2	4.1	0.0		0.0
Queue Clearance Time (*gs*), s				28.0	7.2			
Green Extension Time (*ge*), s				2.0	0.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.00	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				312	204		140	1323			1021	1046
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1689	1509		1612	1769			1846	1737
Queue Service Time (*gs*), s				26.0	18.0		5.2	29.3			145.0	68.9
Cycle Queue Clearance Time (*gc*), s				26.0	18.0		5.2	29.3			145.0	68.9
Green Ratio (*g/C*)				0.21	0.21		0.66	0.71			0.64	0.64
Capacity (*c*), veh/h				350	313		107	2524			1177	1108
Volume-to-Capacity Ratio (*X*)				0.891	0.653		1.301	0.524			0.868	0.944
Available Capacity (*ca*), veh/h				993	887		107	2524			1177	1108
Back of Queue (*Q*), veh/ln (95th percentile)				17.3	11.3		13.6	15.9			23.9	18.0
Queue Storage Ratio (*RQ*) (95th percentile)				3.54	0.29		2.78	0.58			0.44	0.33
Uniform Delay (*d1*), s/veh				55.9	52.7		69.7	12.7			15.3	10.5
Incremental Delay (*d2*), s/veh				7.8	2.3		169.4	0.5			0.9	2.3
Initial Queue Delay (*d3*), s/veh				0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				63.7	55.0		239.1	13.2			16.2	12.7
Level of Service (LOS)				E	D		F	B			B	B
Approach Delay, s/veh / LOS	0.0			60.2	E		34.8	C		14.5	B	
Intersection Delay, s/veh / LOS	27.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	1.6	A	2.0	A
Bicycle LOS Score / LOS			1.3	A	1.7	A	2.3	B

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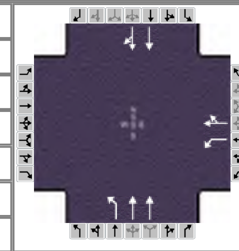
HCS 2010 Signalized Intersection Results Summary

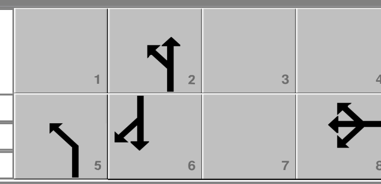
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Minnesota Ave & I-229 SB	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Minnesota_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				210	0	260	120	1960			690	300

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	70	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	77.9	5.7	30.3	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	2.2	1.0	1.7	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				10.0	1.0	4.0		8.3
Phase Duration, s				36.0	10.3	94.0		83.7
Change Period, (*Y+Rc*), s				5.7	5.8	5.8		5.8
Max Allow Headway (*MAH*), s				4.2	4.1	0.0		0.0
Queue Clearance Time (*gs*), s				28.2	2.0			
Green Extension Time (*ge*), s				2.1	2.3	0.0		0.0
Phase Call Probability				1.00	0.99			
Max Out Probability				0.00	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h				247	306		121	1983			600	565
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1648	1472		1599	1800			1740	1622
Queue Service Time (*gs*), s				17.6	26.2		0.0	45.3			57.7	25.1
Cycle Queue Clearance Time (*gc*), s				17.6	26.2		0.0	45.3			57.7	25.1
Green Ratio (*g/C*)				0.23	0.23		0.62	0.68			0.60	0.60
Capacity (*c*), veh/h				384	343		176	2444			1039	969
Volume-to-Capacity Ratio (*X*)				0.644	0.893		0.691	0.811			0.577	0.583
Available Capacity (*ca*), veh/h				638	570		179	2444			1039	969
Back of Queue (*Q*), veh/ln (95th percentile)				11.7	15.6		4.9	15.3			13.9	13.5
Queue Storage Ratio (*RQ*) (95th percentile)				2.40	0.40		1.00	0.56			0.25	0.25
Uniform Delay (*d1*), s/veh				45.0	48.3		54.6	10.7			13.1	13.3
Incremental Delay (*d2*), s/veh				1.8	9.9		1.3	0.4			1.9	2.1
Initial Queue Delay (*d3*), s/veh				0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh				46.8	58.2		55.9	11.0			15.0	15.4
Level of Service (LOS)				D	E		E	B			B	B

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		53.1	D	13.6	B	15.2	B
Intersection Delay, s/veh / LOS	19.8				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	1.6	A	2.0	A
Bicycle LOS Score / LOS			1.4	A	2.5	B	1.4	A

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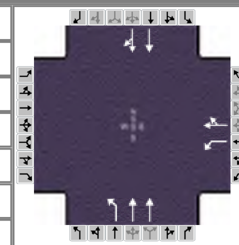
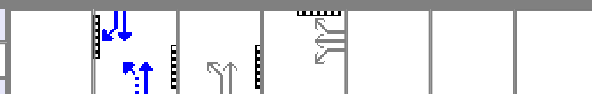
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & I-229 SB	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Minnesota_PM_WorstCase.xus				
Project Description	2035 NB PM				

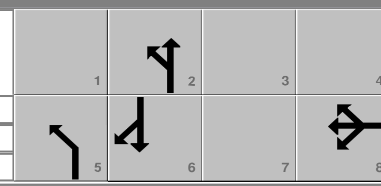


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				290	0	190	130	1230			1490	510

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	35	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	92.4	6.4	30.1	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	2.2	1.0	1.7	0.0	0.0	0.0



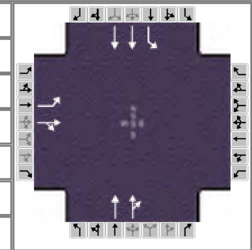
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8	5	2		6
Case Number				10.0	1.0	4.0		8.3
Phase Duration, s				35.8	11.0	109.2		98.2
Change Period, ($Y+R_c$), s				5.7	5.8	5.8		5.8
Max Allow Headway (MAH), s				4.2	4.1	0.0		0.0
Queue Clearance Time (g_s), s				28.0	7.2			
Green Extension Time (g_e), s				2.0	0.0	0.0		0.0
Phase Call Probability				1.00	1.00			
Max Out Probability				0.00	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h				312	204		140	1323			1062	1089
Adjusted Saturation Flow Rate (s), veh/h/ln				1689	1509		1612	1769			1844	1737
Queue Service Time (g_s), s				26.0	18.0		5.2	34.8			145.0	83.1
Cycle Queue Clearance Time (g_c), s				26.0	18.0		5.2	34.8			145.0	83.1
Green Ratio (g/C)				0.21	0.21		0.66	0.71			0.64	0.64
Capacity (c), veh/h				350	313		107	2524			1175	1108
Volume-to-Capacity Ratio (X)				0.891	0.653		1.301	0.524			0.903	0.983
Available Capacity (c_a), veh/h				993	887		107	2524			1175	1108
Back of Queue (Q), veh/ln (95th percentile)				17.3	11.3		13.5	19.7			26.9	22.9
Queue Storage Ratio (RQ) (95th percentile)				3.54	0.29		2.76	0.72			0.49	0.42
Uniform Delay (d_1), s/veh				55.9	52.7		69.0	17.5			14.1	10.4
Incremental Delay (d_2), s/veh				7.8	2.3		168.5	0.4			4.1	11.7
Initial Queue Delay (d_3), s/veh				0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (d), s/veh				63.7	55.0		237.5	18.0			18.2	22.2
Level of Service (LOS)				E	D		F	B			B	C
Approach Delay, s/veh / LOS	0.0			60.2	E		39.0	D		20.2	C	
Intersection Delay, s/veh / LOS	31.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	1.6	A	2.0	A
Bicycle LOS Score / LOS			1.3	A	1.7	A	2.3	B

HCS 2010 Signalized Intersection Results Summary

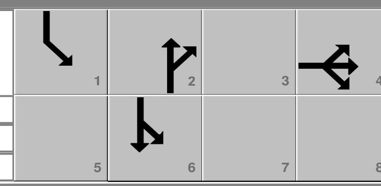
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Minnesota Ave & I-229 NB	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Minnesota_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	400	0	120					1680	340	150	750	

Signal Information			
Cycle, s	150.0	Reference Phase	6
Offset, s	43	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	14.1	90.7	28.4	0.0	0.0	0.0
Yellow	4.3	4.3	4.0	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



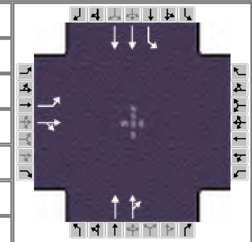
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		34.0				96.6	19.4	116.0
Change Period, ($Y+R_c$), s		5.6				5.9	5.3	5.9
Max Allow Headway (MAH), s		4.1				0.0	4.1	0.0
Queue Clearance Time (g_s), s		30.4					13.6	
Green Extension Time (g_e), s		0.0				0.0	0.5	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		1.00					0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	471	54						1002	1035	176	882	
Adjusted Saturation Flow Rate (s), veh/h/ln	1774	1585						1830	1791	1631	1696	
Queue Service Time (g_s), s	28.4	4.3						150.0	77.3	11.6	32.2	
Cycle Queue Clearance Time (g_c), s	28.4	4.3						150.0	77.3	11.6	32.2	
Green Ratio (g/C)	0.19	0.19						0.60	0.60	0.71	0.45	
Capacity (c), veh/h	336	300						1106	1083	202	1534	
Volume-to-Capacity Ratio (X)	1.401	0.180						0.906	0.956	0.875	0.575	
Available Capacity (c_a), veh/h	336	300						1106	1083	436	1534	
Back of Queue (Q), veh/ln (95th percentile)	46.9	3.1						23.7	27.5	11.2	19.6	
Queue Storage Ratio (RQ) (95th percentile)	9.60	0.08						0.19	0.22	2.30	0.72	
Uniform Delay (d_1), s/veh	60.8	51.0						16.5	17.9	55.1	23.1	
Incremental Delay (d_2), s/veh	197.7	0.3						1.4	2.9	9.3	1.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	258.5	51.3						17.9	20.8	64.4	24.4	
Level of Service (LOS)	F	D						B	C	E	C	
Approach Delay, s/veh / LOS	237.1	F		0.0			19.4	B		31.0	C	
Intersection Delay, s/veh / LOS	54.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS	1.4	A			2.4	B	1.4	A

HCS 2010 Signalized Intersection Results Summary

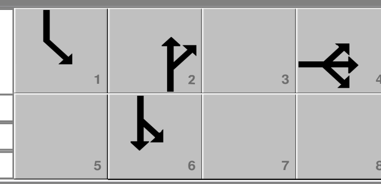
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & I-229 NB	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Minnesota_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	260	0	160					1100	180	330	1450	

Signal Information			
Cycle, s	145.0	Reference Phase	6
Offset, s	104	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	25.4	75.5	27.4	0.0	0.0	0.0
Yellow	4.3	4.3	4.0	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		33.0				81.4	30.7	112.0
Change Period, ($Y+R_c$), s		5.6				5.9	5.3	5.9
Max Allow Headway (MAH), s		6.1				0.0	4.1	0.0
Queue Clearance Time (g_s), s		25.6					24.7	
Green Extension Time (g_e), s		1.8				0.0	1.3	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.27					0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	280	44						689	667	343	1508	
Adjusted Saturation Flow Rate (s), veh/h/ln	1674	1495						1861	1779	1703	1800	
Queue Service Time (g_s), s	23.6	3.6						67.2	48.7	22.7	27.6	
Cycle Queue Clearance Time (g_c), s	23.6	3.6						67.2	48.7	22.7	27.6	
Green Ratio (g/C)	0.19	0.19						0.52	0.52	0.71	0.73	
Capacity (c), veh/h	316	282						976	933	367	2635	
Volume-to-Capacity Ratio (X)	0.885	0.156						0.707	0.715	0.934	0.572	
Available Capacity (c_a), veh/h	420	375						976	933	766	2635	
Back of Queue (Q), veh/ln (95th percentile)	17.2	2.5						28.8	28.9	17.5	12.5	
Queue Storage Ratio (RQ) (95th percentile)	3.52	0.06						0.23	0.23	3.59	0.46	
Uniform Delay (d_1), s/veh	57.3	49.2						39.1	42.0	57.0	8.7	
Incremental Delay (d_2), s/veh	20.2	0.5						2.3	2.5	4.3	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	77.5	49.7						41.4	44.5	61.4	9.0	
Level of Service (LOS)	E	D						D	D	E	A	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	73.7	E	0.0		42.9	D	18.7	B
Intersection Delay, s/veh / LOS	33.1				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.9	A	1.8	A
Bicycle LOS Score / LOS	1.0	A			1.6	A	2.1	B

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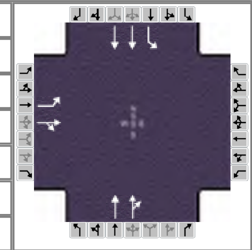
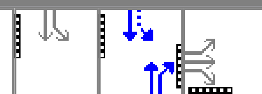
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Minnesota Ave & I-229 NB	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Minnesota_AM_WorstCase.xus				
Project Description	2035 NB AM				

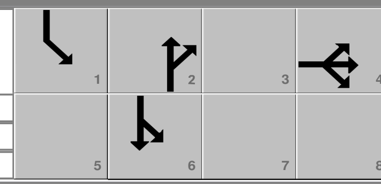


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	400	0	120					1680	340	150	750	

Signal Information			
Cycle, s	130.0	Reference Phase	6
Offset, s	34	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.7	78.1	29.4	0.0	0.0	0.0
Yellow	4.3	4.3	4.0	0.0	0.0	0.0
Red	1.0	1.6	1.6	0.0	0.0	0.0



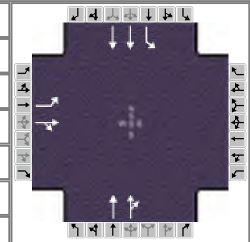
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		35.0				84.0	11.0	95.0
Change Period, ($Y+R_c$), s		5.6				5.9	5.3	5.9
Max Allow Headway (*MAH*), s		4.1				0.0	4.1	0.0
Queue Clearance Time (g_s), s		31.4					7.7	
Green Extension Time (g_e), s		0.0				0.0	0.0	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	471	54						1004	1036	176	882	
Adjusted Saturation Flow Rate (s), veh/h/ln	1741	1556						1833	1791	1620	1676	
Queue Service Time (g_s), s	29.4	3.6						115.2	61.5	5.7	11.9	
Cycle Queue Clearance Time (g_c), s	29.4	3.6						115.2	61.5	5.7	11.9	
Green Ratio (g/C)	0.23	0.23						0.60	0.60	0.66	0.69	
Capacity (c), veh/h	394	352						1101	1076	126	2298	
Volume-to-Capacity Ratio (X)	1.195	0.154						0.912	0.963	1.396	0.384	
Available Capacity (c_a), veh/h	394	352						1101	1076	126	2298	
Back of Queue (Q), veh/ln (95th percentile)	36.0	2.5						10.4	7.3	18.1	6.3	
Queue Storage Ratio (RQ) (95th percentile)	7.37	0.06						0.08	0.06	3.70	0.23	
Uniform Delay (d_1), s/veh	50.3	40.3						9.6	8.1	42.7	6.5	
Incremental Delay (d_2), s/veh	110.1	0.2						1.5	3.3	211.2	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	160.4	40.5						11.1	11.3	253.9	6.9	
Level of Service (LOS)	F	D						B	B	F	A	
Approach Delay, s/veh / LOS	148.0	F		0.0			11.2	B		48.0	D	
Intersection Delay, s/veh / LOS	41.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.9	A	1.8	A
Bicycle LOS Score / LOS	1.4	A			2.4	B	1.4	A

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & I-229 NB	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Minnesota_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	260	0	160					1100	180	330	1450	

Signal Information										
Cycle, s	145.0	Reference Phase	6							
Offset, s	104	Reference Point	Begin	Green	26.8	74.1	27.4	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.3	4.3	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.6	1.6	0.0	0.0	0.0

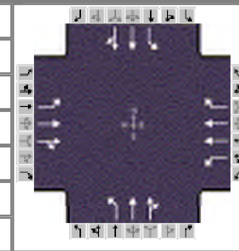
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				8.3	1.0	4.0
Phase Duration, s		33.0				80.0	32.1	112.0
Change Period, (Y+R_c), s		5.6				5.9	5.3	5.9
Max Allow Headway (MAH), s		6.1				0.0	4.1	0.0
Queue Clearance Time (g_s), s		25.6					25.9	
Green Extension Time (g_e), s		1.8				0.0	1.3	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.27					0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	280	44						689	667	355	1559	
Adjusted Saturation Flow Rate (s), veh/h/ln	1674	1495						1861	1779	1709	1800	
Queue Service Time (g_s), s	23.6	3.6						67.2	51.4	23.9	29.7	
Cycle Queue Clearance Time (g_c), s	23.6	3.6						67.2	51.4	23.9	29.7	
Green Ratio (g/C)	0.19	0.19						0.51	0.51	0.71	0.73	
Capacity (c), veh/h	316	282						956	914	382	2635	
Volume-to-Capacity Ratio (X)	0.885	0.156						0.721	0.729	0.928	0.592	
Available Capacity (c_a), veh/h	420	375						956	914	764	2635	
Back of Queue (Q), veh/ln (95th percentile)	17.2	2.5						31.0	30.6	17.6	13.1	
Queue Storage Ratio (RQ) (95th percentile)	3.52	0.06						0.24	0.24	3.60	0.48	
Uniform Delay (d_1), s/veh	57.3	49.2						48.4	50.2	57.8	9.2	
Incremental Delay (d_2), s/veh	20.2	0.5						2.1	2.3	3.2	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	77.5	49.7						50.5	52.5	61.0	9.5	
Level of Service (LOS)	E	D						D	D	E	A	
Approach Delay, s/veh / LOS	73.7		E	0.0			51.5		D	19.0		B
Intersection Delay, s/veh / LOS	36.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	1.9	A	1.8	A
Bicycle LOS Score / LOS	1.0	A			1.6	A	2.1	B

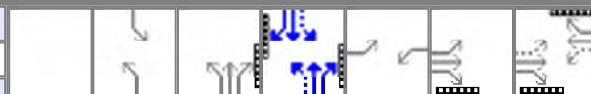
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Minnesota Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Minnesota_AM_BestCase.xus				
Project Description	2035 NB AM				

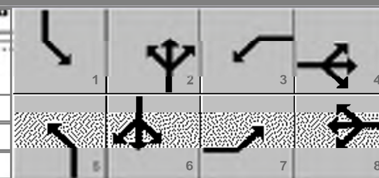


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	330	430	250	120	740	320	300	1150	100	150	540	160

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	13.7	5.4	45.2	10.9	4.1	44.0
Yellow	4.0	4.0	3.9	4.0	0.0	4.3
Red	1.0	1.0	1.9	1.0	0.0	1.6



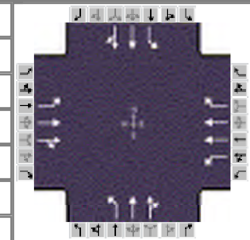
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	20.0	54.0	15.9	49.9	29.1	61.4	18.7	51.0
Change Period, ($Y+R_c$), s	5.0	5.9	5.0	5.9	5.0	5.8	5.0	5.8
Max Allow Headway (*MAH*), s	4.1	5.6	3.1	5.6	3.6	0.0	3.6	0.0
Queue Clearance Time (g_s), s	17.0	29.4	10.7	39.1	23.2		13.5	
Green Extension Time (g_e), s	0.0	13.1	0.2	4.9	1.0	0.0	0.3	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	0.63	0.00	0.99	0.00		0.01	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	388	371	337	141	871	226	353	743	727	176	407	381
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1593	1681	1680	1496	1664	1748	1698	1664	1748	1630
Queue Service Time (g_s), s	15.0	27.1	27.4	8.7	37.1	18.9	21.2	55.6	55.6	11.5	27.8	27.3
Cycle Queue Clearance Time (g_c), s	15.0	27.1	27.4	8.7	37.1	18.9	21.2	55.6	55.6	11.5	27.8	27.3
Green Ratio (*g/C*)	0.40	0.32	0.32	0.37	0.29	0.29	0.48	0.37	0.37	0.39	0.30	0.30
Capacity (*c*), veh/h	239	565	510	261	985	439	396	648	629	200	526	491
Volume-to-Capacity Ratio (*X*)	1.624	0.657	0.661	0.542	0.884	0.515	0.892	1.147	1.156	0.881	0.774	0.776
Available Capacity (c_a), veh/h	239	577	521	575	1010	450	784	648	629	294	526	491
Back of Queue (*Q*), veh/ln (95th percentile)	40.1	18.0	16.7	6.5	23.5	11.6	13.8	53.6	53.3	9.4	15.6	14.0
Queue Storage Ratio (*RQ*) (95th percentile)	8.15	0.46	0.42	1.11	0.60	1.96	3.52	1.37	1.36	1.60	0.12	0.11
Uniform Delay (d_1), s/veh	38.2	43.9	44.0	35.6	50.6	44.1	31.6	47.2	47.2	44.7	31.1	29.1
Incremental Delay (d_2), s/veh	299.1	3.3	3.7	0.7	9.7	1.6	5.4	83.5	87.3	14.1	8.8	9.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	337.3	47.2	47.7	36.3	60.2	45.7	37.0	130.7	134.5	58.8	39.9	38.6
Level of Service (LOS)	F	D	D	D	E	D	D	F	F	E	D	D
Approach Delay, s/veh / LOS	150.1	F		54.9	D		114.1	F		42.8	D	
Intersection Delay, s/veh / LOS	94.1						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	3.1	C	3.0	C
Bicycle LOS Score / LOS	1.4	A	1.5	A	2.0	A	1.3	A

HCS 2010 Signalized Intersection Results Summary

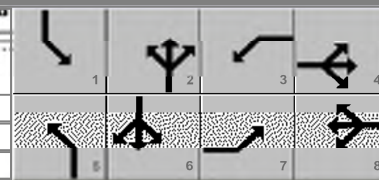
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & 57th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Minnesota_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	300	880	300	180	570	230	250	700	200	340	840	230

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	9.0	1.0	51.2	7.0	11.5	33.6
Yellow	4.0	4.0	3.9	4.0	4.0	4.3
Red	1.0	1.0	1.9	1.0	1.0	1.6



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	28.5	56.0	12.0	39.5	14.0	57.0	20.0	63.0
Change Period, ($Y+R_c$), s	5.0	5.9	5.0	5.9	5.0	5.8	5.0	5.8
Max Allow Headway (*MAH*), s	4.1	5.6	3.1	5.6	3.6	0.0	3.6	0.0
Queue Clearance Time (g_s), s	22.4	52.1	9.0	26.9	11.0		17.0	
Green Extension Time (g_e), s	1.1	0.0	0.0	5.7	0.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	0.00	1.00	1.00	0.97	1.00		1.00	

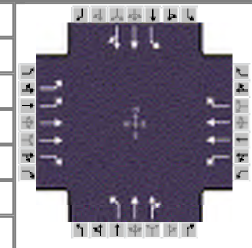
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	323	642	594	194	613	125	269	501	463	356	570	531
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1622	1681	1680	1496	1664	1748	1615	1664	1748	1626
Queue Service Time (g_s), s	20.4	50.1	50.1	7.0	24.9	10.1	9.0	37.7	37.7	15.0	39.5	39.2
Cycle Queue Clearance Time (g_c), s	20.4	50.1	50.1	7.0	24.9	10.1	9.0	37.7	37.7	15.0	39.5	39.2
Green Ratio (*g/C*)	0.41	0.35	0.35	0.28	0.23	0.23	0.42	0.35	0.35	0.47	0.39	0.39
Capacity (*c*), veh/h	365	610	560	131	777	346	214	617	570	276	689	641
Volume-to-Capacity Ratio (*X*)	0.884	1.054	1.060	1.480	0.789	0.361	1.259	0.811	0.811	1.291	0.826	0.827
Available Capacity (c_a), veh/h	625	610	560	131	777	346	214	617	570	276	689	641
Back of Queue (*Q*), veh/ln (95th percentile)	13.9	40.6	38.5	17.8	16.5	7.0	19.7	24.8	23.3	27.3	22.3	20.7
Queue Storage Ratio (*RQ*) (95th percentile)	2.82	1.03	0.98	3.01	0.42	1.19	5.05	0.63	0.60	4.67	0.18	0.16
Uniform Delay (d_1), s/veh	35.3	47.5	47.5	49.5	52.4	46.7	43.1	42.5	42.5	38.8	29.9	29.0
Incremental Delay (d_2), s/veh	7.9	51.4	54.9	252.3	6.0	1.1	148.5	11.1	11.9	151.2	9.0	9.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	43.2	98.9	102.4	301.8	58.4	47.8	191.6	53.6	54.4	190.0	38.9	38.6
Level of Service (LOS)	D	F	F	F	E	D	F	D	D	F	D	D
Approach Delay, s/veh / LOS	88.7		F	107.6		F	84.0		F	75.7		E
Intersection Delay, s/veh / LOS	87.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	3.1	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	1.3	A	1.5	A	1.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:33:53 AM

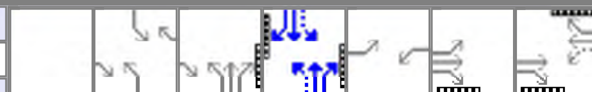
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Minnesota Ave & 57th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Minnesota_AM_WorstCase.xus				
Project Description	2035 NB AM				

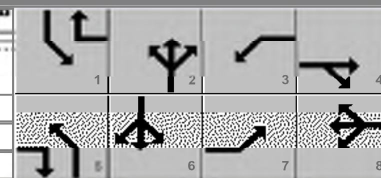


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	330	430	250	120	740	320	300	1150	100	150	540	160

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.4	5.9	31.2	5.0	7.0	36.8
Yellow	4.0	4.0	3.9	4.0	4.0	4.3
Red	1.0	1.0	1.9	1.0	1.0	1.6



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	22.0	54.7	10.0	42.7	28.3	47.9	17.4	37.0
Change Period, ($Y+R_c$), s	5.0	5.9	5.0	5.9	5.0	5.8	5.0	5.8
Max Allow Headway (*MAH*), s	4.1	5.6	3.1	5.6	3.6	0.0	3.6	0.0
Queue Clearance Time (g_s), s	17.3	16.4	7.0	34.6	24.5		12.3	
Green Extension Time (g_e), s	0.0	18.3	0.0	2.2	0.0	0.0	0.1	0.0
Phase Call Probability	1.00	1.00	0.99	1.00	1.00		1.00	
Max Out Probability	1.00	0.40	1.00	1.00	1.00		0.65	

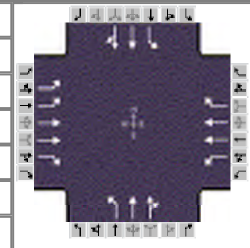
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	388	506	202	141	871	226	353	743	727	176	407	381
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1632	1680	1496	1681	1680	1496	1664	1748	1698	1664	1748	1630
Queue Service Time (g_s), s	15.3	14.4	9.1	5.0	32.6	14.4	22.5	42.2	42.2	10.3	30.0	30.1
Cycle Queue Clearance Time (g_c), s	15.3	14.4	9.1	5.0	32.6	14.4	22.5	42.2	42.2	10.3	30.0	30.1
Green Ratio (*g/C*)	0.13	0.38	0.55	0.32	0.28	0.38	0.43	0.32	0.32	0.34	0.24	0.24
Capacity (*c*), veh/h	427	1261	829	304	951	565	361	567	551	214	420	392
Volume-to-Capacity Ratio (*X*)	0.910	0.401	0.244	0.465	0.916	0.400	0.979	1.311	1.321	0.826	0.970	0.972
Available Capacity (c_a), veh/h	427	1269	833	304	959	569	361	567	551	264	420	392
Back of Queue (*Q*), veh/ln (95th percentile)	12.1	9.7	5.5	2.4	21.6	9.0	19.0	61.2	60.8	8.3	23.5	22.3
Queue Storage Ratio (*RQ*) (95th percentile)	2.45	0.25	1.39	0.41	0.55	1.53	4.86	1.57	1.56	1.42	0.19	0.18
Uniform Delay (d_1), s/veh	55.7	29.9	14.9	34.8	45.1	29.6	38.0	43.9	43.9	35.3	49.0	48.6
Incremental Delay (d_2), s/veh	23.2	0.4	0.3	0.4	13.4	0.8	41.4	152.4	156.9	14.0	35.6	37.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	78.9	30.2	15.2	35.2	58.6	30.4	79.4	196.3	200.8	49.4	84.6	86.2
Level of Service (LOS)	E	C	B	D	E	C	E	F	F	D	F	F
Approach Delay, s/veh / LOS	44.7		D	50.8		D	175.5		F	78.8		E
Intersection Delay, s/veh / LOS	99.1						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	3.1	C	3.2	C
Bicycle LOS Score / LOS	1.4	A	1.5	A	2.0	A	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:33:02 AM

HCS 2010 Signalized Intersection Results Summary

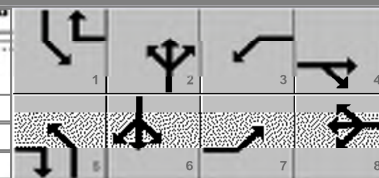
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Minnesota Ave & 57th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Minnesota_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	300	880	300	180	570	230	250	700	200	340	840	230

Signal Information				
Cycle, s	145.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	20.6	1.5	44.2	14.0	3.4	39.6
Yellow	4.0	0.0	3.9	4.0	0.0	4.3
Red	1.0	0.0	1.9	1.0	0.0	1.6



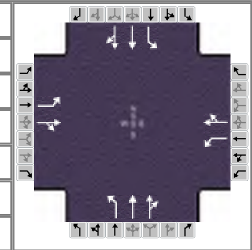
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	2.0	3.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	22.3	48.9	19.0	45.5	25.6	50.0	27.1	51.6
Change Period, (Y+R_c), s	5.0	5.9	5.0	5.9	5.0	5.8	5.0	5.8
Max Allow Headway (MAH), s	4.1	5.6	3.1	5.6	3.6	0.0	3.6	0.0
Queue Clearance Time (g_s), s	16.0	42.0	13.9	25.5	20.7		24.0	
Green Extension Time (g_e), s	1.3	1.0	0.0	11.0	0.2	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	0.00	1.00	1.00	0.79	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	323	946	290	194	613	125	269	501	463	366	585	545
Adjusted Saturation Flow Rate (s), veh/h/ln	1632	1680	1496	1681	1680	1496	1664	1748	1615	1664	1748	1626
Queue Service Time (g_s), s	14.0	40.0	19.7	11.9	23.5	7.6	18.7	40.4	40.4	22.0	46.1	46.1
Cycle Queue Clearance Time (g_c), s	14.0	40.0	19.7	11.9	23.5	7.6	18.7	40.4	40.4	22.0	46.1	46.1
Green Ratio (g/C)	0.12	0.30	0.44	0.37	0.27	0.43	0.45	0.31	0.31	0.46	0.32	0.32
Capacity (c), veh/h	391	996	652	214	918	636	284	534	494	321	555	517
Volume-to-Capacity Ratio (X)	0.826	0.950	0.445	0.903	0.668	0.196	0.946	0.938	0.938	1.140	1.053	1.055
Available Capacity (c_a), veh/h	1035	999	654	215	920	637	318	534	494	322	555	517
Back of Queue (Q), veh/ln (95th percentile)	10.0	26.1	11.5	11.3	15.3	5.0	18.1	28.7	27.1	29.1	33.0	31.0
Queue Storage Ratio (RQ) (95th percentile)	2.03	0.66	2.92	1.92	0.39	0.84	4.63	0.74	0.69	4.97	0.26	0.24
Uniform Delay (d_1), s/veh	62.3	50.0	28.6	38.2	46.9	26.1	44.4	49.0	49.0	51.9	38.1	37.2
Incremental Delay (d_2), s/veh	4.5	17.9	0.8	35.3	2.3	0.3	34.1	26.2	27.6	88.6	48.8	50.6
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	66.8	67.9	29.4	73.5	49.1	26.4	78.6	75.2	76.6	140.5	86.9	87.8
Level of Service (LOS)	E	E	C	E	D	C	E	E	E	F	F	F
Approach Delay, s/veh / LOS	60.5	E		51.1	D		76.5	E		100.3	F	
Intersection Delay, s/veh / LOS	74.0						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.8	A	1.3	A	1.5	A	1.7	A

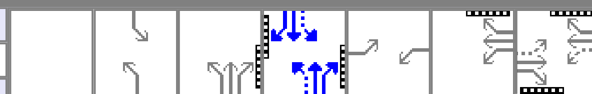
HCS 2010 Signalized Intersection Results Summary

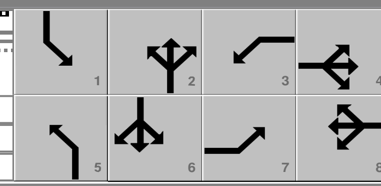
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	60	100	95	200	30	150	860	20	15	450	80

Signal Information										
Cycle, s	95.0	Reference Phase	2							
Offset, s	68	Reference Point	Begin	Green	1.5	0.7	45.1	5.1	2.0	16.2
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	1.9	1.0	0.0	1.5





Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.7	21.3	11.7	23.3	11.4	55.9	6.1	50.6
Change Period, (*Y+R$_c$*), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	5.8	12.6	7.2	16.5	6.3		2.5	
Green Extension Time (g_e), s	0.0	1.8	0.3	1.7	0.6	0.0	0.0	0.0
Phase Call Probability	0.89	1.00	0.95	1.00	0.99		0.37	
Max Out Probability	1.00	0.00	0.00	0.00	0.00		0.00	

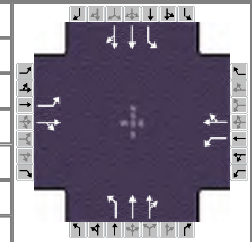
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	82	188		112	271		159	469	465	18	319	304
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1586		1664	1707		1664	1748	1733	1664	1748	1655
Queue Service Time (g_s), s	3.8	10.6		5.2	14.5		4.3	10.4	10.3	0.5	8.4	8.5
Cycle Queue Clearance Time (g_c), s	3.8	10.6		5.2	14.5		4.3	10.4	10.3	0.5	8.4	8.5
Green Ratio (*g/C*)	0.22	0.17		0.25	0.19		0.57	0.53	0.53	0.49	0.47	0.47
Capacity (*c*), veh/h	189	271		270	327		496	926	919	335	828	785
Volume-to-Capacity Ratio (*X*)	0.437	0.695		0.414	0.827		0.322	0.507	0.507	0.053	0.385	0.388
Available Capacity (c_a), veh/h	193	687		713	776		1205	926	919	840	828	785
Back of Queue (*Q*), veh/ln (95th percentile)	2.9	7.7		3.8	10.6		2.9	5.4	5.3	0.3	5.6	5.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.37	0.20		0.78	0.27		0.74	0.07	0.07	0.09	0.14	0.14
Uniform Delay (d_1), s/veh	31.2	37.1		29.6	36.9		11.2	7.0	6.9	12.7	10.7	10.8
Incremental Delay (d_2), s/veh	1.6	3.2		1.0	5.3		0.2	1.2	1.2	0.1	1.4	1.4
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	32.8	40.3		30.6	42.2		11.4	8.2	8.1	12.8	12.1	12.2
Level of Service (LOS)	C	D		C	D		B	A	A	B	B	B
Approach Delay, s/veh / LOS	38.0	D		38.8	D		8.6	A		12.2	B	
Intersection Delay, s/veh / LOS	17.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A	1.5	A	1.0	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:17:36 PM

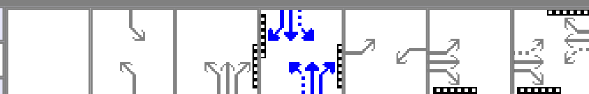
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_BestCase.xus				
Project Description	2035 NB PM				

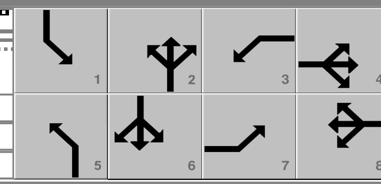


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	110	120	130	70	100	10	120	470	80	20	950	120

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	93	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.7	3.9	46.4	4.8	1.6	16.8
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	11.0	23.5	9.4	21.9	10.2	55.8	6.3	51.9
Change Period, ($Y+R_c$), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (MAH), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	7.4	17.3	5.5	7.8	5.5		2.6	
Green Extension Time (g_e), s	0.0	1.1	0.1	1.4	0.3	0.0	0.0	0.0
Phase Call Probability	0.96	1.00	0.86	1.00	0.97		0.43	
Max Out Probability	1.00	0.07	0.02	0.00	0.00		0.00	

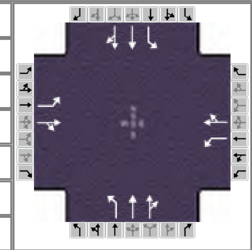
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	118	269		75	118		129	302	289	22	586	564
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1614		1664	1719		1664	1748	1659	1664	1748	1678
Queue Service Time (g_s), s	5.4	15.3		3.5	5.8		3.5	11.1	11.1	0.6	20.2	20.2
Cycle Queue Clearance Time (g_c), s	5.4	15.3		3.5	5.8		3.5	11.1	11.1	0.6	20.2	20.2
Green Ratio (g/C)	0.24	0.19		0.23	0.18		0.56	0.53	0.53	0.51	0.49	0.49
Capacity (c), veh/h	337	312		173	304		306	925	878	424	853	819
Volume-to-Capacity Ratio (X)	0.351	0.861		0.436	0.389		0.422	0.327	0.330	0.051	0.688	0.689
Available Capacity (c_a), veh/h	337	467		323	469		531	925	878	647	853	819
Back of Queue (Q), veh/ln (95th percentile)	4.0	11.1		2.6	4.4		2.3	8.1	7.7	0.4	11.0	10.7
Queue Storage Ratio (RQ) (95th percentile)	0.51	0.28		0.54	0.11		0.58	0.10	0.10	0.10	0.28	0.28
Uniform Delay (d_1), s/veh	29.4	37.1		31.1	34.6		13.1	16.2	16.1	12.1	12.0	12.0
Incremental Delay (d_2), s/veh	0.6	10.3		1.7	0.8		0.8	0.8	0.9	0.0	4.5	4.7
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	30.0	47.3		32.8	35.4		13.9	17.0	16.9	12.2	16.5	16.7
Level of Service (LOS)	C	D		C	D		B	B	B	B	B	B
Approach Delay, s/veh / LOS	42.0	D		34.4	C		16.4	B		16.5	B	
Intersection Delay, s/veh / LOS	21.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	1.1	A	1.5	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:22:08 PM

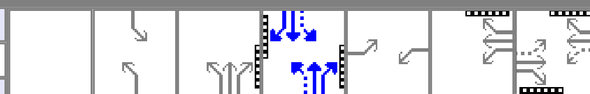
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_WorstCase.xus				
Project Description	2035 NB AM				

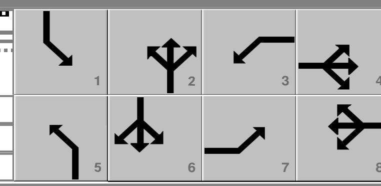


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	60	100	95	200	30	150	860	20	15	450	80

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	68	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.5	1.0	44.7	5.1	2.0	16.2
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	1.0	1.0	1.9	1.0	0.0	1.5



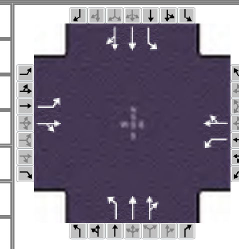
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	9.7	21.3	11.7	23.3	11.7	55.9	6.1	50.2
Change Period, ($Y+R_c$), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	5.8	12.6	7.2	16.5	6.6		2.5	
Green Extension Time (g_e), s	0.0	1.8	0.3	1.7	0.6	0.0	0.0	0.0
Phase Call Probability	0.89	1.00	0.95	1.00	0.99		0.37	
Max Out Probability	1.00	0.00	0.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	82	188		112	271		169	498	494	18	319	304
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1586		1664	1707		1664	1748	1733	1664	1748	1655
Queue Service Time (g_s), s	3.8	10.6		5.2	14.5		4.6	11.3	11.1	0.5	8.5	8.6
Cycle Queue Clearance Time (g_c), s	3.8	10.6		5.2	14.5		4.6	11.3	11.1	0.5	8.5	8.6
Green Ratio (g/C)	0.22	0.17		0.25	0.19		0.57	0.53	0.53	0.49	0.47	0.47
Capacity (*c*), veh/h	189	271		270	327		498	926	919	318	822	779
Volume-to-Capacity Ratio (*X*)	0.437	0.695		0.414	0.827		0.340	0.538	0.538	0.056	0.388	0.391
Available Capacity (c_a), veh/h	193	687		713	776		1202	926	919	823	822	779
Back of Queue (*Q*), veh/ln (95th percentile)	2.9	7.7		3.8	10.6		3.1	5.4	5.3	0.4	5.7	5.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.37	0.20		0.78	0.27		0.80	0.07	0.07	0.09	0.15	0.14
Uniform Delay (d_1), s/veh	31.2	37.1		29.6	36.9		11.4	6.9	6.8	13.0	11.0	11.0
Incremental Delay (d_2), s/veh	1.6	3.2		1.0	5.3		0.2	1.2	1.2	0.1	1.4	1.5
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	32.8	40.3		30.6	42.2		11.6	8.1	8.0	13.0	12.3	12.5
Level of Service (LOS)	C	D		C	D		B	A	A	B	B	B
Approach Delay, s/veh / LOS	38.0	D		38.8	D		8.6	A		12.4	B	
Intersection Delay, s/veh / LOS	17.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A	1.5	A	1.0	A

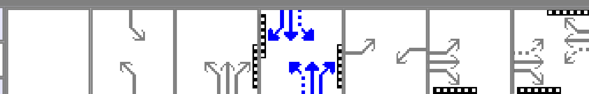
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 33rd St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_WorstCase.xus				
Project Description	2035 NB PM				

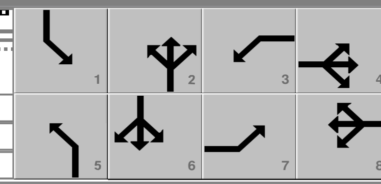


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	120	130	70	100	10	120	470	80	20	950	120

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	16	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	1.8	3.9	50.3	5.0	2.4	16.7
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	1.0	0.0	1.9	1.0	0.0	1.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	12.1	24.3	9.6	21.8	10.3	59.7	6.4	55.8
Change Period, ($Y+R_c$), s	4.6	5.1	4.6	5.1	4.6	5.5	4.6	5.5
Max Allow Headway (*MAH*), s	4.2	4.2	4.2	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	7.7	18.2	5.7	8.2	5.6		2.6	
Green Extension Time (g_e), s	0.0	1.0	0.0	1.3	0.3	0.0	0.0	0.0
Phase Call Probability	0.96	1.00	0.88	1.00	0.97		0.45	
Max Out Probability	1.00	0.11	1.00	0.00	0.00		0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	118	269		75	118		129	302	289	22	586	564
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1614		1664	1719		1664	1748	1659	1664	1748	1678
Queue Service Time (g_s), s	5.7	16.2		3.7	6.2		3.6	8.7	8.2	0.6	20.0	20.1
Cycle Queue Clearance Time (g_c), s	5.7	16.2		3.7	6.2		3.6	8.7	8.2	0.6	20.0	20.1
Green Ratio (g/C)	0.24	0.19		0.22	0.17		0.57	0.54	0.54	0.52	0.50	0.50
Capacity (*c*), veh/h	332	309		167	288		312	947	899	454	878	844
Volume-to-Capacity Ratio (*X*)	0.356	0.869		0.450	0.411		0.414	0.319	0.322	0.047	0.668	0.669
Available Capacity (c_a), veh/h	348	440		223	427		491	947	899	698	878	844
Back of Queue (*Q*), veh/ln (95th percentile)	4.3	11.8		2.8	4.8		2.3	6.1	5.3	0.4	10.8	10.6
Queue Storage Ratio (*RQ*) (95th percentile)	0.54	0.30		0.58	0.12		0.59	0.08	0.07	0.11	0.28	0.27
Uniform Delay (d_1), s/veh	31.1	39.2		33.4	37.2		12.7	11.2	10.1	11.8	11.5	11.5
Incremental Delay (d_2), s/veh	0.6	12.4		1.9	0.9		0.8	0.8	0.9	0.0	4.0	4.2
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	31.8	51.6		35.3	38.2		13.5	12.0	10.9	11.9	15.5	15.7
Level of Service (LOS)	C	D		D	D		B	B	B	B	B	B
Approach Delay, s/veh / LOS	45.6		D	37.0		D	11.8		B	15.5		B
Intersection Delay, s/veh / LOS	20.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	0.8	A	1.1	A	1.5	A

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 5/10/2016
Analysis Time Period: AM Peak
Intersection: Cliff Ave & Lincoln High S Dwy
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year:
Project ID: I-229 MIS
East/West Street: Lincoln High S Dwy
North/South Street: Cliff Ave
Intersection Orientation: NS   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1390	300	50	775	
Peak-Hour Factor, PHF		0.85	0.85	0.85	0.85	
Hourly Flow Rate, HFR		1635	352	58	911	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	TWLTL			/ 0		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	25		60			
Peak Hour Factor, PHF	0.85		0.85			
Hourly Flow Rate, HFR	29		70			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	1		1			
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		58	29		70			
C(m) (vph)		282	23		296			
v/c		0.21	1.26		0.24			
95% queue length		0.76	3.69		0.90			
Control Delay		21.0	524.0		20.9			
LOS		C	F		C			
Approach Delay				168.3				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 5/10/2016
Analysis Time Period: AM Peak
Intersection: Cliff Ave & Lincoln High S Dwy
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year:
Project ID: I-229 MIS
East/West Street: Lincoln High S Dwy
North/South Street: Cliff Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1390	300	50	775	
Peak-Hour Factor, PHF		0.85	0.85	0.85	0.85	
Peak-15 Minute Volume		409	88	15	228	
Hourly Flow Rate, HFR		1635	352	58	911	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	TWLTL			/ 0		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	25		60			
Peak Hour Factor, PHF	0.85		0.85			
Peak-15 Minute Volume	7		18			
Hourly Flow Rate, HFR	29		70			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.5		6.2			
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3	2		2			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.8		6.2			
2-stage		4.2	5.8		6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		3	2		2			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		1987	2382		994			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	1811	571						
s		3000						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	994	
Potential Capacity	296	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	296	
Probability of Queue free St.	0.76	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	1987	
Potential Capacity	282	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	282	
Probability of Queue free St.	0.79	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	0.79
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2382	
Potential Capacity	29	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.79
Maj. L, Min T Adj. Imp Factor.		0.84
Cap. Adj. factor due to Impeding mvmnt	0.79	0.64
Movement Capacity	23	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	129	310
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.79
Movement Capacity	129	246
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	310	105
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	1.00
Movement Capacity	246	105

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	0.79
Movement Capacity		

Result for 2 stage process:		
a	1.00	1.00
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows	1811	
Potential Capacity	116	306
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.79
Movement Capacity	116	243

Part 2 - Second Stage		
Conflicting Flows	571	
Potential Capacity	529	395
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	0.76
Movement Capacity	420	302

Part 3 - Single Stage		
Conflicting Flows	2382	
Potential Capacity	29	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.79
Maj. L, Min T Adj. Imp Factor.		0.84
Cap. Adj. factor due to Impeding mvmnt	0.79	0.64
Movement Capacity	23	

Results for Two-stage process:		
a	1.00	1.00
y	0.23	
C t	23	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	29		70			
Movement Capacity (vph)	23		296			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	23		296			
Volume	29		70			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		58	29		70			
C(m) (vph)		282	23		296			
v/c		0.21	1.26		0.24			
95% queue length		0.76	3.69		0.90			
Control Delay		21.0	524.0		20.9			
LOS		C	F		C			
Approach Delay				168.3				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.79
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		21.0
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 5/10/2016
Analysis Time Period: PM Peak
Intersection: Cliff Ave & Lincoln High S Dwy
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: Lincoln High S Dwy
North/South Street: Cliff Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		905	15	5	1630	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Hourly Flow Rate, HFR		973	16	5	1752	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	TWLTL			/ 0		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	20		10			
Peak Hour Factor, PHF	0.93		0.93			
Hourly Flow Rate, HFR	21		10			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes	1		1			
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		5	21		10			
C(m) (vph)		689	64		573			
v/c		0.01	0.33		0.02			
95% queue length		0.02	1.20		0.05			
Control Delay		10.3	86.6		11.4			
LOS		B	F		B			
Approach Delay				62.3				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 5/10/2016
Analysis Time Period: PM Peak
Intersection: Cliff Ave & Lincoln High S Dwy
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: Lincoln High S Dwy
North/South Street: Cliff Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		905	15	5	1630	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Peak-15 Minute Volume		243	4	1	438	
Hourly Flow Rate, HFR		973	16	5	1752	
Percent Heavy Vehicles		--	--	3	--	--
Median Type/Storage	TWLTL			/ 0		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	20		10			
Peak Hour Factor, PHF	0.93		0.93			
Peak-15 Minute Volume	5		3			
Hourly Flow Rate, HFR	21		10			
Percent Heavy Vehicles	2		2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?			No			
Lanes	1	1				
Configuration	L	R				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1	7.5		6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			3	2		2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00	0.70		0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2	6.8		6.2			
	2-stage		4.2	5.8		6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		3	2		2			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog				

```
Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)
_______________________________________________________________________________
Computation 2-Proportion of TWSC Intersection Time  blocked
                                            Movement 2        Movement 5
                                         V(t)   V(l,prot)  V(t)   V(l,prot)
_______________________________________________________________________________
alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c,max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
Proportion time blocked, p                     0.000             0.000
_______________________________________________________________________________
Computation 3-Platoon Event Periods     Result
_______________________________________________________________________________
p(2)                                     0.000
p(5)                                     0.000
p(dom)
p(subo)
Constrained or unconstrained?
_______________________________________________________________________________
Proportion
unblocked                  (1)             (2)             (3)
for minor              Single-stage        Two-Stage Process
movements, p(x)          Process       Stage I         Stage II
_______________________________________________________________________________
p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)
_______________________________________________________________________________
Computation 4 and 5
Single-Stage Process
Movement                   1      4      7      8      9     10      11     12
                           L      L      L      T      R      L      T      R
_______________________________________________________________________________
V c,x                             989    1867          494
s
Px
V c,u,x
_______________________________________________________________________________
C r,x
C plat,x
_______________________________________________________________________________
Two-Stage Process
                     7               8               10              11
```

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	981	886						
s		3000						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	494	
Potential Capacity	573	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	573	
Probability of Queue free St.	0.98	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	989	
Potential Capacity	689	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	689	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	1867	
Potential Capacity	64	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.99
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.98
Movement Capacity	64	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	326	136
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity	326	135
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	136	323
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	135	323
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Result for 2 stage process:		
a	1.00	1.00
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows	981	
Potential Capacity	324	123
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity	324	122
Part 2 - Second Stage		
Conflicting Flows	886	
Potential Capacity	363	584
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.98
Movement Capacity	360	574
Part 3 - Single Stage		
Conflicting Flows	1867	
Potential Capacity	64	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.99
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.98
Movement Capacity	64	
Results for Two-stage process:		
a	1.00	1.00
y	0.88	
C t	64	

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	21		10			
Movement Capacity (vph)	64		573			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	64		573			
Volume	21		10			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

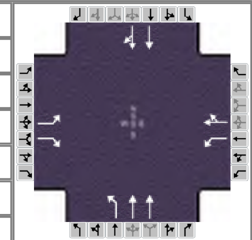
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		5	21		10			
C(m) (vph)		689	64		573			
v/c		0.01	0.33		0.02			
95% queue length		0.02	1.20		0.05			
Control Delay		10.3	86.6		11.4			
LOS		B	F		B			
Approach Delay				62.3				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		10.3
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

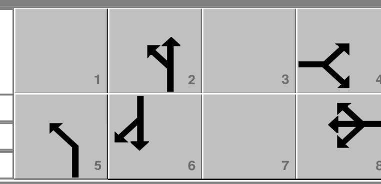
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	160		260	200	130	100	260	1430			700	100

Signal Information										
Cycle, s	95.0	Reference Phase	2							
Offset, s	4	Reference Point	Begin	Green	8.6	41.9	28.7	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		33.8		33.8	13.2	61.2		48.0
Change Period, (Y+R_c), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (MAH), s		4.3		4.3	4.2	0.0		0.0
Queue Clearance Time (g_s), s		27.8		13.3	10.7			
Green Extension Time (g_e), s		0.9		2.3	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		0.02	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h	188		0	235	216		271	1491			474	455
Adjusted Saturation Flow Rate (s), veh/h/ln	1119		1448	1618	1616		1629	1707			1732	1660
Queue Service Time (g_s), s	15.5		0.0	11.3	10.2		8.7	27.4			19.7	21.0
Cycle Queue Clearance Time (g_c), s	25.8		0.0	11.3	10.2		8.7	27.4			19.7	21.0
Green Ratio (g/C)	0.30		0.30	0.30	0.30		0.55	0.58			0.44	0.44
Capacity (c), veh/h	293		438	565	489		352	1979			762	730
Volume-to-Capacity Ratio (X)	0.643		0.000	0.417	0.442		0.770	0.754			0.622	0.624
Available Capacity (c_a), veh/h	318		471	601	526		352	1979			762	730
Back of Queue (Q), veh/ln (95th percentile)	7.9		0.0	7.6	6.9		3.8	9.6			13.6	13.5
Queue Storage Ratio (RQ) (95th percentile)	1.01		0.00	1.56	0.18		0.96	0.31			0.17	0.17
Uniform Delay (d_1), s/veh	37.1		0.0	27.1	26.7		16.3	10.9			21.8	22.6
Incremental Delay (d_2), s/veh	3.9		0.0	0.5	0.6		1.4	0.4			3.4	3.6
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (d), s/veh	41.0		0.0	27.6	27.3		17.7	11.3			25.2	26.2
Level of Service (LOS)	D			C	C		B	B			C	C
Approach Delay, s/veh / LOS	41.0		D	27.4		C	12.3		B	25.7		C
Intersection Delay, s/veh / LOS	19.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	2.6	B
Bicycle LOS Score / LOS		F	1.2	A	2.1	B	1.3	A

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HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/09/2014
Analysis Time Period: AM Peak
Intersection: Cliff Ave & I-229 SB On-Ramp
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: I-229 SB On-Ramp
North/South Street: Cliff Ave
Intersection Orientation: NS   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	350	1690			940	220
Peak-Hour Factor, PHF	0.85	0.85			0.85	0.85
Hourly Flow Rate, HFR	411	1988			1105	258
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				0		0
Peak Hour Factor, PHF				0.85		0.85
Hourly Flow Rate, HFR				0		0
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0		0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	411						0	
C(m) (vph)	519							
v/c	0.79							
95% queue length	7.38							
Control Delay	33.4							
LOS	D							
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/09/2014
Analysis Time Period: AM Peak
Intersection: Cliff Ave & I-229 SB On-Ramp
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: I-229 SB On-Ramp
North/South Street: Cliff Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	350	1690			940	220
Peak-Hour Factor, PHF	0.85	0.85			0.85	0.85
Peak-15 Minute Volume	103	497			276	65
Hourly Flow Rate, HFR	411	1988			1105	258
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				0		0
Peak Hour Factor, PHF				0.85		0.85
Peak-15 Minute Volume				0		0
Hourly Flow Rate, HFR				0		0
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	100	30	600
	Through	1640	1800	4	52	100	30	600
S5	Left-Turn	0	1800	3	0	100	30	200
	Through	700	1800	4	55	100	30	200

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		2					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.8		6.2
	2-stage	4.1					5.8		6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	2					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	1640	0	700	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	52	0	55	0
Cycle Length, C (sec)	100	100	100	100
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.693	0.000	0.733	0.000
g(q1)	14.0	0.0	5.2	0.0
g(q2)	21.6	0.0	1.8	0.0
g(q)	35.6	0.0	7.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	13.605		4.535	
Smoothing Factor, F	0.221		0.460	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3600	0	3552	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	48.8	0.0	7.1	0.0
Proportion time blocked, p	0.488		0.071	

Computation 3-Platoon Event Periods	Result
p(2)	0.488
p(5)	0.071
p(dom)	0.488
p(subo)	0.071
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.929		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.477	0.929	0.512
p(11)			
p(12)	0.929		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1363					3050		682
s	3000					3000		3000
Px	0.929					0.477		0.929
V c,u,x	1237					3105		504
C r,x	559					9		566
C plat,x	519					4		526

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					1234	1816		
s					3000	3000		
P(x)					0.929	0.512		
V(c,u,x)					1098	690		
C(r,x)					281	459		
C(plat,x)					261	235		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		682
Potential Capacity		526
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		526
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		1363
Potential Capacity		519
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		519
Probability of Queue free St.	1.00	0.21
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.21	0.21
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		3050
Potential Capacity		4
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.21	
Maj. L, Min T Adj. Imp Factor.	0.34	
Cap. Adj. factor due to Impeding mvmnt	0.34	0.21
Movement Capacity		1

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	26	270
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.21	1.00
Movement Capacity	5	270
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	232	26
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.21
Movement Capacity	232	5

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.21	0.21
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		1234
Potential Capacity	21	261
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.21	1.00
Movement Capacity	4	261

Part 2 - Second Stage		
Conflicting Flows		1816
Potential Capacity	631	235
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.21
Movement Capacity	631	49

Part 3 - Single Stage		
Conflicting Flows		3050
Potential Capacity		4
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.21	
Maj. L, Min T Adj. Imp Factor.	0.34	
Cap. Adj. factor due to Impeding mvmnt	0.34	0.21
Movement Capacity		1

Results for Two-stage process:		
a	0.91	0.91
y		5.42
C t		38

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				0		0
Movement Capacity (vph)				38		526
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				38		526
Volume				0		0
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

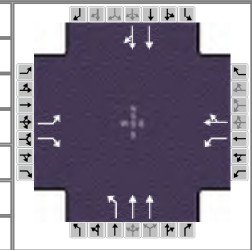
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	411						0	
C(m) (vph)	519							
v/c	0.79							
95% queue length	7.38							
Control Delay	33.4							
LOS	D							
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.21	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	33.4	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

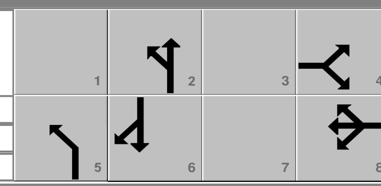
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	200		680	300	80	40	200	680			1470	180

Signal Information										
Cycle, s	95.0	Reference Phase	2							
Offset, s	14	Reference Point	Begin	Green	10.2	52.2	16.9	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.4	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		22.0		22.0	14.8	73.0		58.2
Change Period, ($Y+R_c$), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (MAH), s		4.2		4.2	4.2	0.0		0.0
Queue Clearance Time (g_s), s		18.9		18.9	9.5			
Green Extension Time (g_e), s		0.0		0.0	0.8	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		1.00	0.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (v), veh/h	215		0	323	117		215	731			888	877
Adjusted Saturation Flow Rate (s), veh/h/ln	1219		1441	1659	1665		1613	1626			1828	1760
Queue Service Time (g_s), s	11.0		0.0	16.9	5.9		7.5	7.8			94.8	38.1
Cycle Queue Clearance Time (g_c), s	16.9		0.0	16.9	5.9		7.5	7.8			94.8	38.1
Green Ratio (g/C)	0.18		0.18	0.18	0.18		0.68	0.64			0.55	0.55
Capacity (c), veh/h	217		256	371	296		250	2086			1001	965
Volume-to-Capacity Ratio (X)	0.992		0.000	0.870	0.396		0.861	0.351			0.886	0.909
Available Capacity (c_a), veh/h	217		256	371	296		1050	2086			1001	965
Back of Queue (Q), veh/ln (95th percentile)	13.4		0.0	14.4	4.3		7.7	4.2			17.3	15.9
Queue Storage Ratio (RQ) (95th percentile)	1.71		0.00	2.92	0.11		1.97	0.13			0.22	0.20
Uniform Delay (d_1), s/veh	43.9		0.0	39.8	34.5		24.1	4.9			12.3	11.1
Incremental Delay (d_2), s/veh	58.9		0.0	19.4	0.9		6.7	0.4			8.0	9.9
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (d), s/veh	102.8		0.0	59.1	35.4		30.7	5.2			20.3	21.0
Level of Service (LOS)	F			E	D		C	A			C	C

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	102.8	F	52.8	D	11.0	B	20.7	C
Intersection Delay, s/veh / LOS	27.4				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.6	A	3.2	C
Bicycle LOS Score / LOS		F	1.2	A	1.3	A	1.9	A

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                 HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:              GHM
Agency/Co.:           HDR
Date Performed:       10/09/2014
Analysis Time Period: PM Peak
Intersection:         Cliff Ave & I-229 SB On-Ramp
Jurisdiction:         Sioux Falls, SD
Units: U. S. Customary
Analysis Year:        2035
Project ID:  I-229 MIS
East/West Street:     I-229 SB On-Ramp
North/South Street:   Cliff Ave
Intersection Orientation: NS              Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments_________________________
Major Street:  Approach       Northbound              Southbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                      210    880                    1950   500
Peak-Hour Factor, PHF       0.93   0.93                   0.93   0.93
Hourly Flow Rate, HFR       225    946                    2096   537
Percent Heavy Vehicles      3      --     --              --     --
Median Type/Storage         TWLTL               / 1
RT Channelized?
Lanes                          1   2                      2    0
Configuration                   L  T                      T   TR
Upstream Signal?                   Yes                    Yes
______________________________________________________________________________
Minor Street:  Approach       Westbound               Eastbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                             0             0
Peak Hour Factor, PHF                              0.93          0.93
Hourly Flow Rate, HFR                              0             0
Percent Heavy Vehicles                             3             3
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage              /               No     /
Lanes                                                 0        0
Configuration                                             LR
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service___________________
Approach            NB     SB         Westbound             Eastbound
Movement            1      4   |  7      8      9    |  10     11     12
Lane Config         L          |                     |         LR
______________________________________________________________________________
v (vph)             225                                        0
C(m) (vph)          126
v/c                 1.79
95% queue length    17.26
Control Delay       443.2
LOS                  F
Approach Delay
Approach LOS
______________________________________________________________________________
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HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/09/2014
Analysis Time Period: PM Peak
Intersection: Cliff Ave & I-229 SB On-Ramp
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: I-229 SB On-Ramp
North/South Street: Cliff Ave
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	210	880			1950	500
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Peak-15 Minute Volume	56	237			524	134
Hourly Flow Rate, HFR	225	946			2096	537
Percent Heavy Vehicles	3	--	--		--	--
Median Type/Storage	TWLTL			/ 1		
RT Channelized?						
Lanes	1	2			2	0
Configuration	L	T			T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				0		0
Peak Hour Factor, PHF				0.93		0.93
Peak-15 Minute Volume				0		0
Hourly Flow Rate, HFR				0		0
Percent Heavy Vehicles				3		3
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	100	30	600
	Through	890	1800	4	54	100	30	600
S5	Left-Turn	0	1800	3	0	100	30	200
	Through	1470	1800	4	54	100	30	200

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		3					3		3
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.9		6.3
	2-stage	4.2					5.9		6.3

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	3					3		3
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	890	0	1470	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	54	0	54	0
Cycle Length, C (sec)	100	100	100	100
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.720	0.000	0.720	0.000
g(q1)	6.9	0.0	11.4	0.0
g(q2)	3.4	0.0	13.7	0.0
g(q)	10.3	0.0	25.1	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.350		0.350	
beta	0.741		0.741	
Travel time, t(a) (sec)	13.605		4.535	
Smoothing Factor, F	0.221		0.460	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3326	0	3600	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	11.0	0.0	29.8	0.0
Proportion time blocked, p	0.110		0.298	

Computation 3-Platoon Event Periods	Result
p(2)	0.110
p(5)	0.298
p(dom)	0.298
p(subo)	0.110
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.702		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.647	0.702	0.890
p(11)			
p(12)	0.702		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	2633					3287		1316
s	3000					3000		3000
Px	0.702					0.647		0.702
V c,u,x	2477					3444		601
C r,x	180					5		496
C plat,x	126					3		348

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					2364	923		
s					3000	3000		
P(x)					0.702	0.890		
V(c,u,x)					2094	668		
C(r,x)					79	469		
C(plat,x)					55	418		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		1316
Potential Capacity		348
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		348
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		2633
Potential Capacity		126
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		126
Probability of Queue free St.	1.00	0.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		3287
Potential Capacity		3
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	
Maj. L, Min T Adj. Imp Factor.	0.00	
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	232	67
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	1.00
Movement Capacity	0	67
Probability of Queue free St.		1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	42	232
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.00
Movement Capacity	42	0

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		2364
Potential Capacity	224	55
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	1.00
Movement Capacity	0	55

Part 2 - Second Stage		
Conflicting Flows		923
Potential Capacity	563	418
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	
Movement Capacity	563	

Part 3 - Single Stage		
Conflicting Flows		3287
Potential Capacity		3
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	
Maj. L, Min T Adj. Imp Factor.	0.00	
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		0

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				0		0
Movement Capacity (vph)						348
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						348
Volume				0		0
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

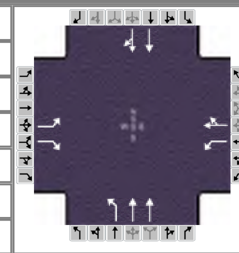
Movement	1	4	7	8	9	10	11	12
Lane Config	L						LR	
v (vph)	225						0	
C(m) (vph)	126							
v/c	1.79							
95% queue length	17.26							
Control Delay	443.2							
LOS	F							
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	443.2	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

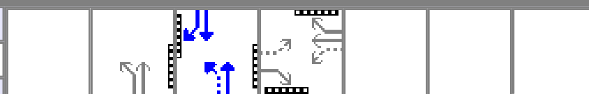
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_WorstCase.xus				
Project Description	2035 NB AM				

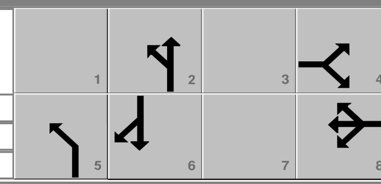


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	160		260	200	130	100	260	1430			700	100

Signal Information			
Cycle, s	95.0	Reference Phase	2
Offset, s	4	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.6	41.9	28.7	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



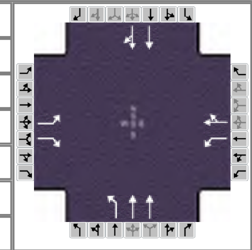
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		33.8		33.8	13.2	61.2		48.0
Change Period, (*Y*+*R*c), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.3		4.3	4.2	0.0		0.0
Queue Clearance Time (*g*s), s		27.8		13.3	10.7			
Green Extension Time (*g*e), s		0.9		2.3	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		0.02	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	188		0	235	216		291	1600			474	455
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1119		1448	1618	1616		1634	1720			1732	1660
Queue Service Time (*g*s), s	15.5		0.0	11.3	10.2		8.7	30.9			19.7	20.8
Cycle Queue Clearance Time (*g*c), s	25.8		0.0	11.3	10.2		8.7	30.9			19.7	20.8
Green Ratio (*g/C*)	0.30		0.30	0.30	0.30		0.55	0.58			0.44	0.44
Capacity (*c*), veh/h	293		438	565	489		353	1993			762	730
Volume-to-Capacity Ratio (*X*)	0.643		0.000	0.417	0.442		0.824	0.803			0.622	0.624
Available Capacity (*c*a), veh/h	318		471	601	526		353	1993			762	730
Back of Queue (*Q*), veh/ln (95th percentile)	7.9		0.0	7.6	6.9		3.9	10.3			13.3	13.3
Queue Storage Ratio (*RQ*) (95th percentile)	1.01		0.00	1.56	0.18		1.00	0.33			0.17	0.17
Uniform Delay (*d*1), s/veh	37.1		0.0	27.1	26.7		18.3	11.2			21.2	22.0
Incremental Delay (*d*2), s/veh	3.9		0.0	0.5	0.6		1.5	0.3			3.4	3.6
Initial Queue Delay (*d*3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	41.0		0.0	27.6	27.3		19.8	11.5			24.7	25.6
Level of Service (LOS)	D			C	C		B	B			C	C
Approach Delay, s/veh / LOS	41.0	D		27.4	C		12.8	B		25.1	C	
Intersection Delay, s/veh / LOS	19.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	2.6	B
Bicycle LOS Score / LOS		F	1.2	A	2.1	B	1.3	A

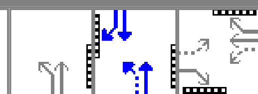
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & I-229 SB Off-rar	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_WorstCase.xus				
Project Description	2035 NB PM				

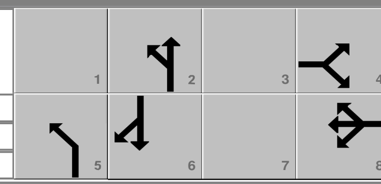


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200		680	300	80	40	200	680			1470	180

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	62	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	52.9	24.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



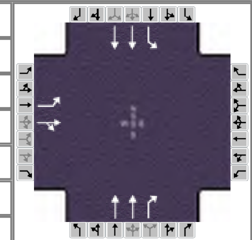
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		30.0		30.0	11.0	70.0		59.0
Change Period, (*Y+R*c), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		4.2		4.2	4.2	0.0		0.0
Queue Clearance Time (*g*s), s		24.9		20.1	8.4			
Green Extension Time (*g*e), s		0.0		1.2	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		1.00		0.82	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7		14	3	8	18	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	215		0	323	117		215	731			888	877
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1221		1444	1664	1670		1616	1630			1839	1771
Queue Service Time (*g*s), s	17.3		0.0	18.1	5.7		6.4	11.0			49.6	47.2
Cycle Queue Clearance Time (*g*c), s	22.9		0.0	18.1	5.7		6.4	11.0			49.6	47.2
Green Ratio (*g/C*)	0.25		0.25	0.25	0.25		0.61	0.64			0.53	0.53
Capacity (*c*), veh/h	307		360	486	416		184	2083			973	937
Volume-to-Capacity Ratio (*X*)	0.701		0.000	0.663	0.282		1.169	0.351			0.912	0.936
Available Capacity (*c*a), veh/h	307		360	486	416		184	2083			973	937
Back of Queue (*Q*), veh/ln (95th percentile)	9.6		0.0	12.0	4.1		16.3	6.6			28.4	29.7
Queue Storage Ratio (*RQ*) (95th percentile)	1.23		0.00	2.43	0.10		4.18	0.21			0.35	0.37
Uniform Delay (*d*1), s/veh	39.6		0.0	35.0	30.3		31.4	9.0			25.1	26.7
Incremental Delay (*d*2), s/veh	6.9		0.0	3.4	0.4		113.1	0.4			10.4	13.1
Initial Queue Delay (*d*3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	46.5		0.0	38.3	30.7		144.6	9.4			35.4	39.8
Level of Service (LOS)	D			D	C		F	A			D	D
Approach Delay, s/veh / LOS	46.5	D		36.3	D		40.1	D		37.6	D	
Intersection Delay, s/veh / LOS	38.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	3.2	C
Bicycle LOS Score / LOS		F	1.2	A	1.3	A	1.9	A

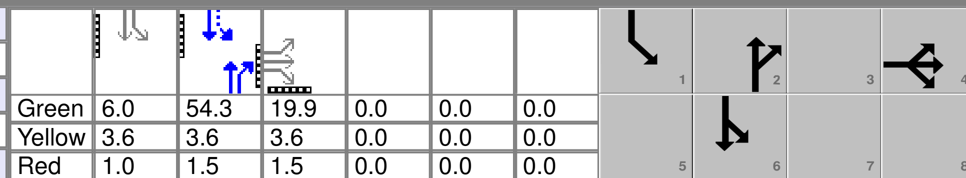
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	400	0	170					1640	380	140	800	

Signal Information										
Cycle, s	95.0	Reference Phase	6							
Offset, s	51	Reference Point	Begin	Green	6.0	54.3	19.9	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		25.0				59.4	10.6	70.0
Change Period, (Y+R_c), s		5.1				5.1	4.6	5.1
Max Allow Headway (MAH), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		21.9					6.0	
Green Extension Time (g_e), s		0.0				0.0	0.1	0.0
Phase Call Probability		1.00					0.99	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	471	200						1774	411	165	941	
Adjusted Saturation Flow Rate (s), veh/h/ln	1687	1507						1740	1462	1599	1648	
Queue Service Time (g_s), s	19.9	11.5						40.9	6.2	4.0	18.8	
Cycle Queue Clearance Time (g_c), s	19.9	11.5						40.9	6.2	4.0	18.8	
Green Ratio (g/C)	0.21	0.21						0.57	0.57	0.66	0.48	
Capacity (c), veh/h	353	316						1989	836	201	1591	
Volume-to-Capacity Ratio (X)	1.332	0.633						0.892	0.492	0.821	0.591	
Available Capacity (c_a), veh/h	353	316						1989	836	241	1591	
Back of Queue (Q), veh/ln (95th percentile)	37.1	7.8						15.2	1.8	4.9	10.6	
Queue Storage Ratio (RQ) (95th percentile)	6.33	0.20						0.16	0.18	1.26	0.34	
Uniform Delay (d_1), s/veh	37.6	34.2						15.0	3.1	20.5	11.2	
Incremental Delay (d_2), s/veh	167.5	4.1						0.7	0.2	13.9	1.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	205.1	38.3						15.7	3.3	34.4	12.5	
Level of Service (LOS)	F	D						B	A	C	B	

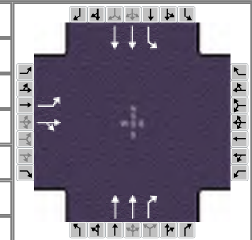
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	155.3	F	0.0		13.4	B	15.8	B
Intersection Delay, s/veh / LOS	38.1				D			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.6	A			2.4	B	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:17:36 PM

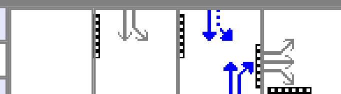
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_BestCase.xus				
Project Description	2035 NB PM				

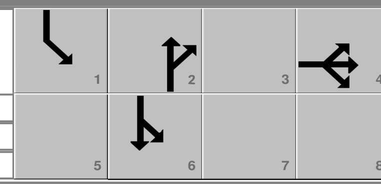


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	0	350					890	220	200	1750	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	80	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.2	43.1	28.0	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		33.1				48.2	13.8	61.9
Change Period, ($Y+R_c$), s		5.1				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		4.2				0.0	4.2	0.0
Queue Clearance Time (g_s), s		25.7					8.5	
Green Extension Time (g_e), s		2.3				0.0	0.7	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.00					0.00	

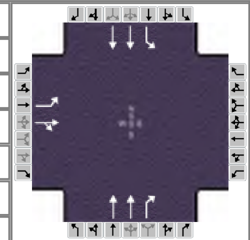
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	215	376						957	237	215	1882	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1613	1441						1649	1430	1613	1752	
Queue Service Time (g_s), s	10.3	23.7						16.2	5.3	6.5	39.5	
Cycle Queue Clearance Time (g_c), s	10.3	23.7						16.2	5.3	6.5	39.5	
Green Ratio (*g/C*)	0.29	0.29						0.45	0.45	0.57	0.60	
Capacity (*c*), veh/h	475	425						1496	648	358	2096	
Volume-to-Capacity Ratio (*X*)	0.453	0.887						0.640	0.365	0.600	0.898	
Available Capacity (c_a), veh/h	796	711						1496	648	667	2096	
Back of Queue (*Q*), veh/ln (95th percentile)	7.0	13.5						7.6	2.8	3.3	12.9	
Queue Storage Ratio (*RQ*) (95th percentile)	1.19	0.35						0.08	0.29	0.84	0.41	
Uniform Delay (d_1), s/veh	27.3	32.0						11.5	7.0	12.3	10.1	
Incremental Delay (d_2), s/veh	0.7	7.5						1.7	1.3	0.5	2.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	27.9	39.5						13.2	8.3	12.8	12.5	
Level of Service (LOS)	C	D						B	A	B	B	
Approach Delay, s/veh / LOS	35.3		D	0.0			12.2		B	12.5		B
Intersection Delay, s/veh / LOS	15.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS	1.5	A			1.5	A	2.2	B

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:22:08 PM

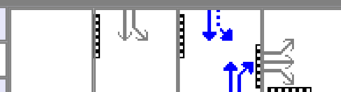
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_WorstCase.xus				
Project Description	2035 NB AM				

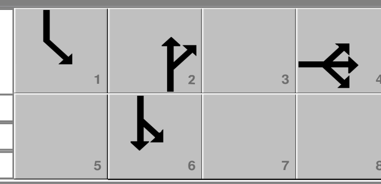


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	400	0	170					1640	380	140	800	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	51	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	53.9	19.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		25.0				59.0	11.0	70.0
Change Period, ($Y+R_c$), s		5.1				5.1	4.6	5.1
Max Allow Headway (MAH), s		4.1				0.0	4.2	0.0
Queue Clearance Time (g_s), s		21.9					6.4	
Green Extension Time (g_e), s		0.0				0.0	0.1	0.0
Phase Call Probability		1.00					0.99	
Max Out Probability		1.00					1.00	

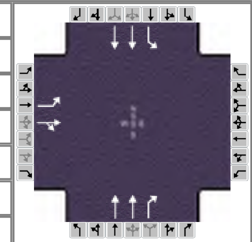
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	471	200						1929	447	165	941	
Adjusted Saturation Flow Rate (s), veh/h/ln	1687	1507						1758	1468	1599	1648	
Queue Service Time (g_s), s	19.9	11.5						49.0	7.3	4.4	18.9	
Cycle Queue Clearance Time (g_c), s	19.9	11.5						49.0	7.3	4.4	18.9	
Green Ratio (g/C)	0.21	0.21						0.57	0.57	0.66	0.48	
Capacity (c), veh/h	353	316						1998	834	190	1591	
Volume-to-Capacity Ratio (X)	1.332	0.633						0.966	0.536	0.865	0.591	
Available Capacity (c_a), veh/h	353	316						1998	834	225	1591	
Back of Queue (Q), veh/ln (95th percentile)	37.1	7.8						22.1	2.8	5.5	10.7	
Queue Storage Ratio (RQ) (95th percentile)	6.33	0.20						0.23	0.29	1.40	0.34	
Uniform Delay (d_1), s/veh	37.6	34.2						15.8	3.3	22.7	11.4	
Incremental Delay (d_2), s/veh	167.5	4.1						7.5	1.1	20.7	1.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	205.1	38.3						23.3	4.4	43.4	12.7	
Level of Service (LOS)	F	D						C	A	D	B	
Approach Delay, s/veh / LOS	155.3		F	0.0			19.7		B	17.3		B
Intersection Delay, s/veh / LOS	41.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.6	A			2.4	B	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:19:46 PM

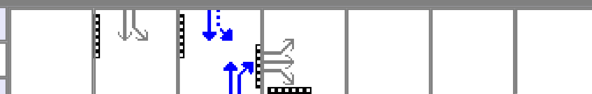
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & NB I-229 Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_WorstCase.xus				
Project Description	2035 NB PM				

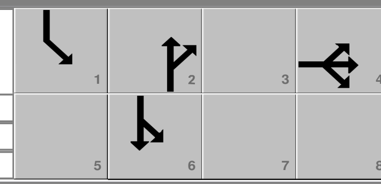


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	200	0	350					890	220	200	1750	

Signal Information				
Cycle, s	100.0	Reference Phase	6
Offset, s	48	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	51.9	26.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



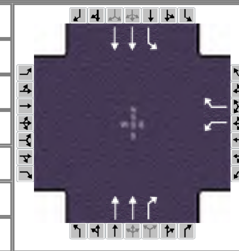
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4				2	1	6
Case Number		10.0				7.3	1.0	4.0
Phase Duration, s		32.0				57.0	11.0	68.0
Change Period, ($Y+R_c$), s		5.1				5.1	4.6	5.1
Max Allow Headway (MAH), s		4.2				0.0	4.2	0.0
Queue Clearance Time (g_s), s		27.8					7.8	
Green Extension Time (g_e), s		0.0				0.0	0.0	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14					2	12	1	6	
Adjusted Flow Rate (v), veh/h	215	376						957	237	215	1882	
Adjusted Saturation Flow Rate (s), veh/h/ln	1616	1444						1655	1432	1616	1764	
Queue Service Time (g_s), s	11.2	25.8						13.7	4.7	5.8	44.1	
Cycle Queue Clearance Time (g_c), s	11.2	25.8						13.7	4.7	5.8	44.1	
Green Ratio (g/C)	0.27	0.27						0.52	0.52	0.60	0.63	
Capacity (c), veh/h	435	388						1718	743	347	2219	
Volume-to-Capacity Ratio (X)	0.495	0.969						0.557	0.318	0.620	0.848	
Available Capacity (c_a), veh/h	435	388						1718	743	347	2219	
Back of Queue (Q), veh/ln (95th percentile)	7.7	18.5						6.8	2.5	3.7	21.3	
Queue Storage Ratio (RQ) (95th percentile)	1.32	0.47						0.07	0.26	0.95	0.68	
Uniform Delay (d_1), s/veh	30.8	36.1						8.9	5.6	12.0	17.1	
Incremental Delay (d_2), s/veh	0.9	37.4						1.1	1.0	1.2	1.6	
Initial Queue Delay (d_3), s/veh	0.0	0.0						0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	31.7	73.6						10.0	6.6	13.2	18.6	
Level of Service (LOS)	C	E						A	A	B	B	
Approach Delay, s/veh / LOS	58.3		E	0.0			9.3		A	18.1		B
Intersection Delay, s/veh / LOS	21.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.6	A
Bicycle LOS Score / LOS	1.5	A			1.5	A	2.2	B

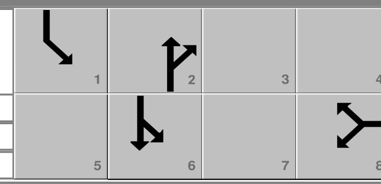
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				60		560		1360	30	210	760	

Signal Information									
Cycle, s	95.0	Reference Phase	6						
Offset, s	0	Reference Point	Begin	Green	12.6	42.7	24.9	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				30.0		47.8	17.2	65.0
Change Period, (*Y+Rc*), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.4		0.0	4.2	0.0
Queue Clearance Time (g_s), s				26.9			11.7	
Green Extension Time (g_e), s				0.0		0.0	0.9	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			0.00	

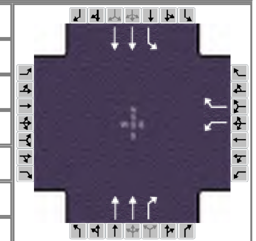
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				71		485		1600	35	247	894	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1664	1525	1664	1664	
Queue Service Time (g_s), s				3.1		24.9		42.8	1.2	9.7	9.4	
Cycle Queue Clearance Time (g_c), s				3.1		24.9		42.8	1.2	9.7	9.4	
Green Ratio (*g/C*)				0.26		0.26		0.45	0.45	0.60	0.63	
Capacity (*c*), veh/h				441		392		1498	687	296	2098	
Volume-to-Capacity Ratio (*X*)				0.160		1.237		1.068	0.051	0.836	0.426	
Available Capacity (c_a), veh/h				441		392		1498	687	837	2098	
Back of Queue (*Q*), veh/ln (95th percentile)				2.2		34.1		34.8	0.8	10.6	4.8	
Queue Storage Ratio (*RQ*) (95th percentile)				0.76		0.87		0.89	0.08	1.08	0.05	
Uniform Delay (d_1), s/veh				27.0		35.1		26.1	14.7	32.8	5.6	
Incremental Delay (d_2), s/veh				0.2		126.6		43.7	0.1	4.8	0.5	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				27.2		161.7		69.8	14.8	37.6	6.0	
Level of Service (LOS)				C		F		F	B	D	A	
Approach Delay, s/veh / LOS	0.0			144.6	F		68.6	E		12.9	B	
Intersection Delay, s/veh / LOS	62.2						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:17:36 PM

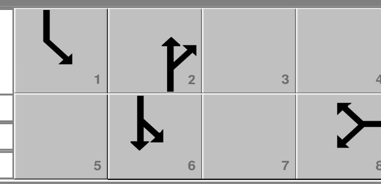
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 9, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				80		300		1000	70	500	1500	

Signal Information										
Cycle, s	95.0	Reference Phase	6							
Offset, s	0	Reference Point	Begin	Green	20.3	52.6	7.3	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				12.4		57.7	24.9	82.6
Change Period, (Y+R_c), s				5.1		5.1	4.6	5.1
Max Allow Headway (MAH), s				4.3		0.0	4.2	0.0
Queue Clearance Time (g_s), s				7.2			18.0	
Green Extension Time (g_e), s				0.1		0.0	2.3	0.0
Phase Call Probability				0.99			1.00	
Max Out Probability				1.00			0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h				86		84		1075	63	538	1613	
Adjusted Saturation Flow Rate (s), veh/h/ln				1681		1496		1664	1525	1664	1664	
Queue Service Time (g_s), s				4.7		5.2		20.2	1.8	16.0	12.2	
Cycle Queue Clearance Time (g_c), s				4.7		5.2		20.2	1.8	16.0	12.2	
Green Ratio (g/C)				0.08		0.08		0.55	0.55	0.79	0.82	
Capacity (c), veh/h				129		114		1845	846	598	2715	
Volume-to-Capacity Ratio (X)				0.669		0.733		0.583	0.075	0.899	0.594	
Available Capacity (c_a), veh/h				175		156		1845	846	1032	2715	
Back of Queue (Q), veh/ln (95th percentile)				3.9		4.1		11.9	1.1	16.5	3.0	
Queue Storage Ratio (RQ) (95th percentile)				1.32		0.10		0.30	0.03	1.69	0.03	
Uniform Delay (d_1), s/veh				42.7		42.9		13.9	9.8	22.1	1.9	
Incremental Delay (d_2), s/veh				5.9		10.9		1.4	0.2	2.1	0.3	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (d), s/veh				48.6		53.8		15.3	10.0	24.2	2.2	
Level of Service (LOS)				D		D		B	B	C	A	

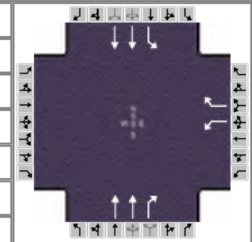
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		51.2	D	15.0	B	7.7	A
Intersection Delay, s/veh / LOS	12.2				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.6	B	0.6	A
Bicycle LOS Score / LOS				F	1.4	A	2.3	B

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:22:08 PM

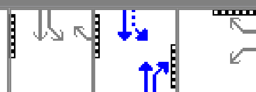
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Cliff_AM_WorstCase.xus				
Project Description	2035 NB AM				

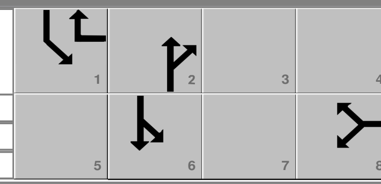


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				60		560		1360	30	210	760	

Signal Information			
Cycle, s	95.0	Reference Phase	6
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.7	48.7	19.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				25.0		53.8	16.3	70.0
Change Period, (Y+R_c), s				5.1		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				4.4		0.0	4.2	0.0
Queue Clearance Time (g_s), s				21.9			10.7	
Green Extension Time (g_e), s				0.0		0.0	0.9	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			0.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				71		485		1600	35	247	894	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1664	1481	1664	1664	
Queue Service Time (g_s), s				3.3		19.9		42.9	1.1	8.7	7.9	
Cycle Queue Clearance Time (g_c), s				3.3		19.9		42.9	1.1	8.7	7.9	
Green Ratio (*g/C*)				0.21		0.33		0.51	0.51	0.66	0.68	
Capacity (*c*), veh/h				352		497		1704	758	298	2273	
Volume-to-Capacity Ratio (*X*)				0.201		0.976		0.939	0.047	0.829	0.393	
Available Capacity (c_a), veh/h				352		497		1704	758	854	2273	
Back of Queue (*Q*), veh/ln (95th percentile)				2.4		21.7		25.1	0.7	10.4	3.8	
Queue Storage Ratio (*RQ*) (95th percentile)				0.82		0.55		0.64	0.07	1.07	0.04	
Uniform Delay (d_1), s/veh				31.0		31.3		21.8	11.6	31.6	4.1	
Incremental Delay (d_2), s/veh				0.3		34.0		11.5	0.1	4.6	0.4	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				31.3		65.3		33.3	11.7	36.2	4.5	
Level of Service (LOS)				C		E		C	B	D	A	

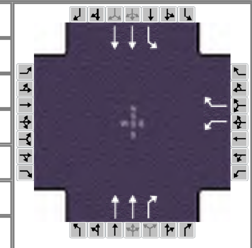
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		61.0	E	32.8	C	11.3	B
Intersection Delay, s/veh / LOS	30.2				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.5	B	0.7	A
Bicycle LOS Score / LOS				F	1.8	A	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:19:46 PM

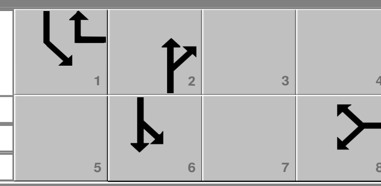
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 2, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Cliff Ave & 49th St	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Cliff_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				80		300		1000	70	500	1500	

Signal Information										
Cycle, s	100.0	Reference Phase	6							
Offset, s	0	Reference Point	Begin	Green	18.0	59.9	7.3	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				8		2	1	6
Case Number				9.0		7.3	1.0	4.0
Phase Duration, s				12.4		65.0	22.6	87.6
Change Period, ($Y+R_c$), s				5.1		5.1	4.6	5.1
Max Allow Headway (MAH), s				4.3		0.0	4.2	0.0
Queue Clearance Time (g_s), s				7.0			16.7	
Green Extension Time (g_e), s				0.3		0.0	1.3	0.0
Phase Call Probability				0.99			1.00	
Max Out Probability				0.08			0.48	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				3		18		2	12	1	6	
Adjusted Flow Rate (v), veh/h				86		84		1075	63	538	1613	
Adjusted Saturation Flow Rate (s), veh/h/ln				1681		1496		1664	1481	1664	1664	
Queue Service Time (g_s), s				5.0		4.4		19.1	1.8	14.7	11.1	
Cycle Queue Clearance Time (g_c), s				5.0		4.4		19.1	1.8	14.7	11.1	
Green Ratio (g/C)				0.07		0.25		0.60	0.60	0.80	0.83	
Capacity (c), veh/h				122		378		1994	888	570	2746	
Volume-to-Capacity Ratio (X)				0.704		0.222		0.539	0.071	0.943	0.587	
Available Capacity (c_a), veh/h				250		492		1994	888	653	2746	
Back of Queue (Q), veh/ln (95th percentile)				4.2		2.9		11.1	1.1	11.9	2.8	
Queue Storage Ratio (RQ) (95th percentile)				1.41		0.07		0.28	0.03	1.21	0.03	
Uniform Delay (d_1), s/veh				45.3		29.6		11.9	8.4	15.9	1.6	
Incremental Delay (d_2), s/veh				7.2		0.3		1.1	0.2	10.2	0.4	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (d), s/veh				52.5		29.9		12.9	8.5	26.2	1.9	
Level of Service (LOS)				D		C		B	A	C	A	
Approach Delay, s/veh / LOS	0.0			41.3	D		12.7	B		8.0	A	
Intersection Delay, s/veh / LOS	11.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.6	B	0.6	A
Bicycle LOS Score / LOS				F	1.4	A	2.3	B

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/13/2014
Analysis Time Period: AM Peak
Intersection: E 26th St & Yeager Rd
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 26th St
North/South Street: Yeager Rd
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		430	100	370	1060	
Peak-Hour Factor, PHF		0.85	0.85	0.85	0.85	
Hourly Flow Rate, HFR		505	117	435	1247	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	1	2	
Configuration			TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			110			
Peak Hour Factor, PHF			0.85			
Hourly Flow Rate, HFR			129			
Percent Heavy Vehicles			2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L			R			
v (vph)		435			129			
C(m) (vph)		955			523			
v/c		0.46			0.25			
95% queue length		2.42			0.96			
Control Delay		11.9			14.1			
LOS		B			B			
Approach Delay				14.1				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/13/2014
Analysis Time Period: AM Peak
Intersection: E 26th St & Yeager Rd
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 26th St
North/South Street: Yeager Rd
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		430	100	370	1060	
Peak-Hour Factor, PHF		0.85	0.85	0.85	0.85	
Peak-15 Minute Volume		126	29	109	312	
Hourly Flow Rate, HFR		505	117	435	1247	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	1	2	
Configuration			TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			110			
Peak Hour Factor, PHF			0.85			
Peak-15 Minute Volume			32			
Hourly Flow Rate, HFR			129			
Percent Heavy Vehicles			2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?			No			
Lanes			1			
Configuration			R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	67	30	1100
	Through	480	1800	3	50	67	30	1100
S5	Left-Turn	0	1800	3	0	146	30	415
	Through	1230	1800	3	119	146	30	415

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1			6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			2			2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00			0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1			6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20			3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		2			2			
t(f)		2.2			3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	480	0	1230	0

Total Saturation Flow Rate, s (vph)	1800	1800	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	50	0	119	0
Cycle Length, C (sec)	67	67	146	146
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.746	0.000	0.815	0.000
g(q1)	4.5	0.0	9.2	0.0
g(q2)	1.6	0.0	4.8	0.0
g(q)	6.2	0.0	14.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.550		0.500	
beta	0.645		0.667	
Travel time, t(a) (sec)	24.943		9.410	
Smoothing Factor, F	0.102		0.242	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	871	0	3525	0
Min platooned flow, V(c,min)	1000	1000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	15.0	0.0
Proportion time blocked, p	0.000		0.103	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.103
p(dom)	0.103
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	1.000		
p(7)			
p(8)			
p(9)	1.000		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		622			564			
s		1500			1500			
Px		1.000			1.000			
V c,u,x		622			564			
C r,x		955			523			
C plat,x		955			523			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	564	
Potential Capacity	523	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	523	
Probability of Queue free St.	0.75	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	622	
Potential Capacity	955	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	955	
Probability of Queue free St.	0.54	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.54	0.54
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.54
Maj. L, Min T Adj. Imp Factor.		0.64
Cap. Adj. factor due to Impeding mvmnt	0.54	0.48
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.54	0.54
Movement Capacity		

Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.54
Maj. L, Min T Adj. Imp Factor.		0.64
Cap. Adj. factor due to Impeding mvmnt	0.54	0.48
Movement Capacity		

Results for Two-stage process:		
a		
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			129			
Movement Capacity (vph)			523			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			523			
Volume			129			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L			R			
v (vph)		435			129			
C(m) (vph)		955			523			
v/c		0.46			0.25			
95% queue length		2.42			0.96			
Control Delay		11.9			14.1			
LOS		B			B			
Approach Delay				14.1				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.54
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		11.9
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

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TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/13/2014
Analysis Time Period: PM Peak
Intersection: E 26th St & Yeager Rd
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 26th St
North/South Street: Yeager Rd
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		760	70	190	690	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Hourly Flow Rate, HFR		817	75	204	741	
Percent Heavy Vehicles		--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	1	2	
Configuration			TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			350			
Peak Hour Factor, PHF			0.93			
Hourly Flow Rate, HFR			376			
Percent Heavy Vehicles			2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L			R			
v (vph)		204			376			
C(m) (vph)		700			352			
v/c		0.29			1.07			
95% queue length		1.21			13.47			
Control Delay		12.2			102.3			
LOS		B			F			
Approach Delay				102.3				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.6

```
Phone:                                       Fax:
E-Mail:

_____________________TWO-WAY STOP CONTROL(TWSC) ANALYSIS_________________________

Analyst:                GHM
Agency/Co.:             HDR
Date Performed:         10/13/2014
Analysis Time Period:   PM Peak
Intersection:           E 26th St & Yeager Rd
Jurisdiction:           Sioux Falls, SD
Units: U. S. Customary
Analysis Year:          2035
Project ID:  I-229 MIS
East/West Street:       E 26th St
North/South Street:     Yeager Rd
Intersection Orientation: EW                   Study period (hrs):  0.25

_______________________Vehicle Volumes and Adjustments___________________________
Major Street Movements      1       2       3       4       5       6
                            L       T       R       L       T       R
_________________________________________________________________________________
Volume                              760     70      190     690
Peak-Hour Factor, PHF               0.93    0.93    0.93    0.93
Peak-15 Minute Volume               204     19      51      185
Hourly Flow Rate, HFR               817     75      204     741
Percent Heavy Vehicles              --      --      2       --      --
Median Type/Storage         Undivided               /
RT Channelized?
Lanes                               1   0              1    2
Configuration                           TR               L  T
Upstream Signal?                    Yes                     Yes
_________________________________________________________________________________
Minor Street Movements      7       8       9       10      11      12
                            L       T       R       L       T       R
_________________________________________________________________________________
Volume                                      350
Peak Hour Factor, PHF                       0.93
Peak-15 Minute Volume                       94
Hourly Flow Rate, HFR                       376
Percent Heavy Vehicles                      2
Percent Grade (%)                   0                       0
Flared Approach:  Exists?/Storage                  /                      /
RT Channelized?                             No
Lanes                                   1
Configuration                          R
_________________________________________________________________________________

_____________________Pedestrian Volumes and Adjustments__________________________
Movements                    13      14      15      16
_________________________________________________________________________________
Flow (ped/hr)                0       0       0       0
```

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	73	30	1100
	Through	770	1800	3	57	73	30	1100
S5	Left-Turn	0	1800	3	0	146	30	415
	Through	680	1800	3	124	146	30	415

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1			6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			2			2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00			0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.1			6.2			
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20			3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		2			2			
t(f)		2.2			3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	770	0	680	0

Total Saturation Flow Rate, s (vph)	1800	1800	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	57	0	124	0
Cycle Length, C (sec)	73	73	146	146
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.781	0.000	0.849	0.000
g(q1)	6.8	0.0	4.2	0.0
g(q2)	5.1	0.0	1.0	0.0
g(q)	12.0	0.0	5.1	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.550		0.500	
beta	0.645		0.667	
Travel time, t(a) (sec)	24.943		9.410	
Smoothing Factor, F	0.102		0.242	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	1300	0	2728	0
Min platooned flow, V(c,min)	1000	1000	2000	2000
Duration of blocked period, t(p)	12.2	0.0	3.8	0.0
Proportion time blocked, p	0.167		0.026	

Computation 3-Platoon Event Periods	Result
p(2)	0.167
p(5)	0.026
p(dom)	0.167
p(subo)	0.026
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	0.833		
p(7)			
p(8)			
p(9)	0.833		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		892			854			
s		1500			1500			
Px		0.833			0.833			
V c,u,x		770			725			
C r,x		840			423			
C plat,x		700			352			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	854	
Potential Capacity	352	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	352	
Probability of Queue free St.	0.00	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	892	
Potential Capacity	700	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	700	
Probability of Queue free St.	0.71	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.71	0.71
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.71
Maj. L, Min T Adj. Imp Factor.		0.77
Cap. Adj. factor due to Impeding mvmnt	0.71	0.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

```
Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.71             0.71
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St.                   1.00             1.00

Step 4: LT from Minor St.                          7               10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                                   0.71
Maj. L, Min T Adj. Imp Factor.                                   0.77
Cap. Adj. factor due to Impeding mvmnt          0.71             0.00
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R

Volume (vph)                                       376
Movement Capacity (vph)                            352
Shared Lane Capacity (vph)
```

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			352			
Volume			376			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L			R			
v (vph)		204			376			
C(m) (vph)		700			352			
v/c		0.29			1.07			
95% queue length		1.21			13.47			
Control Delay		12.2			102.3			
LOS		B			F			
Approach Delay				102.3				
Approach LOS				F				

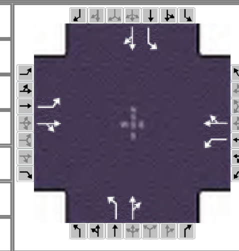
Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.71
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		12.2
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS 2010 Signalized Intersection Results Summary

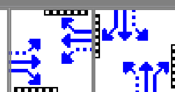
General Information			
Agency	HDR		
Analyst	GHM	Analysis Date	Oct 10, 2014
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak
Intersection	18th St & Cleveland Ave	Analysis Year	2035
File Name	2035_NB_18th_St_AM_BestCase.xus		
Project Description	2035 NB AM		

Intersection Information	
Duration, h	0.25
Area Type	Other
PHF	0.85
Analysis Period	1> 7:15

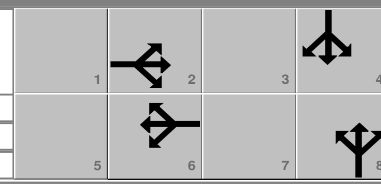


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	80	120	40	30	280	90	70	160	30	50	160	80

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	86	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	68.0	67.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		73.0		73.0		72.0		72.0
Change Period, ($Y+R_c$), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						25.6		18.5
Green Extension Time (g_e), s		0.0		0.0		2.7		2.7
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

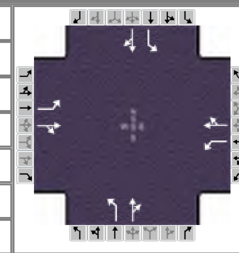
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	94	188		35	435		82	224		59	282	
Adjusted Saturation Flow Rate (s), veh/h/ln	940	1672		1179	1674		1092	1716		1153	1665	
Queue Service Time (g_s), s	10.5	9.2		2.7	27.1		7.7	11.7		4.8	15.9	
Cycle Queue Clearance Time (g_c), s	38.2	9.2		13.3	27.1		23.6	11.7		16.5	15.9	
Green Ratio (g/C)	0.47	0.47		0.47	0.47		0.46	0.46		0.46	0.46	
Capacity (c), veh/h	315	784		516	785		434	793		489	769	
Volume-to-Capacity Ratio (X)	0.299	0.240		0.068	0.554		0.190	0.282		0.120	0.367	
Available Capacity (c_a), veh/h	315	784		516	785		434	793		489	769	
Back of Queue (Q), veh/ln (95th percentile)	4.9	6.6		1.5	17.0		3.9	8.7		2.6	10.9	
Queue Storage Ratio (RQ) (95th percentile)	2.53	0.08		0.50	0.44		0.80	0.22		0.52	0.28	
Uniform Delay (d_1), s/veh	37.8	21.4		27.3	27.6		32.9	24.1		29.2	25.3	
Incremental Delay (d_2), s/veh	2.0	0.6		0.3	2.8		1.0	0.9		0.5	1.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	39.8	22.0		27.6	30.4		33.9	25.0		29.7	26.6	
Level of Service (LOS)	D	C		C	C		C	C		C	C	
Approach Delay, s/veh / LOS	27.9	C		30.2	C		27.4	C		27.2	C	
Intersection Delay, s/veh / LOS	28.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.0	A	1.3	A	1.0	A	1.1	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:29:26 PM

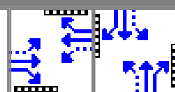
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	18th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_18th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

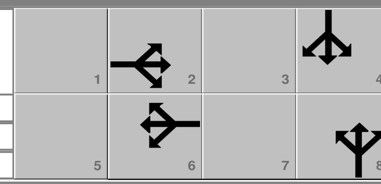


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	110	290	60	30	170	50	50	250	40	90	300	130

Signal Information				
Cycle, s	120.0	Reference Phase	2	
Offset, s	60	Reference Point	End	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	



Green	54.0	56.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		59.0		59.0		61.0		61.0
Change Period, ($Y+R_c$), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						31.9		26.4
Green Extension Time (g_e), s		0.0		0.0		4.1		4.2
Phase Call Probability						1.00		1.00
Max Out Probability						0.02		0.01

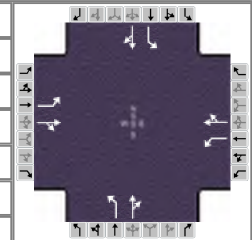
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	118	376		32	237		54	312		97	462	
Adjusted Saturation Flow Rate (s), veh/h/ln	1128	1695		993	1679		926	1722		1063	1674	
Queue Service Time (g_s), s	10.6	21.8		3.0	10.8		5.5	14.2		7.8	24.4	
Cycle Queue Clearance Time (g_c), s	20.8	21.8		25.3	10.8		29.9	14.2		22.0	24.4	
Green Ratio (g/C)	0.45	0.45		0.45	0.45		0.47	0.47		0.47	0.47	
Capacity (c), veh/h	466	763		322	756		304	804		431	781	
Volume-to-Capacity Ratio (X)	0.254	0.493		0.100	0.313		0.177	0.388		0.225	0.592	
Available Capacity (c_a), veh/h	466	763		322	756		304	804		431	781	
Back of Queue (Q), veh/ln (95th percentile)	5.4	14.7		1.4	7.9		2.4	10.0		3.9	15.5	
Queue Storage Ratio (RQ) (95th percentile)	2.78	0.18		0.48	0.20		0.49	0.25		0.79	0.39	
Uniform Delay (d_1), s/veh	33.2	30.7		33.6	21.1		34.6	20.8		28.0	23.6	
Incremental Delay (d_2), s/veh	1.2	2.0		0.6	1.1		1.3	1.4		1.2	3.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	34.4	32.7		34.2	22.2		35.9	22.3		29.2	26.9	
Level of Service (LOS)	C	C		C	C		D	C		C	C	
Approach Delay, s/veh / LOS	33.1		C	23.6		C	24.3		C	27.3		C
Intersection Delay, s/veh / LOS	27.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.3	A	0.9	A	1.1	A	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:31:34 PM

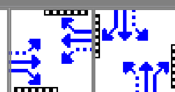
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	18th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_18th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

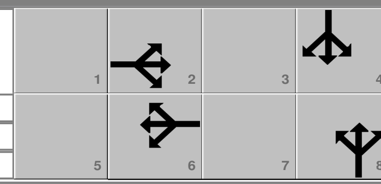


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	120	40	30	280	90	70	160	30	50	160	80

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	86	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	68.0	67.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		73.0		73.0		72.0		72.0
Change Period, (*Y+Rc*), s		5.0		5.0		5.0		5.0
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (*gs*), s						25.6		18.5
Green Extension Time (*ge*), s		0.0		0.0		2.7		2.7
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

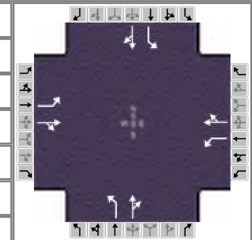
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	94	188		35	435		82	224		59	282	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	940	1672		1179	1674		1092	1716		1153	1665	
Queue Service Time (*gs*), s	10.5	9.2		2.7	27.1		7.7	11.7		4.8	15.9	
Cycle Queue Clearance Time (*gc*), s	38.2	9.2		13.3	27.1		23.6	11.7		16.5	15.9	
Green Ratio (*g/C*)	0.47	0.47		0.47	0.47		0.46	0.46		0.46	0.46	
Capacity (*c*), veh/h	315	784		516	785		434	793		489	769	
Volume-to-Capacity Ratio (*X*)	0.299	0.240		0.068	0.554		0.190	0.282		0.120	0.367	
Available Capacity (*ca*), veh/h	315	784		516	785		434	793		489	769	
Back of Queue (*Q*), veh/ln (95th percentile)	4.9	6.6		1.5	17.0		3.9	8.7		2.6	10.9	
Queue Storage Ratio (*RQ*) (95th percentile)	2.53	0.08		0.50	0.44		0.80	0.22		0.52	0.28	
Uniform Delay (*d1*), s/veh	37.8	21.4		27.3	27.6		32.9	24.1		29.2	25.3	
Incremental Delay (*d2*), s/veh	2.0	0.6		0.3	2.8		1.0	0.9		0.5	1.4	
Initial Queue Delay (*d3*), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	39.8	22.0		27.6	30.4		33.9	25.0		29.7	26.6	
Level of Service (LOS)	D	C		C	C		C	C		C	C	
Approach Delay, s/veh / LOS	27.9	C		30.2	C		27.4	C		27.2	C	
Intersection Delay, s/veh / LOS	28.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.0	A	1.3	A	1.0	A	1.1	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:30:42 PM

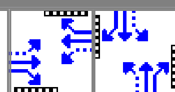
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	18th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_18th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

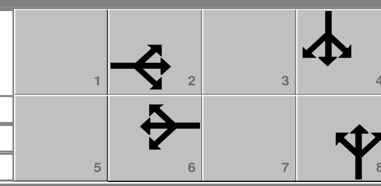


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	290	60	30	170	50	50	250	40	90	300	130

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	60	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	54.0	56.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		59.0		59.0		61.0		61.0
Change Period, (*Y+Rc*), s		5.0		5.0		5.0		5.0
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (*gs*), s						31.9		26.4
Green Extension Time (*ge*), s		0.0		0.0		4.1		4.2
Phase Call Probability						1.00		1.00
Max Out Probability						0.02		0.01

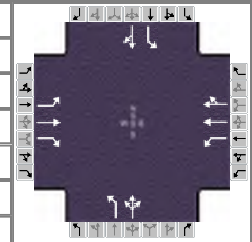
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	118	376		32	237		54	312		97	462	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1128	1695		993	1679		926	1722		1063	1674	
Queue Service Time (*gs*), s	10.6	21.8		3.0	10.8		5.5	14.2		7.8	24.4	
Cycle Queue Clearance Time (*gc*), s	20.8	21.8		25.3	10.8		29.9	14.2		22.0	24.4	
Green Ratio (*g/C*)	0.45	0.45		0.45	0.45		0.47	0.47		0.47	0.47	
Capacity (*c*), veh/h	466	763		322	756		304	804		431	781	
Volume-to-Capacity Ratio (*X*)	0.254	0.493		0.100	0.313		0.177	0.388		0.225	0.592	
Available Capacity (*ca*), veh/h	466	763		322	756		304	804		431	781	
Back of Queue (*Q*), veh/ln (95th percentile)	5.4	14.7		1.4	7.9		2.4	10.0		3.9	15.5	
Queue Storage Ratio (*RQ*) (95th percentile)	2.78	0.18		0.48	0.20		0.49	0.25		0.79	0.39	
Uniform Delay (*d1*), s/veh	33.2	30.7		33.6	21.1		34.6	20.8		28.0	23.6	
Incremental Delay (*d2*), s/veh	1.2	2.0		0.6	1.1		1.3	1.4		1.2	3.3	
Initial Queue Delay (*d3*), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	34.4	32.7		34.2	22.2		35.9	22.3		29.2	26.9	
Level of Service (LOS)	C	C		C	C		D	C		C	C	
Approach Delay, s/veh / LOS	33.1	C		23.6	C		24.3	C		27.3	C	
Intersection Delay, s/veh / LOS	27.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.3	A	0.9	A	1.1	A	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:32:19 PM

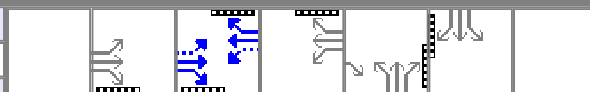
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	18th St & Southeastern Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_18th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

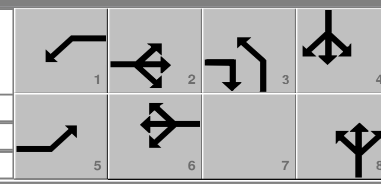


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	180	160	70	340	20	1240	160	50	10	70	30

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.5	16.0	3.9	82.1	11.0	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	2.3	2.3	2.3	2.3	2.3	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.2	3.0	1.3	4.0		10.0		10.0
Phase Duration, s	8.4	30.3	9.8	31.7		88.0		16.9
Change Period, (*Y+Rc*), s	5.9	5.9	5.9	5.9		5.9		5.9
Max Allow Headway (*MAH*), s	4.1	0.0	4.2	0.0		4.2		4.2
Queue Clearance Time (*gs*), s	3.8		2.0			73.9		10.8
Green Extension Time (*ge*), s	0.0	0.0	1.9	0.0		10.2		0.3
Phase Call Probability	0.61		0.96			1.00		0.99
Max Out Probability	0.00		0.00			0.15		0.00

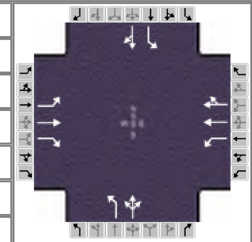
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	24	212	154	82	212	209	875	875		12	105	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664	1748	1481	1664	1748	1716	1664	1664		1681	1699	
Queue Service Time (*gs*), s	1.8	16.4	4.5	0.0	14.3	14.6	71.9	71.9		0.9	8.8	
Cycle Queue Clearance Time (*gc*), s	1.8	16.4	4.5	0.0	14.3	14.6	71.9	71.9		0.9	8.8	
Green Ratio (*g/C*)	0.15	0.17	0.72	0.14	0.18	0.18	0.57	0.57		0.08	0.08	
Capacity (*c*), veh/h	153	317	1087	219	336	330	920	920		127	128	
Volume-to-Capacity Ratio (*X*)	0.154	0.668	0.142	0.377	0.631	0.635	0.951	0.951		0.093	0.817	
Available Capacity (*ca*), veh/h	449	317	1087	1092	336	330	1206	1206		405	410	
Back of Queue (*Q*), veh/ln (95th percentile)	1.4	12.8	2.2	5.3	9.8	10.0	40.6	40.6		0.8	7.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.35	0.33	0.06	1.79	0.12	0.13	1.04	1.04		0.19	0.19	
Uniform Delay (*d1*), s/veh	52.8	55.3	5.1	59.1	40.4	41.7	30.6	30.6		62.4	66.0	
Incremental Delay (*d2*), s/veh	0.5	10.6	0.3	0.9	7.8	8.0	13.5	13.5		0.3	11.8	
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	53.3	65.9	5.4	60.0	48.1	49.7	44.1	44.1		62.7	77.9	
Level of Service (LOS)	D	E	A	E	D	D	D	D		E	E	
Approach Delay, s/veh / LOS	41.2	D		50.7	D		39.1	D		76.4	E	
Intersection Delay, s/veh / LOS	43.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	2.5	B	2.9	C
Bicycle LOS Score / LOS	1.1	A	0.9	A	3.3	C	0.7	A

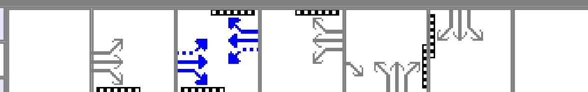
 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:29:26 PM

HCS 2010 Signalized Intersection Results Summary

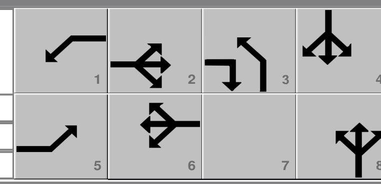
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	18th St & Southeastern Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_18th_St_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	40	360	940	120	200	30	300	100	60	40	200	40



Signal Information										
Cycle, s	120.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	3.0	42.6	4.0	22.9	17.9	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.3	2.3	2.3	2.3	2.3	0.0



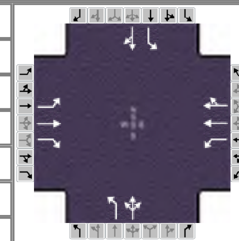
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.2	3.0	1.3	4.0		10.0		10.0
Phase Duration, s	8.9	57.5	9.9	58.4		28.8		23.8
Change Period, (*Y+R*c), s	5.9	5.9	5.9	5.9		5.9		5.9
Max Allow Headway (*MAH*), s	4.1	0.0	4.2	0.0		4.2		4.1
Queue Clearance Time (*g*s), s	3.9		2.0			21.1		18.4
Green Extension Time (*g*e), s	0.1	0.0	1.4	0.0		1.8		1.1
Phase Call Probability	0.76		0.99			1.00		1.00
Max Out Probability	0.00		0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	43	387	888	129	119	117	194	194		43	247	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664	1748	1481	1664	1748	1694	1664	1664		1681	1724	
Queue Service Time (*g*s), s	1.9	19.1	53.0	0.0	3.7	3.9	12.8	12.8		2.7	16.4	
Cycle Queue Clearance Time (*g*c), s	1.9	19.1	53.0	0.0	3.7	3.9	12.8	12.8		2.7	16.4	
Green Ratio (*g/C*)	0.41	0.43	0.62	0.38	0.44	0.44	0.19	0.19		0.15	0.15	
Capacity (*c*), veh/h	493	773	938	393	787	763	318	318		229	235	
Volume-to-Capacity Ratio (*X*)	0.087	0.501	0.947	0.328	0.151	0.153	0.609	0.609		0.188	1.051	
Available Capacity (*c*a), veh/h	1123	773	938	1198	787	763	1068	1068		815	836	
Back of Queue (*Q*), veh/ln (95th percentile)	1.3	12.9	19.5	5.3	2.7	2.8	9.3	9.3		2.1	15.3	
Queue Storage Ratio (*RQ*) (95th percentile)	0.34	0.33	0.50	1.80	0.03	0.04	0.24	0.24		0.53	0.39	
Uniform Delay (*d*1), s/veh	21.6	24.0	10.0	31.5	14.3	14.9	44.4	44.4		45.9	51.8	
Incremental Delay (*d*2), s/veh	0.1	2.3	19.1	0.4	0.4	0.4	1.9	1.9		0.4	41.9	
Initial Queue Delay (*d*3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	21.6	26.3	29.1	31.9	14.7	15.3	46.3	46.3		46.3	93.7	
Level of Service (LOS)	C	C	C	C	B	B	D	D		D	F	
Approach Delay, s/veh / LOS	28.0	C		21.0	C		50.7	D		86.7	F	
Intersection Delay, s/veh / LOS	38.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	2.5	B	3.0	C
Bicycle LOS Score / LOS	2.7	B	0.8	A	1.3	A	1.0	A

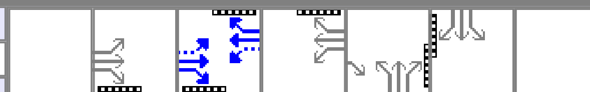
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	18th St & Southeastern Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_18th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

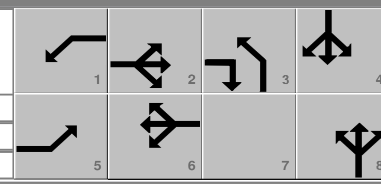


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	180	160	70	340	20	1240	160	50	10	70	30

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.5	16.0	3.9	82.1	11.0	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	2.3	2.3	2.3	2.3	2.3	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.2	3.0	1.3	4.0		10.0		10.0
Phase Duration, s	8.4	30.3	9.8	31.7		88.0		16.9
Change Period, (*Y+Rc*), s	5.9	5.9	5.9	5.9		5.9		5.9
Max Allow Headway (*MAH*), s	4.1	0.0	4.2	0.0		4.2		4.2
Queue Clearance Time (*gs*), s	3.8		2.0			73.9		10.8
Green Extension Time (*ge*), s	0.0	0.0	1.9	0.0		10.2		0.3
Phase Call Probability	0.61		0.96			1.00		0.99
Max Out Probability	0.00		0.00			0.15		0.00

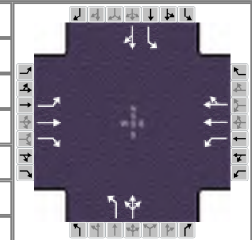
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	24	212	154	82	212	209	875	875		12	105	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664	1748	1481	1664	1748	1716	1664	1664		1681	1699	
Queue Service Time (*gs*), s	1.8	16.4	4.5	0.0	14.3	14.6	71.9	71.9		0.9	8.8	
Cycle Queue Clearance Time (*gc*), s	1.8	16.4	4.5	0.0	14.3	14.6	71.9	71.9		0.9	8.8	
Green Ratio (*g/C*)	0.15	0.17	0.72	0.14	0.18	0.18	0.57	0.57		0.08	0.08	
Capacity (*c*), veh/h	153	317	1087	219	336	330	920	920		127	128	
Volume-to-Capacity Ratio (*X*)	0.154	0.668	0.142	0.377	0.631	0.635	0.951	0.951		0.093	0.817	
Available Capacity (*ca*), veh/h	449	317	1087	1092	336	330	1206	1206		405	410	
Back of Queue (*Q*), veh/ln (95th percentile)	1.4	12.8	2.2	5.3	9.8	10.0	40.6	40.6		0.8	7.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.35	0.33	0.06	1.79	0.12	0.13	1.04	1.04		0.19	0.19	
Uniform Delay (*d1*), s/veh	52.8	55.3	5.1	59.1	40.4	41.7	30.6	30.6		62.4	66.0	
Incremental Delay (*d2*), s/veh	0.5	10.6	0.3	0.9	7.8	8.0	13.5	13.5		0.3	11.8	
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	53.3	65.9	5.4	60.0	48.1	49.7	44.1	44.1		62.7	77.9	
Level of Service (LOS)	D	E	A	E	D	D	D	D		E	E	
Approach Delay, s/veh / LOS	41.2	D		50.7	D		39.1	D		76.4	E	
Intersection Delay, s/veh / LOS	43.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	2.5	B	2.9	C
Bicycle LOS Score / LOS	1.1	A	0.9	A	3.3	C	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:30:42 PM

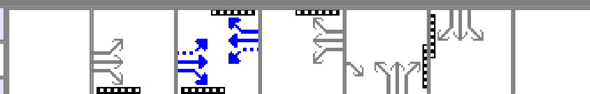
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	18th St & Southeastern Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_18th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

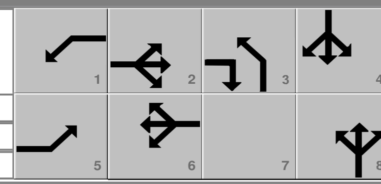


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	40	360	940	120	200	30	300	100	60	40	200	40

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.0	42.6	4.0	22.9	17.9	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	2.3	2.3	2.3	2.3	2.3	0.0



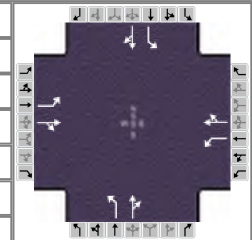
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.2	3.0	1.3	4.0		10.0		10.0
Phase Duration, s	8.9	57.5	9.9	58.4		28.8		23.8
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9		5.9		5.9
Max Allow Headway (MAH), s	4.1	0.0	4.2	0.0		4.2		4.1
Queue Clearance Time (g_s), s	3.9		2.0			21.1		18.4
Green Extension Time (g_e), s	0.1	0.0	1.4	0.0		1.8		1.1
Phase Call Probability	0.76		0.99			1.00		1.00
Max Out Probability	0.00		0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	43	387	888	129	119	117	194	194		43	247	
Adjusted Saturation Flow Rate (s), veh/h/ln	1664	1748	1481	1664	1748	1694	1664	1664		1681	1724	
Queue Service Time (g_s), s	1.9	19.1	53.0	0.0	3.7	3.9	12.8	12.8		2.7	16.4	
Cycle Queue Clearance Time (g_c), s	1.9	19.1	53.0	0.0	3.7	3.9	12.8	12.8		2.7	16.4	
Green Ratio (g/C)	0.41	0.43	0.62	0.38	0.44	0.44	0.19	0.19		0.15	0.15	
Capacity (c), veh/h	493	773	938	393	787	763	318	318		229	235	
Volume-to-Capacity Ratio (X)	0.087	0.501	0.947	0.328	0.151	0.153	0.609	0.609		0.188	1.051	
Available Capacity (c_a), veh/h	1123	773	938	1198	787	763	1068	1068		815	836	
Back of Queue (Q), veh/ln (95th percentile)	1.3	12.9	19.5	5.3	2.7	2.8	9.3	9.3		2.1	15.3	
Queue Storage Ratio (RQ) (95th percentile)	0.34	0.33	0.50	1.80	0.03	0.04	0.24	0.24		0.53	0.39	
Uniform Delay (d_1), s/veh	21.6	24.0	10.0	31.5	14.3	14.9	44.4	44.4		45.9	51.8	
Incremental Delay (d_2), s/veh	0.1	2.3	19.1	0.4	0.4	0.4	1.9	1.9		0.4	41.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	21.6	26.3	29.1	31.9	14.7	15.3	46.3	46.3		46.3	93.7	
Level of Service (LOS)	C	C	C	C	B	B	D	D		D	F	
Approach Delay, s/veh / LOS	28.0		C	21.0		C	50.7		D	86.7		F
Intersection Delay, s/veh / LOS	38.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	2.5	B	3.0	C
Bicycle LOS Score / LOS	2.7	B	0.8	A	1.3	A	1.0	A

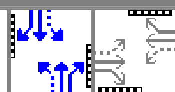
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	12th St & Cleveland	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_12th_AM_BestCase.xus				
Project Description	2035 NB AM				

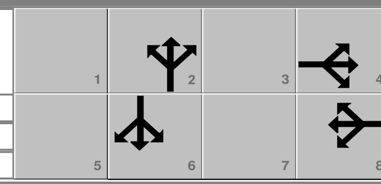


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	100	120	50	50	360	80	190	340	50	50	160	120

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	25.0	25.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



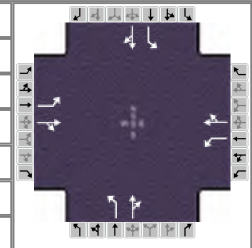
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		30.0		30.0		30.0		30.0
Change Period, (Y+R_c), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		4.4		4.4		0.0		0.0
Queue Clearance Time (g_s), s		25.0		17.2				
Green Extension Time (g_e), s		0.0		2.6		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		1.00		0.51				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	118	200		59	518		224	459		59	329	
Adjusted Saturation Flow Rate (s), veh/h/ln	880	1676		1178	1709		1046	1725		929	1638	
Queue Service Time (g_s), s	7.8	4.7		2.1	15.2		11.9	12.7		3.2	8.8	
Cycle Queue Clearance Time (g_c), s	23.0	4.7		6.9	15.2		20.7	12.7		15.9	8.8	
Green Ratio (g/C)	0.42	0.42		0.42	0.42		0.42	0.42		0.42	0.42	
Capacity (c), veh/h	263	698		517	712		403	719		311	683	
Volume-to-Capacity Ratio (X)	0.447	0.286		0.114	0.727		0.555	0.638		0.189	0.482	
Available Capacity (c_a), veh/h	263	698		517	712		403	719		311	683	
Back of Queue (Q), veh/ln (95th percentile)	2.9	2.9		0.9	9.8		5.8	8.8		1.4	5.9	
Queue Storage Ratio (RQ) (95th percentile)	0.97	0.07		0.32	0.25		1.48	0.22		0.35	0.17	
Uniform Delay (d_1), s/veh	24.3	11.6		13.9	14.6		20.3	13.9		20.2	12.8	
Incremental Delay (d_2), s/veh	1.2	0.2		0.1	3.7		5.4	4.3		1.3	2.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	25.5	11.8		14.0	18.4		25.7	18.2		21.5	15.2	
Level of Service (LOS)	C	B		B	B		C	B		C	B	
Approach Delay, s/veh / LOS	16.9	B		17.9	B		20.7	C		16.2	B	
Intersection Delay, s/veh / LOS	18.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.0	A	1.4	A	1.6	A	1.1	A

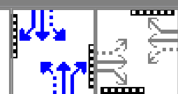
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	12th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_12th_PM_BestCase.xus				
Project Description	2035 NB PM				

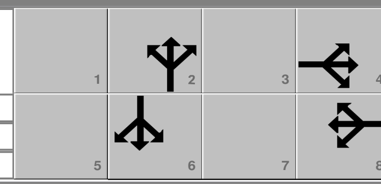


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	120	350	150	40	240	70	70	260	60	80	330	90

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	24.0	26.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		31.0		31.0		29.0		29.0
Change Period, ($Y+R_c$), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		4.3		4.3		0.0		0.0
Queue Clearance Time (g_s), s		18.1		21.5				
Green Extension Time (g_e), s		4.7		4.5		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		0.06		0.10				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	129	538		43	333		75	344		86	452	
Adjusted Saturation Flow Rate (s), veh/h/ln	1043	1674		864	1696		935	1707		1032	1699	
Queue Service Time (g_s), s	6.1	16.1		2.7	8.3		4.2	9.1		4.0	13.0	
Cycle Queue Clearance Time (g_c), s	14.9	16.1		19.5	8.3		16.6	9.1		12.6	13.0	
Green Ratio (g/C)	0.43	0.43		0.43	0.43		0.40	0.40		0.40	0.40	
Capacity (c), veh/h	417	725		252	735		302	683		387	680	
Volume-to-Capacity Ratio (X)	0.309	0.741		0.171	0.454		0.249	0.504		0.222	0.664	
Available Capacity (c_a), veh/h	661	1116		454	1131		302	683		387	680	
Back of Queue (Q), veh/ln (95th percentile)	2.5	9.4		1.0	5.1		1.9	6.4		1.9	9.1	
Queue Storage Ratio (RQ) (95th percentile)	0.84	0.24		0.32	0.13		0.47	0.16		0.47	0.26	
Uniform Delay (d_1), s/veh	17.5	14.2		22.7	12.0		21.2	13.5		18.0	14.7	
Incremental Delay (d_2), s/veh	0.4	1.5		0.3	0.4		2.0	2.6		1.3	5.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	17.9	15.7		23.0	12.4		23.1	16.2		19.3	19.8	
Level of Service (LOS)	B	B		C	B		C	B		B	B	
Approach Delay, s/veh / LOS	16.1	B		13.6	B		17.4	B		19.7	B	
Intersection Delay, s/veh / LOS	16.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.6	A	1.1	A	1.2	A	1.4	A

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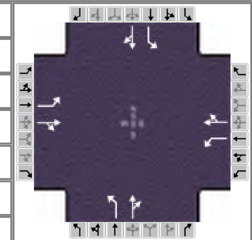
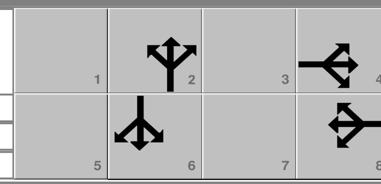
HCS 2010 Signalized Intersection Results Summary



General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	12th St & Cleveland	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_12th_AM_WorstCase.xus				
Project Description	2035 NB AM				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	100	120	50	50	360	80	190	340	50	50	160	120

Signal Information										
Cycle, s	60.0	Reference Phase	2							
Offset, s	0	Reference Point	Begin	Green	25.0	25.0	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		30.0		30.0		30.0		30.0
Change Period, (Y+R_c), s		5.0		5.0		5.0		5.0
Max Allow Headway (*MAH*), s		4.4		4.4		0.0		0.0
Queue Clearance Time (g_s), s		25.0		17.2				
Green Extension Time (g_e), s		0.0		2.6		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		1.00		0.51				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	118	200		59	518		224	459		59	329	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	880	1676		1178	1709		1046	1725		929	1638	
Queue Service Time (g_s), s	7.8	4.7		2.1	15.2		11.9	12.7		3.2	8.8	
Cycle Queue Clearance Time (g_c), s	23.0	4.7		6.9	15.2		20.7	12.7		15.9	8.8	
Green Ratio (*g/C*)	0.42	0.42		0.42	0.42		0.42	0.42		0.42	0.42	
Capacity (*c*), veh/h	263	698		517	712		403	719		311	683	
Volume-to-Capacity Ratio (*X*)	0.447	0.286		0.114	0.727		0.555	0.638		0.189	0.482	
Available Capacity (c_a), veh/h	263	698		517	712		403	719		311	683	
Back of Queue (*Q*), veh/ln (95th percentile)	2.9	2.9		0.9	9.8		5.8	8.8		1.4	5.9	
Queue Storage Ratio (*RQ*) (95th percentile)	0.97	0.07		0.32	0.25		1.48	0.22		0.35	0.17	
Uniform Delay (d_1), s/veh	24.3	11.6		13.9	14.6		20.3	13.9		20.2	12.8	
Incremental Delay (d_2), s/veh	1.2	0.2		0.1	3.7		5.4	4.3		1.3	2.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	25.5	11.8		14.0	18.4		25.7	18.2		21.5	15.2	
Level of Service (LOS)	C	B		B	B		C	B		C	B	
Approach Delay, s/veh / LOS	16.9		B	17.9		B	20.7		C	16.2		B
Intersection Delay, s/veh / LOS	18.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.0	A	1.4	A	1.6	A	1.1	A

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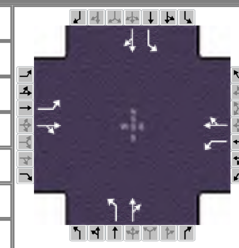
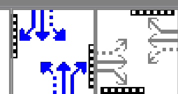
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	12th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_12th_PM_WorstCase.xus				
Project Description	2035 NB PM				

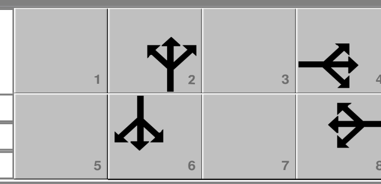


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	120	350	150	40	240	70	70	260	60	80	330	90

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	24.0	26.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		4		8		2		6
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		31.0		31.0		29.0		29.0
Change Period, (*Y+R$_c$*), s		5.0		5.0		5.0		5.0
Max Allow Headway (*MAH*), s		4.3		4.3		0.0		0.0
Queue Clearance Time (*g$_s$*), s		18.1		21.5				
Green Extension Time (*g$_e$*), s		4.7		4.5		0.0		0.0
Phase Call Probability		1.00		1.00				
Max Out Probability		0.06		0.10				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	129	538		43	333		75	344		86	452	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1043	1674		864	1696		935	1707		1032	1699	
Queue Service Time (*g$_s$*), s	6.1	16.1		2.7	8.3		4.2	9.1		4.0	13.0	
Cycle Queue Clearance Time (*g$_c$*), s	14.9	16.1		19.5	8.3		16.6	9.1		12.6	13.0	
Green Ratio (*g/C*)	0.43	0.43		0.43	0.43		0.40	0.40		0.40	0.40	
Capacity (*c*), veh/h	417	725		252	735		302	683		387	680	
Volume-to-Capacity Ratio (*X*)	0.309	0.741		0.171	0.454		0.249	0.504		0.222	0.664	
Available Capacity (*c$_a$*), veh/h	661	1116		454	1131		302	683		387	680	
Back of Queue (*Q*), veh/ln (95th percentile)	2.5	9.4		1.0	5.1		1.9	6.4		1.9	9.1	
Queue Storage Ratio (*RQ*) (95th percentile)	0.84	0.24		0.32	0.13		0.47	0.16		0.47	0.26	
Uniform Delay (*d$_1$*), s/veh	17.5	14.2		22.7	12.0		21.2	13.5		18.0	14.7	
Incremental Delay (*d$_2$*), s/veh	0.4	1.5		0.3	0.4		2.0	2.6		1.3	5.1	
Initial Queue Delay (*d$_3$*), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	17.9	15.7		23.0	12.4		23.1	16.2		19.3	19.8	
Level of Service (LOS)	B	B		C	B		C	B		B	B	
Approach Delay, s/veh / LOS	16.1	B		13.6	B		17.4	B		19.7	B	
Intersection Delay, s/veh / LOS	16.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.6	A	1.1	A	1.2	A	1.4	A

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TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E 12th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 12th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	40	210	20	20	590	60
Peak-Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Hourly Flow Rate, HFR	47	247	23	23	694	70
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	40	60	50	10	40	20
Peak Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Hourly Flow Rate, HFR	47	70	58	11	47	23
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	47	23		175			81	
C(m) (vph)	822	1293		195			182	
v/c	0.06	0.02		0.90			0.45	
95% queue length	0.18	0.05		6.95			2.07	
Control Delay	9.6	7.8		89.8			39.7	
LOS	A	A		F			E	
Approach Delay				89.8			39.7	
Approach LOS				F			E	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E 12th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 12th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	40	210	20	20	590	60
Peak-Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Peak-15 Minute Volume	12	62	6	6	174	18
Hourly Flow Rate, HFR	47	247	23	23	694	70
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	40	60	50	10	40	20
Peak Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Peak-15 Minute Volume	12	18	15	3	12	6
Hourly Flow Rate, HFR	47	70	58	11	47	23
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	65	30	1325
	Through	360	1800	3	17	65	30	1325

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	247	694
Shared ln volume, major rt vehicles:	23	70
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2	2	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog			360	0

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	17	0
Cycle Length, C (sec)	65	65
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.262	0.000
g(q1)	9.6	0.0
g(q2)	2.4	0.0
g(q)	12.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.550	
beta			0.645	
Travel time, t(a) (sec)			30.045	
Smoothing Factor, F			0.086	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			1186	0
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			5.8	0.0
Proportion time blocked, p	0.000		0.089	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.089
p(dom)	0.089
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.911		
p(4)	1.000		
p(7)	0.911		
p(8)	0.911		
p(9)	1.000		
p(10)	0.911		
p(11)	0.911		
p(12)	0.911		

Computation 4 and 5

Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	764	270	1162	1162	258	1191	1139	729
s	1500	1500	1500	1500	1500	1500	1500	1500
Px	0.911	1.000	0.911	0.911	1.000	0.911	0.911	0.911
V c,u,x	692	270	1129	1129	258	1161	1104	653
C r,x	903	1293	181	204	781	172	211	467
C plat,x	822	1293	165	186	781	157	192	425

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500	1500	1500	1500	1500	1500	1500	1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	258	729
Potential Capacity	781	425
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	781	425
Probability of Queue free St.	0.93	0.95

Step 2: LT from Major St.	4	1
Conflicting Flows	270	764
Potential Capacity	1293	822
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1293	822
Probability of Queue free St.	0.98	0.94
Maj L-Shared Prob Q free St.	0.97	0.93

Step 3: TH from Minor St.	8	11
Conflicting Flows	1162	1139
Potential Capacity	186	192
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity	168	174
Probability of Queue free St.	0.58	0.73

Step 4: LT from Minor St.	7	10
Conflicting Flows	1162	1191
Potential Capacity	165	157
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.66	0.53
Maj. L, Min T Adj. Imp Factor.	0.74	0.63
Cap. Adj. factor due to Impeding mvmnt	0.70	0.58
Movement Capacity	115	91

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1162	1139
Potential Capacity	186	192
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity	168	174

Result for 2 stage process:		
a		
y		
C t	168	174
Probability of Queue free St.	0.58	0.73

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1162	1191
Potential Capacity	165	157
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.66	0.53
Maj. L, Min T Adj. Imp Factor.	0.74	0.63
Cap. Adj. factor due to Impeding mvmnt	0.70	0.58
Movement Capacity	115	91

Results for Two-stage process:		
a		
y		
C t	115	91

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	47	70	58	11	47	23
Movement Capacity (vph)	115	168	781	91	174	425
Shared Lane Capacity (vph)		195			182	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	115	168	781	91	174	425
Volume	47	70	58	11	47	23
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		195			182	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	47	23		175			81	
C(m) (vph)	822	1293		195			182	
v/c	0.06	0.02		0.90			0.45	
95% queue length	0.18	0.05		6.95			2.07	
Control Delay	9.6	7.8		89.8			39.7	
LOS	A	A		F			E	
Approach Delay				89.8			39.7	
Approach LOS				F			E	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.94	0.98
v(il), Volume for stream 2 or 5	247	694
v(i2), Volume for stream 3 or 6	23	70
s(il), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.93	0.97
d(M,LT), Delay for stream 1 or 4	9.6	7.8
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.6	0.2

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E 12th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 12th St
North/South Street: Lowell Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	540	40	50	330	20
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	21	580	43	53	354	21
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	20	40	20	60	60	40
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	21	43	21	64	64	43
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	21	53		85			171	
C(m) (vph)	1183	958		181			188	
v/c	0.02	0.06		0.47			0.91	
95% queue length	0.05	0.18		2.24			7.02	
Control Delay	8.1	9.0		41.4			94.6	
LOS	A	A		E			F	
Approach Delay				41.4			94.6	
Approach LOS				E			F	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E 12th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 12th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	20	540	40	50	330	20
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	5	145	11	13	89	5
Hourly Flow Rate, HFR	21	580	43	53	354	21
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	20	40	20	60	60	40
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	5	11	5	16	16	11
Hourly Flow Rate, HFR	21	43	21	64	64	43
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	65	30	1325
	Through	240	1800	3	19	65	30	1325

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	580	354
Shared ln volume, major rt vehicles:	43	21
Sat flow rate, major th vehicles:	1800	1800
Sat flow rate, major rt vehicles:	1800	1800
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2	2	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog			240	0

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	19	0
Cycle Length, C (sec)	65	65
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.292	0.000
g(q1)	6.1	0.0
g(q2)	0.9	0.0
g(q)	7.1	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha				0.550
beta				0.645
Travel time, t(a) (sec)				30.045
Smoothing Factor, F				0.086
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			846	0
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			0.0	0.0
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)	1.000		
p(7)	1.000		
p(8)	1.000		
p(9)	1.000		
p(10)	1.000		
p(11)	1.000		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	375	623	1168	1125	602	1146	1135	364
s	1500	1500	1500	1500	1500	1500	1500	1500
Px	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
V c,u,x	375	623	1168	1125	602	1146	1135	364
C r,x	1183	958	170	205	500	176	202	681
C plat,x	1183	958	170	205	500	176	202	681

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500	1500	1500	1500	1500	1500	1500	1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	602	364
Potential Capacity	500	681
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	500	681
Probability of Queue free St.	0.96	0.94

Step 2: LT from Major St.	4	1
Conflicting Flows	623	375
Potential Capacity	958	1183
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	958	1183
Probability of Queue free St.	0.94	0.98
Maj L-Shared Prob Q free St.	0.93	0.97

Step 3: TH from Minor St.	8	11
Conflicting Flows	1125	1135
Potential Capacity	205	202
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity	185	183
Probability of Queue free St.	0.77	0.65

Step 4: LT from Minor St.	7	10
Conflicting Flows	1168	1146
Potential Capacity	170	176
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.59	0.69
Maj. L, Min T Adj. Imp Factor.	0.68	0.76
Cap. Adj. factor due to Impeding mvmnt	0.64	0.73
Movement Capacity	108	129

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1125	1135
Potential Capacity	205	202
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	0.90
Movement Capacity	185	183

Result for 2 stage process:		
a		
y		
C t	185	183
Probability of Queue free St.	0.77	0.65

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1168	1146
Potential Capacity	170	176
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.59	0.69
Maj. L, Min T Adj. Imp Factor.	0.68	0.76
Cap. Adj. factor due to Impeding mvmnt	0.64	0.73
Movement Capacity	108	129

Results for Two-stage process:		
a		
y		
C t	108	129

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	21	43	21	64	64	43
Movement Capacity (vph)	108	185	500	129	183	681
Shared Lane Capacity (vph)		181			188	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	108	185	500	129	183	681
Volume	21	43	21	64	64	43
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		181			188	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

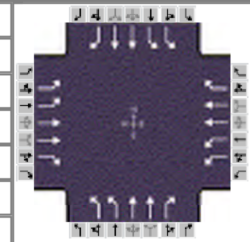
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	21	53		85			171	
C(m) (vph)	1183	958		181			188	
v/c	0.02	0.06		0.47			0.91	
95% queue length	0.05	0.18		2.24			7.02	
Control Delay	8.1	9.0		41.4			94.6	
LOS	A	A		E			F	
Approach Delay				41.4			94.6	
Approach LOS				E			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.94
v(il), Volume for stream 2 or 5	580	354
v(i2), Volume for stream 3 or 6	43	21
s(il), Saturation flow rate for stream 2 or 5	1800	1800
s(i2), Saturation flow rate for stream 3 or 6	1800	1800
P*(oj)	0.97	0.93
d(M,LT), Delay for stream 1 or 4	8.1	9.0
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.2	0.6

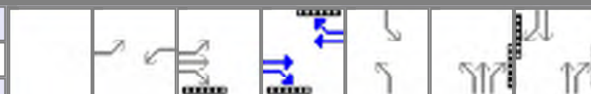
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Sycamore Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	260	690	130	140	1080	130	350	520	100	70	310	310

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	89	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.1	1.0	47.3	4.5	7.7	15.7
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	0.0	0.0	2.0	0.0	0.0	2.0

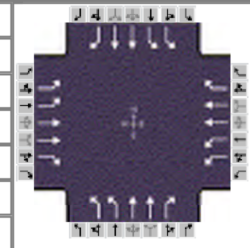
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	16.3	57.5	11.7	52.9	19.5	32.6	8.1	21.3
Change Period, ($Y+R_c$), s	3.6	5.6	3.6	5.6	3.6	5.6	3.6	5.6
Max Allow Headway (MAH), s	4.1	0.0	4.1	0.0	4.2	4.1	4.2	4.1
Queue Clearance Time (g_s), s	11.8		7.6		15.5	19.8	4.7	13.3
Green Extension Time (g_e), s	0.9	0.0	0.5	0.0	0.4	3.6	0.2	2.4
Phase Call Probability	1.00		0.99		1.00	1.00	0.92	1.00
Max Out Probability	0.02		0.00		1.00	0.29	0.00	0.74

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	292	775	124	165	1271	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (s), veh/h/ln	1570	1617	1525	1570	1617	1525	1632	1680	1525	1632	1680	1525
Queue Service Time (g_s), s	9.8	17.0	4.4	5.6	38.7	4.9	13.5	17.8	5.3	2.7	11.3	0.0
Cycle Queue Clearance Time (g_c), s	9.8	17.0	4.4	5.6	38.7	4.9	13.5	17.8	5.3	2.7	11.3	0.0
Green Ratio (g/C)	0.12	0.47	0.47	0.07	0.43	0.43	0.14	0.25	0.25	0.04	0.14	0.14
Capacity (c), veh/h	362	1526	720	231	1391	656	470	825	375	135	480	218
Volume-to-Capacity Ratio (X)	0.806	0.508	0.172	0.712	0.913	0.215	0.875	0.741	0.267	0.609	0.759	0.000
Available Capacity (c_a), veh/h	646	1526	720	732	1391	656	516	923	419	635	579	263
Back of Queue (Q), veh/ln (95th percentile)	6.7	9.8	2.9	4.1	20.0	3.2	10.2	11.4	3.5	2.1	8.4	0.0
Queue Storage Ratio (RQ) (95th percentile)	1.41	0.08	0.02	0.85	0.53	0.08	2.58	0.29	0.09	0.54	0.21	0.00
Uniform Delay (d_1), s/veh	44.0	17.8	14.1	48.5	21.6	14.4	43.5	33.9	29.7	51.1	42.7	0.0
Incremental Delay (d_2), s/veh	3.8	1.1	0.5	4.0	10.7	0.7	14.6	2.9	0.4	4.4	4.8	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	47.8	18.8	14.6	52.5	32.3	15.2	58.0	36.8	30.1	55.5	47.5	0.0
Level of Service (LOS)	D	B	B	D	C	B	E	D	C	E	D	
Approach Delay, s/veh / LOS	25.5	C		32.9	C		44.0	D		49.0	D	
Intersection Delay, s/veh / LOS	35.4						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.5	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.5	A	1.8	A	1.4	A	0.9	A

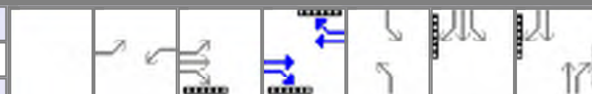
HCS 2010 Signalized Intersection Results Summary

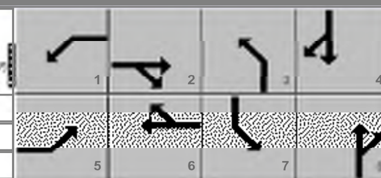
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Sycamore Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	340	1230	340	150	760	70	270	390	270	310	440	380

Signal Information										
Cycle, s	105.0	Reference Phase	2							
Offset, s	82	Reference Point	Begin	Green	7.6	2.7	38.8	11.8	1.7	20.4
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	0.0	2.0	0.0	0.0	2.0





Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	17.4	50.7	11.2	44.4	15.4	26.0	17.1	27.7
Change Period, (Y+R_c), s	3.6	5.6	3.6	5.6	3.6	5.6	3.6	5.6
Max Allow Headway (MAH), s	4.1	0.0	4.1	0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	12.6		7.2		11.0	18.0	12.3	15.1
Green Extension Time (g_e), s	1.2	0.0	0.4	0.0	0.8	2.4	1.2	3.7
Phase Call Probability	1.00		0.99		1.00	1.00	1.00	1.00
Max Out Probability	0.00		0.00		0.08	0.82	0.00	0.36

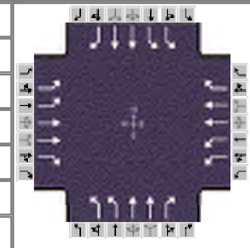
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	329	1190	292	161	817	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (s), veh/h/ln	1570	1617	1525	1570	1617	1525	1632	1680	1525	1632	1680	1525
Queue Service Time (g_s), s	10.6	33.9	12.6	5.2	20.3	2.7	9.0	11.6	16.0	10.3	13.1	0.0
Cycle Queue Clearance Time (g_c), s	10.6	33.9	12.6	5.2	20.3	2.7	9.0	11.6	16.0	10.3	13.1	0.0
Green Ratio (g/C)	0.13	0.43	0.43	0.07	0.37	0.37	0.11	0.19	0.19	0.13	0.21	0.21
Capacity (c), veh/h	417	1389	656	227	1193	563	366	653	297	419	708	321
Volume-to-Capacity Ratio (X)	0.788	0.856	0.446	0.711	0.685	0.128	0.793	0.642	0.830	0.795	0.668	0.000
Available Capacity (c_a), veh/h	848	1389	656	548	1193	563	603	746	339	821	801	363
Back of Queue (Q), veh/ln (95th percentile)	6.7	17.0	7.7	3.8	11.5	1.8	6.7	8.2	11.0	7.5	8.9	0.0
Queue Storage Ratio (RQ) (95th percentile)	1.39	0.14	0.06	0.80	0.30	0.05	1.69	0.21	0.28	1.90	0.23	0.00
Uniform Delay (d_1), s/veh	42.4	23.6	17.4	46.4	22.0	17.5	43.5	35.6	37.3	42.2	34.5	0.0
Incremental Delay (d_2), s/veh	2.2	4.6	1.4	4.1	3.2	0.5	3.9	1.5	14.3	3.5	1.8	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	44.5	28.2	18.8	50.5	25.2	18.0	47.4	37.2	51.6	45.7	36.3	0.0
Level of Service (LOS)	D	C	B	D	C	B	D	D	D	D	D	
Approach Delay, s/veh / LOS	29.7	C		28.6	C		44.0	D		40.2	D	
Intersection Delay, s/veh / LOS	34.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.6	D	3.1	C	3.1	C
Bicycle LOS Score / LOS	2.1	B	1.4	A	1.3	A	1.2	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:41:01 AM

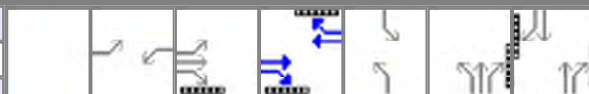
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Sycamore Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	260	690	130	140	1080	130	350	520	100	70	310	310

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	86	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.9	1.2	44.5	4.4	8.0	13.4
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	0.0	0.0	2.0	0.0	0.0	2.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	16.2	54.9	11.5	50.1	19.6	30.6	8.0	19.0
Change Period, ($Y+R_c$), s	3.6	5.6	3.6	5.6	3.6	5.6	3.6	5.6
Max Allow Headway (MAH), s	4.1	0.0	4.1	0.0	4.2	4.1	4.2	4.1
Queue Clearance Time (g_s), s	12.0		7.3		14.7	19.3	4.6	13.1
Green Extension Time (g_e), s	0.6	0.0	0.6	0.0	1.3	2.6	0.2	0.4
Phase Call Probability	1.00		0.99		1.00	1.00	0.91	1.00
Max Out Probability	0.36		0.00		0.04	0.68	0.00	1.00

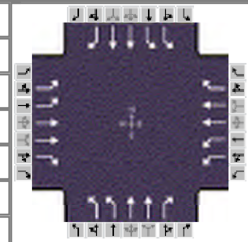
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	304	808	129	165	1271	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (s), veh/h/ln	1570	1617	1439	1570	1617	1496	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	10.0	16.8	4.6	5.3	37.6	4.9	12.7	17.3	5.3	2.6	11.1	0.0
Cycle Queue Clearance Time (g_c), s	10.0	16.8	4.6	5.3	37.6	4.9	12.7	17.3	5.3	2.6	11.1	0.0
Green Ratio (g/C)	0.12	0.47	0.47	0.07	0.42	0.42	0.15	0.24	0.24	0.04	0.13	0.13
Capacity (c), veh/h	379	1521	677	235	1373	635	498	797	355	137	426	190
Volume-to-Capacity Ratio (X)	0.804	0.531	0.190	0.700	0.925	0.222	0.826	0.767	0.282	0.599	0.856	0.000
Available Capacity (c_a), veh/h	539	1521	677	838	1373	635	790	811	361	758	440	196
Back of Queue (Q), veh/ln (95th percentile)	7.5	9.4	2.7	3.9	19.7	3.1	8.8	11.3	3.4	2.0	9.0	0.0
Queue Storage Ratio (RQ) (95th percentile)	1.56	0.08	0.72	0.81	0.52	0.78	2.23	0.29	0.86	0.51	0.23	0.00
Uniform Delay (d_1), s/veh	47.2	16.5	13.1	46.1	21.3	14.2	40.5	33.3	29.2	48.7	42.7	0.0
Incremental Delay (d_2), s/veh	5.1	1.2	0.5	3.8	12.0	0.8	4.1	4.4	0.4	4.1	14.9	0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	52.4	17.7	13.6	49.9	33.2	15.0	44.6	37.7	29.6	52.8	57.6	0.0
Level of Service (LOS)	D	B	B	D	C	B	D	D	C	D	E	
Approach Delay, s/veh / LOS	25.8	C		33.3	C		39.5	D		56.7	E	
Intersection Delay, s/veh / LOS	35.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.5	C	3.1	C	3.1	C
Bicycle LOS Score / LOS	1.5	A	1.8	A	1.4	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:39:33 AM

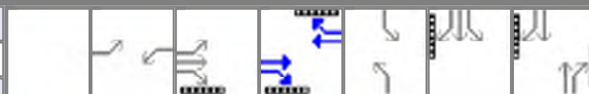
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Sycamore Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

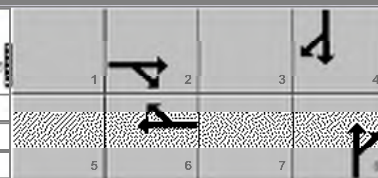


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	340	1230	340	150	760	70	270	390	270	310	440	380

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	71	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.6	4.2	40.5	12.5	1.3	22.0
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	0.0	0.0	2.0	0.0	0.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	19.0	53.9	11.2	46.1	16.1	27.6	17.4	28.9
Change Period, (*Y+Rc*), s	3.6	5.6	3.6	5.6	3.6	5.6	3.6	5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (*gs*), s	13.8		7.5		11.4	19.0	12.8	15.7
Green Extension Time (*ge*), s	1.5	0.0	0.1	0.0	1.1	3.0	1.0	4.0
Phase Call Probability	1.00		0.99		1.00	1.00	1.00	1.00
Max Out Probability	0.00		1.00		0.00	0.61	0.05	0.27

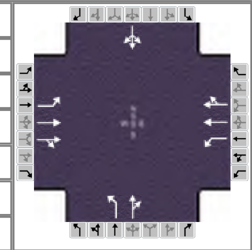
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	350	1267	311	161	817	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (*gs*), s	11.8	38.9	15.3	5.5	21.4	3.0	9.4	12.1	17.0	10.8	13.7	0.0
Cycle Queue Clearance Time (*gc*), s	11.8	38.9	15.3	5.5	21.4	3.0	9.4	12.1	17.0	10.8	13.7	0.0
Green Ratio (*g/C*)	0.14	0.44	0.44	0.07	0.37	0.37	0.11	0.20	0.20	0.13	0.21	0.21
Capacity (*c*), veh/h	440	1419	631	216	1188	529	371	671	299	410	711	317
Volume-to-Capacity Ratio (*X*)	0.797	0.893	0.493	0.748	0.688	0.136	0.783	0.625	0.824	0.813	0.665	0.000
Available Capacity (*ca*), veh/h	1468	1419	631	269	1188	529	813	794	353	665	834	371
Back of Queue (*Q*), veh/ln (95th percentile)	7.2	19.2	7.5	4.2	12.1	1.9	7.0	8.4	11.2	7.9	9.2	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.50	0.16	0.06	0.89	0.32	0.05	1.77	0.21	0.29	2.00	0.23	0.00
Uniform Delay (*d1*), s/veh	44.2	25.1	18.3	49.0	23.2	18.5	45.4	36.7	38.5	44.6	36.0	0.0
Incremental Delay (*d2*), s/veh	2.0	5.5	1.6	8.6	3.3	0.5	3.7	1.2	12.8	4.0	1.6	0.0
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	46.2	30.5	19.9	57.6	26.5	19.0	49.0	37.9	51.3	48.5	37.6	0.0
Level of Service (LOS)	D	C	B	E	C	B	D	D	D	D	D	
Approach Delay, s/veh / LOS	31.7	C		30.7	C		44.7	D		42.1	D	
Intersection Delay, s/veh / LOS	35.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.6	D	3.1	C	3.1	C
Bicycle LOS Score / LOS	2.1	B	1.4	A	1.3	A	1.2	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:42:06 AM

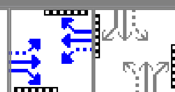
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

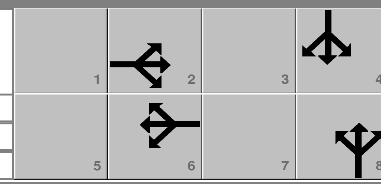


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1030	50	30	1680	30	80	10	40	10	10	10

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	45	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	86.4	12.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		8.0
Phase Duration, s		92.0		92.0		18.0		18.0
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						12.6		6.2
Green Extension Time (g_e), s		0.0		0.0		0.7		0.7
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

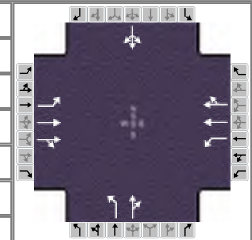
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	610	601	35	1006	1006	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	204	1698	1670	442	1698	1687	1382	1543			1491	
Queue Service Time (g_s), s	2.9	11.7	11.7	0.1	4.8	4.9	7.4	3.9			0.0	
Cycle Queue Clearance Time (g_c), s	7.8	11.7	11.7	12.6	4.8	4.9	10.6	3.9			4.2	
Green Ratio (*g/C*)	0.79	0.79	0.79	0.79	0.79	0.79	0.11	0.11			0.11	
Capacity (*c*), veh/h	218	1348	1326	371	1348	1340	170	161			199	
Volume-to-Capacity Ratio (*X*)	0.103	0.453	0.453	0.095	0.746	0.751	0.555	0.366			0.177	
Available Capacity (c_a), veh/h	218	1348	1326	371	1348	1340	608	651			680	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	5.4	5.3	0.0	1.4	1.4	4.9	2.8			1.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.07	0.11	0.10	0.01	0.01	0.01	1.23	0.14			0.08	
Uniform Delay (d_1), s/veh	3.3	3.2	3.2	0.9	0.3	0.3	50.5	45.9			45.1	
Incremental Delay (d_2), s/veh	0.8	1.0	1.0	0.2	1.2	1.2	2.8	1.4			0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	
Control Delay (*d*), s/veh	4.1	4.2	4.2	1.1	1.5	1.5	53.3	47.3			45.5	
Level of Service (LOS)	A	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	4.2		A	1.5		A	51.0		D	45.5		D
Intersection Delay, s/veh / LOS	5.1						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.6	A	2.2	B	0.7	A	0.5	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:38:32 PM

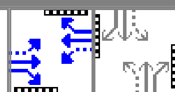
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

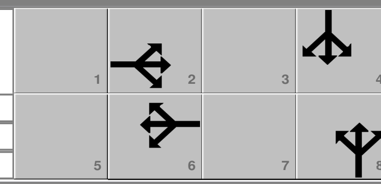


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	1820	150	40	1340	30	80	10	60	30	10	10

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	58	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	80.2	13.6	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



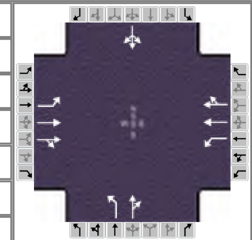
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		8.0
Phase Duration, s		85.8		85.8		19.2		19.2
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						14.2		9.7
Green Extension Time (g_e), s		0.0		0.0		0.8		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	29	951	948	43	739	734	86	75			54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	344	1698	1653	228	1698	1685	1385	1529			969	
Queue Service Time (g_s), s	0.3	11.3	11.5	0.7	5.7	5.6	5.7	4.8			2.2	
Cycle Queue Clearance Time (g_c), s	5.8	11.3	11.5	14.8	5.7	5.6	12.2	4.8			7.7	
Green Ratio (*g/C*)	0.76	0.76	0.76	0.76	0.76	0.76	0.13	0.13			0.13	
Capacity (*c*), veh/h	320	1319	1284	222	1319	1309	144	178			168	
Volume-to-Capacity Ratio (*X*)	0.090	0.721	0.738	0.194	0.560	0.561	0.597	0.423			0.321	
Available Capacity (c_a), veh/h	320	1319	1284	222	1319	1309	885	996			930	
Back of Queue (*Q*), veh/ln (95th percentile)	0.1	3.2	3.2	0.2	2.1	2.0	4.3	3.4			2.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.06	0.06	0.05	0.02	0.02	1.10	0.17			0.13	
Uniform Delay (d_1), s/veh	0.6	1.1	1.0	1.4	0.9	0.8	50.0	43.1			44.6	
Incremental Delay (d_2), s/veh	0.3	2.0	2.3	1.2	1.1	1.1	3.9	1.6			1.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	
Control Delay (*d*), s/veh	1.0	3.1	3.3	2.7	1.9	1.9	53.9	44.7			45.7	
Level of Service (LOS)	A	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	3.1		A	2.0		A	49.6		D	45.7		D
Intersection Delay, s/veh / LOS	5.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.3	B	1.7	A	0.8	A	0.6	A

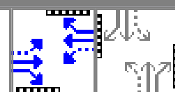
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

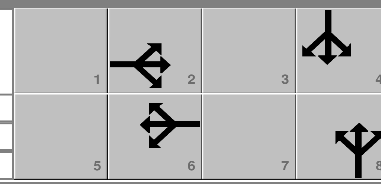


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1030	50	30	1680	30	80	10	40	10	10	10

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	46	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	81.9	11.9	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		8.0
Phase Duration, s		87.5		87.5		17.5		17.5
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						12.1		5.9
Green Extension Time (g_e), s		0.0		0.0		0.7		0.7
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

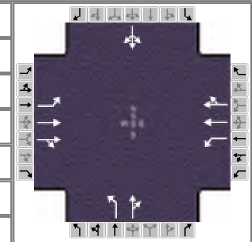
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	23	637	627	35	1006	1006	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	204	1698	1670	420	1698	1687	1382	1543			1512	
Queue Service Time (g_s), s	2.0	8.7	8.7	0.1	4.9	5.0	7.1	3.7			0.0	
Cycle Queue Clearance Time (g_c), s	7.4	8.7	8.7	8.7	4.9	5.0	10.1	3.7			3.9	
Green Ratio (*g/C*)	0.78	0.78	0.78	0.78	0.78	0.78	0.11	0.11			0.11	
Capacity (*c*), veh/h	219	1339	1317	369	1339	1330	174	162			205	
Volume-to-Capacity Ratio (*X*)	0.107	0.476	0.477	0.096	0.751	0.756	0.540	0.363			0.173	
Available Capacity (c_a), veh/h	219	1339	1317	369	1339	1330	627	667			700	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	3.5	3.4	0.0	1.4	1.4	4.6	2.7			1.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.05	0.07	0.07	0.01	0.01	0.01	1.17	0.14			0.08	
Uniform Delay (d_1), s/veh	2.2	2.0	2.0	0.5	0.3	0.3	48.1	43.7			43.0	
Incremental Delay (d_2), s/veh	0.9	1.1	1.1	0.2	1.3	1.3	2.6	1.4			0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	
Control Delay (*d*), s/veh	3.1	3.1	3.1	0.7	1.5	1.6	50.7	45.1			43.4	
Level of Service (LOS)	A	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	3.1		A	1.5		A	48.5		D	43.4		D
Intersection Delay, s/veh / LOS	4.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.6	A	2.2	B	0.7	A	0.5	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:44:46 PM

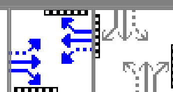
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

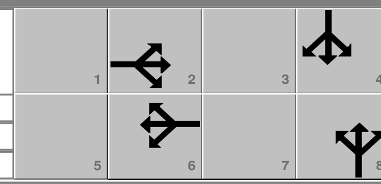


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	30	1820	150	40	1340	30	80	10	60	30	10	10

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	55	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	84.7	14.1	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		8.0
Phase Duration, s		90.3		90.3		19.7		19.7
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						14.7		10.1
Green Extension Time (g_e), s		0.0		0.0		0.8		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	31	1013	1013	43	739	734	86	75			54	
Adjusted Saturation Flow Rate (s), veh/h/ln	344	1698	1653	201	1698	1685	1385	1529			957	
Queue Service Time (g_s), s	0.3	13.5	14.0	0.5	3.6	3.6	5.8	5.0			2.4	
Cycle Queue Clearance Time (g_c), s	3.7	13.5	14.0	17.7	3.6	3.6	12.7	5.0			8.1	
Green Ratio (g/C)	0.77	0.77	0.77	0.77	0.77	0.77	0.13	0.13			0.13	
Capacity (c), veh/h	325	1329	1294	200	1329	1319	138	176			163	
Volume-to-Capacity Ratio (X)	0.095	0.762	0.783	0.215	0.556	0.557	0.622	0.426			0.330	
Available Capacity (c_a), veh/h	325	1329	1294	200	1329	1319	865	978			910	
Back of Queue (Q), veh/ln (95th percentile)	0.1	3.5	3.5	0.2	1.5	1.5	4.6	3.6			2.6	
Queue Storage Ratio (RQ) (95th percentile)	0.02	0.07	0.07	0.06	0.01	0.01	1.17	0.18			0.13	
Uniform Delay (d_1), s/veh	0.4	1.1	1.0	1.6	0.5	0.5	52.6	45.3			47.0	
Incremental Delay (d_2), s/veh	0.3	2.1	2.5	1.6	1.1	1.1	4.5	1.6			1.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	
Control Delay (d), s/veh	0.7	3.2	3.5	3.1	1.6	1.6	57.1	46.9			48.2	
Level of Service (LOS)	A	A	A	A	A	A	E	D			D	
Approach Delay, s/veh / LOS	3.3		A	1.6		A	52.3		D	48.2		D
Intersection Delay, s/veh / LOS	5.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.3	B	1.7	A	0.8	A	0.6	A

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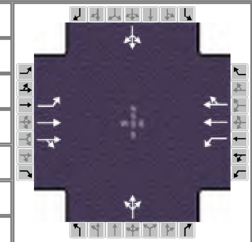
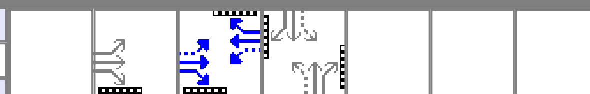
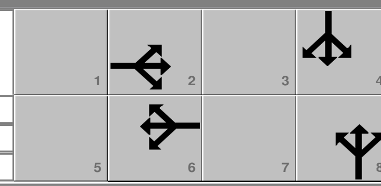
HCS 2010 Signalized Intersection Results Summary



General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	50	1040	40	50	1640	80	30	10	20	40	10	30





Signal Information										
Cycle, s	110.0	Reference Phase	2							
Offset, s	99	Reference Point	Begin	Green	3.3	83.3	9.2	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		6.3		8.0		8.0
Phase Duration, s	6.3	95.2		88.9		14.8		14.8
Change Period, ($Y+R_c$), s	3.0	5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s	4.1	0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.8					7.2		8.9
Green Extension Time (g_e), s	0.2	0.0		0.0		0.4		0.4
Phase Call Probability	0.82					0.99		0.99
Max Out Probability	0.00					0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	56	607	600	59	1012	1012		71			94	
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1676	444	1698	1670		1426			1461	
Queue Service Time (g_s), s	0.8	11.3	11.2	5.9	43.0	44.8		0.0			1.8	
Cycle Queue Clearance Time (g_c), s	0.8	11.3	11.2	10.7	43.0	44.8		5.2			6.9	
Green Ratio (g/C)	0.81	0.81	0.81	0.76	0.76	0.76		0.08			0.08	
Capacity (c), veh/h	184	1384	1365	381	1286	1265		168			171	
Volume-to-Capacity Ratio (X)	0.304	0.439	0.439	0.154	0.787	0.800		0.420			0.551	
Available Capacity (c_a), veh/h	831	1384	1365	381	1286	1265		330			333	
Back of Queue (Q), veh/ln (95th percentile)	1.5	4.7	4.7	1.0	19.6	20.1		3.5			4.8	
Queue Storage Ratio (RQ) (95th percentile)	0.39	0.12	0.12	0.26	0.39	0.40		0.18			0.24	
Uniform Delay (d_1), s/veh	16.7	2.9	2.9	6.6	10.1	10.4		48.5			49.3	
Incremental Delay (d_2), s/veh	0.6	0.6	0.7	0.5	3.0	3.3		1.7			2.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	17.3	3.5	3.5	7.1	13.1	13.7		50.1			52.1	
Level of Service (LOS)	B	A	A	A	B	B		D			D	
Approach Delay, s/veh / LOS	4.2	A		13.2	B		50.1	D		52.1	D	
Intersection Delay, s/veh / LOS	11.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.6	A	2.2	B	0.6	A	0.6	A

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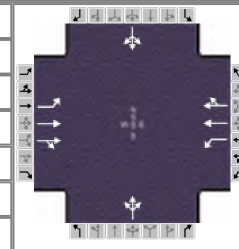
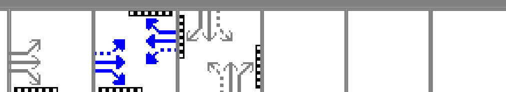
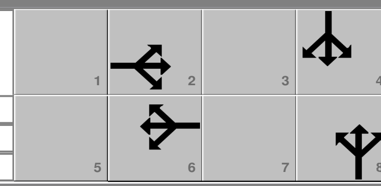
HCS 2010 Signalized Intersection Results Summary



General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	1830	140	40	1260	130	40	10	50	120	10	70





Signal Information									
Cycle, s	105.0	Reference Phase	2						
Offset, s	84	Reference Point	Begin	Green	5.2	69.2	16.4	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		6.3		8.0		8.0
Phase Duration, s	8.2	83.0		74.8		22.0		22.0
Change Period, (*Y+Rc*), s	3.0	5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.1	0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s	4.7					8.9		18.4
Green Extension Time (g_e), s	0.5	0.0		0.0		0.7		0.0
Phase Call Probability	0.98					1.00		1.00
Max Out Probability	0.00					0.20		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	143	941	938	43	756	738		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1656	232	1698	1642		1435			1280	
Queue Service Time (g_s), s	2.7	30.4	31.4	16.3	31.5	32.1		0.0			9.5	
Cycle Queue Clearance Time (g_c), s	2.7	30.4	31.4	38.9	31.5	32.1		6.9			16.4	
Green Ratio (*g/C*)	0.73	0.74	0.74	0.66	0.66	0.66		0.16			0.16	
Capacity (*c*), veh/h	268	1252	1220	167	1117	1080		272			255	
Volume-to-Capacity Ratio (*X*)	0.534	0.752	0.768	0.257	0.677	0.683		0.395			0.844	
Available Capacity (c_a), veh/h	1264	1252	1220	167	1117	1080		272			255	
Back of Queue (*Q*), veh/ln (95th percentile)	2.4	8.1	7.8	1.7	17.2	17.1		4.7			11.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.63	0.20	0.19	0.44	0.34	0.34		0.24			0.59	
Uniform Delay (d_1), s/veh	15.1	6.2	6.1	24.7	13.5	13.7		40.2			45.3	
Incremental Delay (d_2), s/veh	0.1	0.4	0.4	3.0	2.7	2.8		0.9			22.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	15.3	6.6	6.5	27.7	16.2	16.5		41.1			67.3	
Level of Service (LOS)	B	A	A	C	B	B		D			E	
Approach Delay, s/veh / LOS	7.2	A		16.7	B		41.1	D		67.3	E	
Intersection Delay, s/veh / LOS	15.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.4	B	1.8	A	0.7	A	0.8	A

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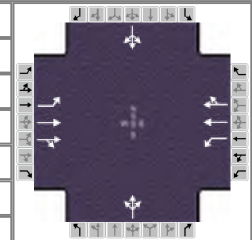
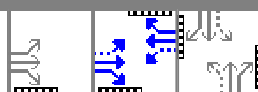
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

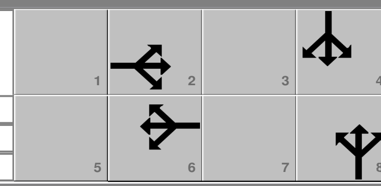


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	50	1040	40	50	1640	80	30	10	20	40	10	30

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	95	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.3	78.7	8.8	0.0	0.0	0.0
Yellow	3.0	3.6	3.6	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



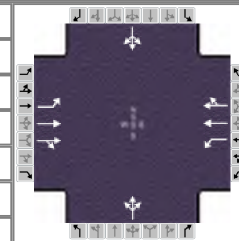
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		6.3		8.0		8.0
Phase Duration, s	6.3	90.6		84.3		14.4		14.4
Change Period, ($Y+R_c$), s	3.0	5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s	4.1	0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.8					6.9		8.6
Green Extension Time (g_e), s	0.1	0.0		0.0		0.3		0.3
Phase Call Probability	0.82					0.99		0.99
Max Out Probability	0.00					0.02		0.07

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	59	636	628	59	1012	1012		71			94	
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1676	420	1698	1670		1432			1468	
Queue Service Time (g_s), s	0.8	14.3	14.1	7.0	42.7	44.4		0.0			1.7	
Cycle Queue Clearance Time (g_c), s	0.8	14.3	14.1	14.6	42.7	44.4		4.9			6.6	
Green Ratio (g/C)	0.80	0.81	0.81	0.75	0.75	0.75		0.08			0.08	
Capacity (c), veh/h	185	1376	1358	352	1274	1253		171			174	
Volume-to-Capacity Ratio (X)	0.316	0.462	0.463	0.167	0.794	0.808		0.414			0.542	
Available Capacity (c_a), veh/h	531	1376	1358	352	1274	1253		277			280	
Back of Queue (Q), veh/ln (95th percentile)	1.6	6.7	6.5	1.1	19.7	20.2		3.3			4.5	
Queue Storage Ratio (RQ) (95th percentile)	0.41	0.17	0.16	0.30	0.39	0.40		0.17			0.23	
Uniform Delay (d_1), s/veh	17.0	4.0	3.9	8.3	10.6	10.9		46.3			47.1	
Incremental Delay (d_2), s/veh	0.7	0.8	0.8	0.6	3.1	3.4		1.6			2.6	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	17.7	4.8	4.8	8.9	13.7	14.3		47.9			49.7	
Level of Service (LOS)	B	A	A	A	B	B		D			D	
Approach Delay, s/veh / LOS	5.4	A		13.9	B		47.9	D		49.7	D	
Intersection Delay, s/veh / LOS	12.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.6	A	2.2	B	0.6	A	0.6	A

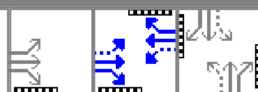
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

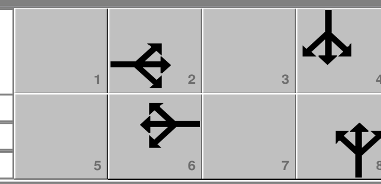


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	1830	140	40	1260	130	40	10	50	120	10	70

Signal Information				
Cycle, s	110.0	Reference Phase	2	
Offset, s	83	Reference Point	Begin	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	



Green	5.6	72.8	17.4	0.0	0.0	0.0
Yellow	3.0	3.6	3.6	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



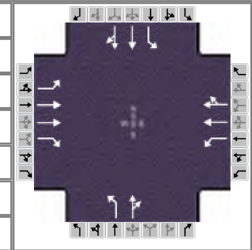
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		6.3		8.0		8.0
Phase Duration, s	8.6	87.0		78.4		23.0		23.0
Change Period, (*Y+Rc*), s	3.0	5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.1	0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s	5.0					9.2		19.4
Green Extension Time (g_e), s	0.6	0.0		0.0		0.8		0.0
Phase Call Probability	0.99					1.00		1.00
Max Out Probability	0.00					0.15		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	154	1009	1009	43	756	738		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1656	203	1698	1642		1433			1275	
Queue Service Time (g_s), s	3.0	42.6	44.9	23.9	32.9	33.6		0.0			10.2	
Cycle Queue Clearance Time (g_c), s	3.0	42.6	44.9	57.1	32.9	33.6		7.2			17.4	
Green Ratio (*g/C*)	0.73	0.74	0.74	0.66	0.66	0.66		0.16			0.16	
Capacity (*c*), veh/h	266	1257	1225	132	1123	1086		272			254	
Volume-to-Capacity Ratio (*X*)	0.578	0.803	0.823	0.326	0.674	0.680		0.395			0.847	
Available Capacity (c_a), veh/h	1241	1257	1225	132	1123	1086		272			254	
Back of Queue (*Q*), veh/ln (95th percentile)	3.5	16.4	16.6	2.2	18.0	17.9		4.9			12.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.91	0.41	0.41	0.57	0.36	0.35		0.25			0.61	
Uniform Delay (d_1), s/veh	16.5	9.6	9.7	35.9	14.1	14.3		41.9			47.3	
Incremental Delay (d_2), s/veh	0.6	1.7	2.0	5.2	2.6	2.8		0.9			22.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	17.1	11.3	11.7	41.1	16.7	17.1		42.8			69.7	
Level of Service (LOS)	B	B	B	D	B	B		D			E	
Approach Delay, s/veh / LOS	11.9		B	17.6		B	42.8		D	69.7		E
Intersection Delay, s/veh / LOS	18.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.4	B	1.8	A	0.7	A	0.8	A

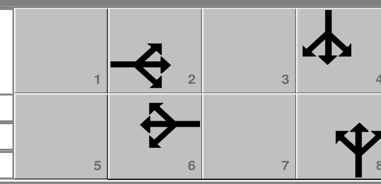
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	300	830	90	40	1360	300	250	320	50	250	250	340

Signal Information										
Cycle, s	110.0	Reference Phase	2							
Offset, s	104	Reference Point	Begin	Green	9.0	50.4	11.0	1.0	21.4	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	3.6	3.0	0.0	3.6	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	0.0	2.0	0.0	0.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	1.0	3.0		6.3	1.1	4.0	1.1	4.0
Phase Duration, s	12.0	68.0		56.0	15.0	28.0	14.0	27.0
Change Period, (*Y+R*c), s	3.0	5.6		5.6	3.0	5.6	3.0	5.6
Max Allow Headway (*MAH*), s	4.2	0.0		0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	11.0				14.0	24.4	13.0	21.6
Green Extension Time (g_e), s	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	1.00	1.00	1.00

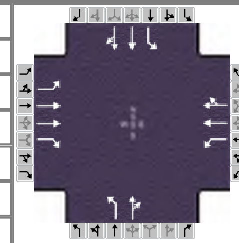
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	353	976	80	47	972	972	294	414		294	294	271
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	552	1698	1596	1681	1736		1681	1765	1496
Queue Service Time (g_s), s	9.0	8.9	1.0	3.3	50.4	50.4	12.0	22.4		11.0	17.7	19.6
Cycle Queue Clearance Time (g_c), s	9.0	8.9	1.0	3.4	50.4	50.4	12.0	22.4		11.0	17.7	19.6
Green Ratio (*g/C*)	0.56	0.57	0.57	0.46	0.46	0.46	0.30	0.20		0.29	0.19	0.19
Capacity (*c*), veh/h	198	1834	816	318	778	731	263	354		234	343	291
Volume-to-Capacity Ratio (*X*)	1.782	0.532	0.098	0.148	1.250	1.329	1.119	1.171		1.259	0.857	0.930
Available Capacity (c_a), veh/h	198	1834	816	318	778	731	263	354		234	343	291
Back of Queue (*Q*), veh/ln (95th percentile)	33.3	3.8	0.6	0.8	52.6	60.9	13.7	29.2		22.7	14.5	15.2
Queue Storage Ratio (*RQ*) (95th percentile)	6.97	0.14	0.12	0.20	1.31	1.52	3.47	0.82		11.53	0.37	0.39
Uniform Delay (d_1), s/veh	17.6	4.2	3.5	9.7	17.1	17.1	35.8	43.8		35.6	42.8	43.6
Incremental Delay (d_2), s/veh	366.2	0.8	0.2	0.5	118.2	153.3	91.3	103.1		146.6	18.8	34.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	383.8	4.9	3.7	10.2	135.3	170.3	127.2	146.9		182.2	61.6	78.3
Level of Service (LOS)	F	A	A	B	F	F	F	F		F	E	E
Approach Delay, s/veh / LOS	99.7	F		149.4	F		138.7	F		108.2	F	
Intersection Delay, s/veh / LOS	126.7						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.6	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.7	A	2.1	B	1.7	A	1.2	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:38:32 PM

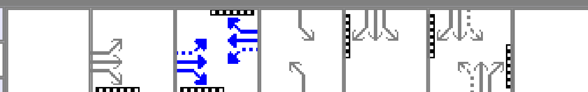
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

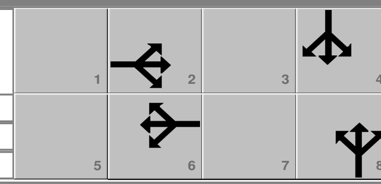


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	360	1530	240	40	970	360	170	190	140	450	310	250

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	90	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	14.0	39.4	8.0	8.0	15.4	0.0
Yellow	3.0	3.6	3.0	3.0	3.6	0.0
Red	0.0	2.0	0.0	0.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	1.0	3.0		6.3	1.1	4.0	1.1	4.0
Phase Duration, s	17.0	62.0		45.0	11.0	21.0	22.0	32.0
Change Period, ($Y+R_c$), s	3.0	5.6		5.6	3.0	5.6	3.0	5.6
Max Allow Headway (MAH), s	4.2	0.0		0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	16.0				10.0	17.4	21.0	18.3
Green Extension Time (g_e), s	0.0	0.0		0.0	0.0	0.0	0.0	2.4
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	1.00	1.00	0.43

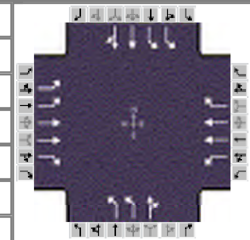
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	360	1531	212	43	723	671	183	328		484	296	262
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1617	1439	326	1698	1550	1681	1653		1681	1765	1529
Queue Service Time (g_s), s	14.0	33.8	3.8	8.2	39.4	39.4	8.0	15.4		19.0	15.8	16.3
Cycle Queue Clearance Time (g_c), s	14.0	33.8	3.8	34.0	39.4	39.4	8.0	15.4		19.0	15.8	16.3
Green Ratio (g/C)	0.53	0.54	0.54	0.38	0.38	0.38	0.22	0.15		0.35	0.25	0.25
Capacity (c), veh/h	285	1737	773	124	637	582	262	242		373	444	384
Volume-to-Capacity Ratio (X)	1.262	0.881	0.274	0.345	1.135	1.154	0.698	1.353		1.298	0.666	0.683
Available Capacity (c_a), veh/h	285	1737	773	124	637	582	262	242		373	444	384
Back of Queue (Q), veh/ln (95th percentile)	16.3	5.7	1.4	1.8	30.6	30.0	2.5	29.1		35.5	11.6	10.7
Queue Storage Ratio (RQ) (95th percentile)	3.42	0.21	0.30	0.47	0.76	0.75	0.64	0.82		18.04	0.29	0.27
Uniform Delay (d_1), s/veh	20.4	8.3	5.0	26.9	18.3	18.2	37.5	44.8		30.6	35.3	35.5
Incremental Delay (d_2), s/veh	120.7	0.7	0.1	5.0	73.8	82.3	7.9	183.5		152.5	3.8	4.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (d), s/veh	141.1	9.0	5.1	31.9	92.2	100.5	45.4	228.3		183.1	39.1	40.4
Level of Service (LOS)	F	A	A	C	F	F	D	F		F	D	D
Approach Delay, s/veh / LOS	31.2		C	94.2		F	162.8		F	106.3		F
Intersection Delay, s/veh / LOS	77.6						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.5	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	2.4	B	1.7	A	1.3	A	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:47:40 PM

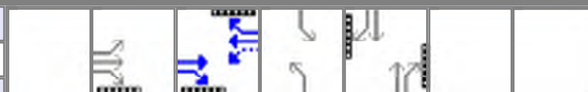
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

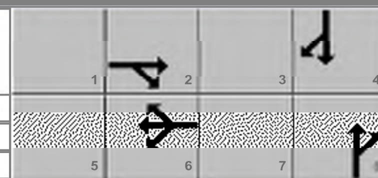


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	300	830	90	40	1360	300	250	320	50	250	250	340

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	100	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.0	44.4	11.0	20.4	0.0	0.0
Yellow	3.0	3.6	3.0	3.6	0.0	0.0
Red	0.0	2.0	0.0	2.0	0.0	0.0



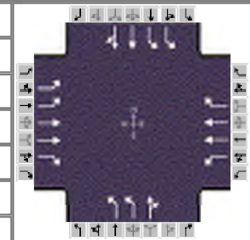
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	3.0		5.3	2.0	4.0	2.0	4.0
Phase Duration, s	15.0	65.0		50.0	14.0	26.0	14.0	26.0
Change Period, ($Y+R_c$), s	3.0	5.6		5.6	3.0	5.6	3.0	5.6
Max Allow Headway (*MAH*), s	4.2	0.0		0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	13.6				11.3	22.4	11.3	20.7
Green Extension Time (g_e), s	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	1.00	1.00	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	353	976	80	47	1600	345	294	414		294	294	271
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	552	1617	1439	1632	1736		1632	1765	1496
Queue Service Time (g_s), s	11.6	6.5	0.6	3.5	44.4	13.6	9.3	20.4		9.3	16.9	18.7
Cycle Queue Clearance Time (g_c), s	11.6	6.5	0.6	3.5	44.4	13.6	9.3	20.4		9.3	16.9	18.7
Green Ratio (*g/C*)	0.11	0.57	0.57	0.42	0.42	0.42	0.10	0.19		0.10	0.19	0.19
Capacity (*c*), veh/h	359	1829	814	302	1367	609	342	337		342	343	291
Volume-to-Capacity Ratio (*X*)	0.983	0.534	0.098	0.156	1.170	0.566	0.860	1.228		0.860	0.858	0.931
Available Capacity (c_a), veh/h	359	1829	814	302	1367	609	342	337		342	343	291
Back of Queue (*Q*), veh/ln (95th percentile)	6.7	2.6	0.3	0.8	35.2	5.5	8.2	30.8		8.2	14.0	14.7
Queue Storage Ratio (*RQ*) (95th percentile)	1.40	0.10	0.07	0.21	0.88	1.45	2.09	0.87		4.17	0.36	0.37
Uniform Delay (d_1), s/veh	25.5	2.8	2.0	10.8	17.8	12.5	46.2	42.3		46.2	40.9	41.6
Incremental Delay (d_2), s/veh	33.6	0.7	0.2	0.6	81.0	2.0	19.3	125.8		19.3	19.0	35.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	59.2	3.5	2.2	11.4	98.8	14.4	65.6	168.1		65.6	59.9	76.7
Level of Service (LOS)	E	A	A	B	F	B	E	F		E	E	E
Approach Delay, s/veh / LOS	17.4	B		82.2	F		125.5	F		67.1	E	
Intersection Delay, s/veh / LOS	67.4						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	3.1	C	3.0	C	3.1	C
Bicycle LOS Score / LOS	1.7	A	2.1	B	1.7	A	1.2	A

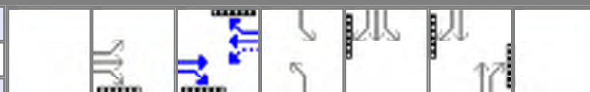
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

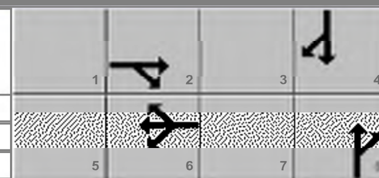


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	360	1530	240	40	970	360	170	190	140	450	310	250

Signal Information				
Cycle, s	110.0	Reference Phase	2
Offset, s	96	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	14.8	41.6	8.2	7.0	18.2	0.0
Yellow	3.0	3.6	3.0	3.0	3.6	0.0
Red	0.0	2.0	0.0	0.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	3.0		5.3	2.0	4.0	2.0	4.0
Phase Duration, s	17.8	65.0		47.2	11.2	23.8	21.2	33.8
Change Period, ($Y+R_c$), s	3.0	5.6		5.6	3.0	5.6	3.0	5.6
Max Allow Headway (*MAH*), s	4.2	0.0		0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	14.0				8.0	20.2	18.0	19.0
Green Extension Time (g_e), s	0.7	0.0		0.0	0.2	0.0	0.3	2.6
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	0.64				1.00	1.00	1.00	0.34

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	366	1558	216	43	1040	356	183	328		484	296	262
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	317	1617	1439	1632	1653		1632	1765	1529
Queue Service Time (g_s), s	12.0	38.8	4.9	7.8	26.1	14.7	6.0	18.2		16.0	16.5	17.0
Cycle Queue Clearance Time (g_c), s	12.0	38.8	4.9	37.3	26.1	14.7	6.0	18.2		16.0	16.5	17.0
Green Ratio (*g/C*)	0.13	0.54	0.54	0.38	0.38	0.38	0.07	0.17		0.17	0.26	0.26
Capacity (*c*), veh/h	424	1746	777	117	1222	544	245	273		541	452	391
Volume-to-Capacity Ratio (*X*)	0.865	0.892	0.278	0.365	0.851	0.654	0.747	1.202		0.895	0.655	0.671
Available Capacity (c_a), veh/h	543	1746	777	117	1222	544	356	273		564	452	391
Back of Queue (*Q*), veh/ln (95th percentile)	4.6	8.6	1.9	1.9	8.6	5.7	4.7	25.2		12.2	12.0	11.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.96	0.32	0.39	0.50	0.22	0.14	1.20	0.71		6.19	0.30	0.28
Uniform Delay (d_1), s/veh	35.0	10.2	6.5	26.2	13.9	12.0	49.9	45.9		44.9	36.6	36.8
Incremental Delay (d_2), s/veh	1.2	0.8	0.1	5.8	5.2	4.1	4.9	120.5		16.3	3.4	4.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	36.1	10.9	6.5	32.0	19.1	16.0	54.8	166.4		61.3	40.0	41.2
Level of Service (LOS)	D	B	A	C	B	B	D	F		E	D	D
Approach Delay, s/veh / LOS	14.8	B		18.7	B		126.5	F		50.2	D	
Intersection Delay, s/veh / LOS	34.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	3.0	C	3.0	C	3.1	C
Bicycle LOS Score / LOS	2.4	B	1.7	A	1.3	A	1.3	A

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HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: 10th St & Blaine Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Blaine Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1160	30		1950	
Peak-Hour Factor, PHF		0.85	0.85		0.85	
Hourly Flow Rate, HFR		1364	35		2294	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			60			
Peak Hour Factor, PHF			0.85			
Hourly Flow Rate, HFR			70			
Percent Heavy Vehicles			2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					70			
C(m) (vph)					560			
v/c					0.13			
95% queue length					0.43			
Control Delay					12.3			
LOS					B			
Approach Delay				12.3				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: 10th St & Blaine Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Blaine Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1160	30		1950	
Peak-Hour Factor, PHF		0.85	0.85		0.85	
Peak-15 Minute Volume		341	9		574	
Hourly Flow Rate, HFR		1364	35		2294	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			60			
Peak Hour Factor, PHF			0.85			
Peak-15 Minute Volume			18			
Hourly Flow Rate, HFR			70			
Percent Heavy Vehicles			2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	375
	Through	520	1800	4	35	116	30	375
S5	Left-Turn	0	1800	3	0	116	30	325
	Through	1360	1800	4	48	116	30	325

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)						6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)						2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)						0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage					6.2			
	2-stage					6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					2			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	520	0	1360	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	35	0	48	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.402	0.000	0.552	0.000
g(q1)	10.0	0.0	19.6	0.0
g(q2)	2.4	0.0	19.9	0.0
g(q)	12.4	0.0	39.6	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.400		0.400	
beta	0.714		0.714	
Travel time, t(a) (sec)	8.503		7.370	
Smoothing Factor, F	0.292		0.322	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3550	0	3600	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	12.3	0.0	43.3	0.0
Proportion time blocked, p	0.106		0.373	

Computation 3-Platoon Event Periods	Result
p(2)	0.106
p(5)	0.373
p(dom)	0.373
p(subo)	0.106
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	0.894		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					700			
s					3000			
Px					0.894			
V c,u,x					427			
C r,x					626			
C plat,x					560			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	700	
Potential Capacity	560	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	560	
Probability of Queue free St.	0.88	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.88
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	235	76
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	235	76
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	76	231
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	76	231

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	228	68
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	228	68

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	614	577
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.88
Movement Capacity	614	505

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.88
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			70			
Movement Capacity (vph)			560			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			560			
Volume			70			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					70			
C(m) (vph)					560			
v/c					0.13			
95% queue length					0.43			
Control Delay					12.3			
LOS					B			
Approach Delay				12.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

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                    HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:                GHM
Agency/Co.:             HDR
Date Performed:         10/10/2014
Analysis Time Period: PM Peak
Intersection:           10th St & Blaine Ave
Jurisdiction:           Sioux Falls, SD
Units: U. S. Customary
Analysis Year:          2035
Project ID:  I-229 MIS - 10th St Corridor
East/West Street:       10th St
North/South Street:     Blaine Ave
Intersection Orientation: EW                Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments__________________________
Major Street:  Approach        Eastbound               Westbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
_______________________________________________________________________________
Volume                             2050   60              1390
Peak-Hour Factor, PHF              0.93   0.93            0.93
Hourly Flow Rate, HFR              2204   64              1494
Percent Heavy Vehicles             --     --              --     --
Median Type/Storage         Raised curb          / 1
RT Channelized?
Lanes                              2    0                 2
Configuration                      T   TR                 T
Upstream Signal?                   Yes                    Yes
_______________________________________________________________________________
Minor Street:  Approach        Northbound              Southbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
_______________________________________________________________________________
Volume                                    80
Peak Hour Factor, PHF                     0.93
Hourly Flow Rate, HFR                     86
Percent Heavy Vehicles                    2
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage               /                      /
Lanes                                   1
Configuration                          R
_______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service____________________
Approach             EB     WB          Northbound           Southbound
Movement             1      4    |  7      8      9    |  10     11     12
Lane Config                      |                R    |
_______________________________________________________________________________
v (vph)                                           86
C(m) (vph)                                        451
v/c                                               0.19
95% queue length                                  0.70
Control Delay                                     14.9
LOS                                                B
Approach Delay                             14.9
Approach LOS                                B
_______________________________________________________________________________
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HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: 10th St & Blaine Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Blaine Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		2050	60		1390	
Peak-Hour Factor, PHF		0.93	0.93		0.93	
Peak-15 Minute Volume		551	16		374	
Hourly Flow Rate, HFR		2204	64		1494	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						
Lanes		2	0		2	
Configuration		T	TR		T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			80			
Peak Hour Factor, PHF			0.93			
Peak-15 Minute Volume			22			
Hourly Flow Rate, HFR			86			
Percent Heavy Vehicles			2			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes		1				
Configuration		R				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	375
	Through	1200	1800	4	34	116	30	375
S5	Left-Turn	0	1800	3	0	116	30	325
	Through	970	1800	4	49	116	30	325

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)						6.2			
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)						2			
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)						0.00			
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage					6.2			
	2-stage					6.2			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					2			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	1200	0	970	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	34	0	49	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.391	0.000	0.563	0.000
g(q1)	23.6	0.0	13.7	0.0
g(q2)	18.8	0.0	7.7	0.0
g(q)	42.4	0.0	21.3	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.400		0.400	
beta	0.714		0.714	
Travel time, t(a) (sec)	8.503		7.370	
Smoothing Factor, F	0.292		0.322	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3600	0	3599	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	31.6	0.0	22.3	0.0
Proportion time blocked, p	0.273		0.192	

Computation 3-Platoon Event Periods	Result
p(2)	0.273
p(5)	0.192
p(dom)	0.273
p(subo)	0.192
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	0.727		
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					1134			
s					3000			
Px					0.727			
V c,u,x					434			
C r,x					620			
C plat,x					451			

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	1134	
Potential Capacity	451	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	451	
Probability of Queue free St.	0.81	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.81
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	81	225
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	81	225
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	225	78
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	225	78

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	72	220
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	72	220

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	654	479
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.81
Movement Capacity	654	388

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.81
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			86			
Movement Capacity (vph)			451			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			451			
Volume			86			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

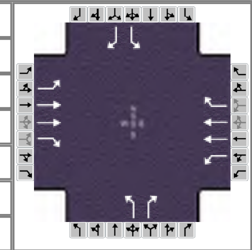
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					86			
C(m) (vph)					451			
v/c					0.19			
95% queue length					0.70			
Control Delay					14.9			
LOS					B			
Approach Delay				14.9				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

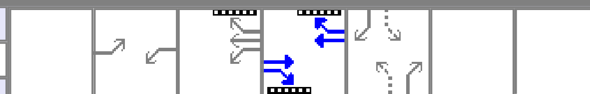
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

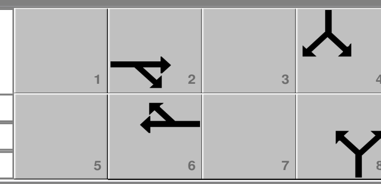


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	140	520	280	480	1000	470	300		470	200		320

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	72	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	13.2	9.8	29.6	25.8	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	4.5	4.5	4.5	3.7	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	21.3	37.7	39.2	55.6		33.1		33.1
Change Period, (Y+R_c), s	8.1	8.1	8.1	8.1		7.3		7.3
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0		4.0		4.0
Queue Clearance Time (g_s), s	13.0		30.9			25.5		16.3
Green Extension Time (g_e), s	0.3	0.0	0.2	0.0		0.3		1.6
Phase Call Probability	0.99		1.00			1.00		1.00
Max Out Probability	0.07		1.00			1.00		0.10

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (v), veh/h	165	612	0	441	919	0	353		0	235		0
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service Time (g_s), s	11.0	16.4	0.0	28.9	24.7	0.0	23.5		0.0	14.3		0.0
Cycle Queue Clearance Time (g_c), s	11.0	16.4	0.0	28.9	24.7	0.0	23.5		0.0	14.3		0.0
Green Ratio (g/C)	0.12	0.27	0.27	0.28	0.43	0.43	0.23		0.23	0.23		0.23
Capacity (c), veh/h	194	870	387	457	1395	621	445		338	445		338
Volume-to-Capacity Ratio (X)	0.847	0.703	0.000	0.965	0.659	0.000	0.793		0.000	0.529		0.000
Available Capacity (c_a), veh/h	306	870	387	467	1395	621	458		349	458		349
Back of Queue (Q), veh/ln (95th percentile)	8.6	9.1	0.0	10.5	10.7	0.0	15.4		0.0	9.5		0.0
Queue Storage Ratio (RQ) (95th percentile)	0.69	0.38	0.00	0.85	0.40	0.00	0.40		0.00	0.25		0.00
Uniform Delay (d_1), s/veh	48.1	25.2	0.0	25.8	24.4	0.0	41.2		0.0	37.7		0.0
Incremental Delay (d_2), s/veh	11.1	4.3	0.0	6.4	0.2	0.0	9.1		0.0	1.1		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0
Control Delay (d), s/veh	59.2	29.5	0.0	32.1	24.7	0.0	50.3		0.0	38.8		0.0
Level of Service (LOS)	E	C		C	C		D			D		
Approach Delay, s/veh / LOS	35.8		D	27.1		C	50.3		D	38.8		D
Intersection Delay, s/veh / LOS	33.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.7	B	3.6	D	3.4	C
Bicycle LOS Score / LOS	1.1	A	1.9	A		F		F

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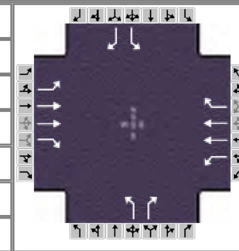
HCS 2010 Signalized Intersection Results Summary

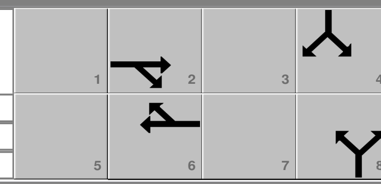
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	320	1200	370	410	700	280	350		500	410		220

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	64	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	23.4	1.2	36.2	20.7	0.0	0.0
Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Red	4.5	0.0	4.5	3.7	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	31.5	44.3	32.7	45.5		28.0		28.0
Change Period, (Y+R_c), s	8.1	8.1	8.1	8.1		7.3		7.3
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0		4.0		4.0
Queue Clearance Time (g_s), s	23.3		25.6			22.7		22.7
Green Extension Time (g_e), s	0.1	0.0	0.1	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			1.00		1.00

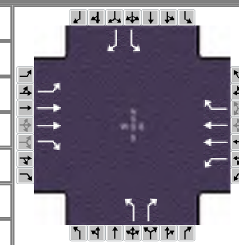
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (v), veh/h	329	1235	0	392	669	0	376		0	441		0
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service Time (g_s), s	21.3	37.2	0.0	23.6	17.3	0.0	20.7		0.0	20.7		0.0
Cycle Queue Clearance Time (g_c), s	21.3	37.2	0.0	23.6	17.3	0.0	20.7		0.0	20.7		0.0
Green Ratio (g/C)	0.22	0.34	0.34	0.23	0.36	0.36	0.20		0.20	0.20		0.20
Capacity (c), veh/h	361	1147	510	363	1150	512	387		284	387		284
Volume-to-Capacity Ratio (X)	0.911	1.077	0.000	1.080	0.582	0.000	0.972		0.000	1.138		0.000
Available Capacity (c_a), veh/h	368	1147	510	399	1150	512	387		284	387		284
Back of Queue (Q), veh/ln (95th percentile)	14.8	22.2	0.0	12.0	7.7	0.0	19.9		0.0	28.7		0.0
Queue Storage Ratio (RQ) (95th percentile)	1.19	0.93	0.00	0.96	0.29	0.00	0.52		0.00	0.75		0.00
Uniform Delay (d_1), s/veh	50.6	20.9	0.0	25.5	26.3	0.0	43.7		0.0	44.0		0.0
Incremental Delay (d_2), s/veh	14.8	43.0	0.0	41.1	0.2	0.0	38.1		0.0	88.9		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0
Control Delay (d), s/veh	65.4	63.9	0.0	66.7	26.5	0.0	81.8		0.0	132.9		0.0
Level of Service (LOS)	E	F		F	C		F			F		
Approach Delay, s/veh / LOS	64.2	E		41.3	D		81.8	F		132.9	F	
Intersection Delay, s/veh / LOS	67.9						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.6	B	3.4	C	3.5	C
Bicycle LOS Score / LOS	1.8	A	1.5	A		F		F

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:47:40 PM

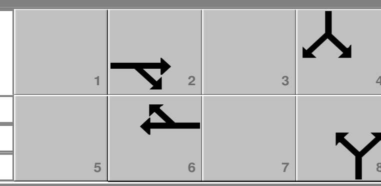
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency	HDR			Duration, h	0.25	
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other	
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85	
Intersection	10th St & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 7:15	
File Name	2035_NB_10th_St_AM_WorstCase.xus					
Project Description	2035 NB AM					



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	140	520	280	480	1000	470	300		470	200		320

Signal Information										
Cycle, s	105.0	Reference Phase	6							
Offset, s	68	Reference Point	Begin	Green	12.7	12.0	26.0	22.7	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	4.5	4.5	4.5	3.7	0.0	0.0



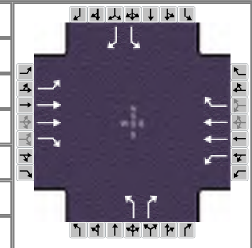
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	20.8	34.1	40.9	54.2		30.0		30.0
Change Period, ($Y+R_c$), s	8.1	8.1	8.1	8.1		7.3		7.3
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0		4.0		4.0
Queue Clearance Time (g_s), s	12.5		32.2			24.7		16.0
Green Extension Time (g_e), s	0.3	0.0	0.6	0.0		0.0		1.2
Phase Call Probability	0.99		1.00			1.00		1.00
Max Out Probability	0.04		1.00			1.00		0.38

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (v), veh/h	165	612	0	489	1019	0	353		0	235		0
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service Time (g_s), s	10.5	16.5	0.0	30.2	25.9	0.0	22.7		0.0	14.0		0.0
Cycle Queue Clearance Time (g_c), s	10.5	16.5	0.0	30.2	25.9	0.0	22.7		0.0	14.0		0.0
Green Ratio (g/C)	0.12	0.25	0.25	0.31	0.44	0.44	0.22		0.22	0.22		0.22
Capacity (c), veh/h	196	801	357	505	1419	632	418		311	418		311
Volume-to-Capacity Ratio (X)	0.842	0.763	0.000	0.969	0.718	0.000	0.844		0.000	0.563		0.000
Available Capacity (c_a), veh/h	322	801	357	538	1419	632	418		311	418		311
Back of Queue (Q), veh/ln (95th percentile)	8.1	9.3	0.0	8.4	10.6	0.0	15.8		0.0	9.4		0.0
Queue Storage Ratio (RQ) (95th percentile)	0.65	0.39	0.00	0.68	0.40	0.00	0.41		0.00	0.25		0.00
Uniform Delay (d_1), s/veh	45.6	25.8	0.0	19.0	21.3	0.0	41.3		0.0	37.7		0.0
Incremental Delay (d_2), s/veh	9.2	6.2	0.0	6.0	0.3	0.0	14.6		0.0	1.7		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0
Control Delay (d), s/veh	54.8	32.0	0.0	25.0	21.6	0.0	55.8		0.0	39.5		0.0
Level of Service (LOS)	D	C		C	C		E			D		
Approach Delay, s/veh / LOS	36.8	D		22.7	C		55.8	E		39.5	D	
Intersection Delay, s/veh / LOS	32.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.7	B	3.6	D	3.4	C
Bicycle LOS Score / LOS	1.1	A	1.9	A		F		F

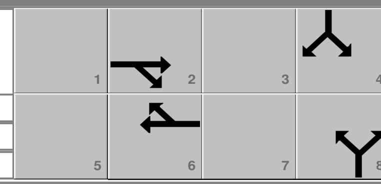
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	320	1200	370	410	700	280	350		500	410		220

Signal Information										
Cycle, s	110.0	Reference Phase	6							
Offset, s	80	Reference Point	Begin	Green	24.3	0.9	38.6	22.7	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	4.5	0.0	4.5	3.7	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	33.3	47.6	32.4	46.7		30.0		30.0
Change Period, ($Y+R_c$), s	8.1	8.1	8.1	8.1		7.3		7.3
Max Allow Headway (MAH), s	4.2	0.0	4.2	0.0		4.0		4.0
Queue Clearance Time (g_s), s	24.1		25.7			24.7		24.7
Green Extension Time (g_e), s	1.0	0.0	0.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.01		1.00			1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (v), veh/h	326	1224	0	440	751	0	376		0	441		0
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service Time (g_s), s	22.1	40.1	0.0	23.7	21.7	0.0	22.7		0.0	22.7		0.0
Cycle Queue Clearance Time (g_c), s	22.1	40.1	0.0	23.7	21.7	0.0	22.7		0.0	22.7		0.0
Green Ratio (g/C)	0.23	0.36	0.36	0.22	0.35	0.35	0.21		0.21	0.21		0.21
Capacity (c), veh/h	371	1178	524	349	1134	505	399		297	399		297
Volume-to-Capacity Ratio (X)	0.881	1.039	0.000	1.260	0.662	0.000	0.943		0.000	1.104		0.000
Available Capacity (c_a), veh/h	543	1178	524	366	1134	505	399		297	399		297
Back of Queue (Q), veh/ln (95th percentile)	14.2	20.7	0.0	26.9	12.0	0.0	19.7		0.0	28.0		0.0
Queue Storage Ratio (RQ) (95th percentile)	1.15	0.87	0.00	2.17	0.45	0.00	0.52		0.00	0.73		0.00
Uniform Delay (d_1), s/veh	52.4	21.5	0.0	28.9	30.6	0.0	44.9		0.0	45.5		0.0
Incremental Delay (d_2), s/veh	6.0	29.6	0.0	128.2	1.5	0.0	30.8		0.0	76.4		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0
Control Delay (d), s/veh	58.5	51.1	0.0	157.0	32.1	0.0	75.7		0.0	121.9		0.0
Level of Service (LOS)	E	F		F	C		E			F		
Approach Delay, s/veh / LOS	52.6	D		78.3	E		75.7	E		121.9	F	
Intersection Delay, s/veh / LOS	72.2						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.6	B	3.4	C	3.5	C
Bicycle LOS Score / LOS	1.8	A	1.5	A		F		F

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: 10th St & Conklin Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Conklin Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		860	10		1610	10
Peak-Hour Factor, PHF		0.85	0.85		0.85	0.85
Hourly Flow Rate, HFR		1011	11		1894	11
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0		2	0
Configuration		T	TR		T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			80			50
Peak Hour Factor, PHF			0.85			0.85
Hourly Flow Rate, HFR			94			58
Percent Heavy Vehicles			2			2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes			1			1
Configuration			R			R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					94			58
C(m) (vph)					561			449
v/c					0.17			0.13
95% queue length					0.60			0.44
Control Delay					12.7			14.2
LOS					B			B
Approach Delay				12.7			14.2	
Approach LOS				B			B	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: 10th St & Conklin Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Conklin Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		860	10		1610	10
Peak-Hour Factor, PHF		0.85	0.85		0.85	0.85
Peak-15 Minute Volume		253	3		474	3
Hourly Flow Rate, HFR		1011	11		1894	11
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0		2	0
Configuration		T	TR		T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			80			50
Peak Hour Factor, PHF			0.85			0.85
Peak-15 Minute Volume			24			15
Hourly Flow Rate, HFR			94			58
Percent Heavy Vehicles			2			2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
RT Channelized?			No			No
Lanes		1			1	
Configuration		R			R	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	325
	Through	760	1800	4	85	116	30	325
S5	Left-Turn	0	1800	3	0	116	30	300
	Through	1000	1800	4	56	116	30	300

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)						6.2			6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)						2			2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)						0.00			0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage					6.2			6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					2			2
t(f)					3.3			3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	760	0	1000	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	85	0	56	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.977	0.000	0.644	0.000
g(q1)	0.6	0.0	11.5	0.0
g(q2)	0.2	0.0	6.8	0.0
g(q)	0.8	0.0	18.2	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	7.370		6.803	
Smoothing Factor, F	0.289		0.306	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	845	0	3595	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	19.4	0.0
Proportion time blocked, p	0.000		0.167	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.167
p(dom)	0.167
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	1.000		
p(10)			
p(11)			
p(12)	0.833		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					511			952
s					3000			3000
Px					1.000			0.833
V c,u,x					511			542
C r,x					561			539
C plat,x					561			449

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	511	952
Potential Capacity	561	449
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	561	449
Probability of Queue free St.	0.83	0.87

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	1.00
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.83
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	1.00
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.87	0.83
Movement Capacity		

Results for Two-stage process:		
a		
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			94			58
Movement Capacity (vph)			561			449
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			561			449
Volume			94			58
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					94			58
C(m) (vph)					561			449
v/c					0.17			0.13
95% queue length					0.60			0.44
Control Delay					12.7			14.2
LOS					B			B
Approach Delay				12.7			14.2	
Approach LOS				B			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: 10th St & Conklin Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Conklin Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		1810	50		1250	20
Peak-Hour Factor, PHF		0.93	0.93		0.93	0.93
Hourly Flow Rate, HFR		1946	53		1344	21
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Raised curb		/ 1			
RT Channelized?						
Lanes		2	0		2	0
Configuration		T	TR		T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume			80			70
Peak Hour Factor, PHF			0.93			0.93
Hourly Flow Rate, HFR			86			75
Percent Heavy Vehicles			2			2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes		1			1	
Configuration		R			R	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					86			75
C(m) (vph)					328			628
v/c					0.26			0.12
95% queue length					1.03			0.40
Control Delay					19.8			11.5
LOS					C			B
Approach Delay				19.8			11.5	
Approach LOS				C			B	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: 10th St & Conklin Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS - 10th St Corridor
East/West Street: 10th St
North/South Street: Conklin Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1810	50		1250	20
Peak-Hour Factor, PHF		0.93	0.93		0.93	0.93
Peak-15 Minute Volume		487	13		336	5
Hourly Flow Rate, HFR		1946	53		1344	21
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						
Lanes		2	0		2	0
Configuration		T	TR		T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume			80			70
Peak Hour Factor, PHF			0.93			0.93
Peak-15 Minute Volume			22			19
Hourly Flow Rate, HFR			86			75
Percent Heavy Vehicles			2			2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			No
Lanes			1			1
Configuration			R			R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	116	30	325
	Through	1650	1800	4	83	116	30	325
S5	Left-Turn	0	1800	3	0	116	30	300
	Through	700	1800	4	42	116	30	300

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)						6.2			6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)						2			2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)						0.00			0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage					6.2			6.2
	2-stage					6.2			6.2

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)					2			2
t(f)					3.3			3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	1650	0	700	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	4	3	4	3
Effective Green, g (sec)	83	0	42	0
Cycle Length, C (sec)	116	116	116	116
Rp (from Exhibit 16-11)	1.333	1.000	1.333	1.000
Proportion vehicles arriving on green P	0.954	0.000	0.483	0.000
g(q1)	2.4	0.0	11.7	0.0
g(q2)	3.8	0.0	4.1	0.0
g(q)	6.3	0.0	15.8	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.400		0.400	
beta	0.714		0.714	
Travel time, t(a) (sec)	7.370		6.803	
Smoothing Factor, F	0.322		0.340	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3287	0	3595	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	80.9	0.0	16.0	0.0
Proportion time blocked, p	0.698		0.138	

Computation 3-Platoon Event Periods	Result
p(2)	0.698
p(5)	0.138
p(dom)	0.698
p(subo)	0.138
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)	0.302		
p(10)			
p(11)			
p(12)	0.862		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					1000			682
s					3000			3000
Px					0.302			0.862
V c,u,x					0			311
C r,x					1084			728
C plat,x					328			628

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s								
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	1000	682
Potential Capacity	328	628
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	328	628
Probability of Queue free St.	0.74	0.88

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	1.00
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.74
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	272	253
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	272	253
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	250	272
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	250	272
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	311	201
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	311	201
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	595	311
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.74
Movement Capacity	524	229
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	1.00
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	0.74
Movement Capacity		
Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			86			75
Movement Capacity (vph)			328			628
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			328			628
Volume			86			75
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

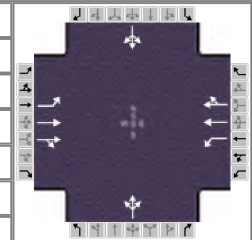
Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					86			75
C(m) (vph)					328			628
v/c					0.26			0.12
95% queue length					1.03			0.40
Control Delay					19.8			11.5
LOS					C			B
Approach Delay				19.8			11.5	
Approach LOS				C			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

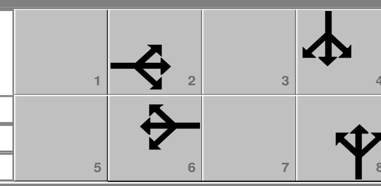
HCS 2010 Signalized Intersection Results Summary



General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Lowell Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	760	20	60	1490	110	20	40	40	70	30	40

Signal Information										
Cycle, s	110.0	Reference Phase	6							
Offset, s	97	Reference Point	Begin	Green	73.3	6.0	16.6	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.0	3.5	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	0.0	2.0	0.0	0.0	0.0



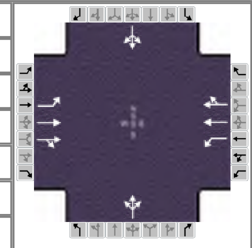
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		78.9	9.0	87.9		22.1		22.1
Change Period, ($Y+R_c$), s		5.6	5.6	5.6		5.5		5.5
Max Allow Headway (*MAH*), s		0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s			2.0			9.3		15.7
Green Extension Time (g_e), s		0.0	1.5	0.0		1.0		1.0
Phase Call Probability			0.85			1.00		1.00
Max Out Probability			1.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	461	457	61	823	812		118			165	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	294	1698	1683	1617	1698	1657		1567			1312	
Queue Service Time (g_s), s	6.6	15.3	15.3	0.0	4.6	4.3		0.0			6.2	
Cycle Queue Clearance Time (g_c), s	10.7	15.3	15.3	0.0	4.6	4.3		7.3			13.7	
Green Ratio (*g/C*)	0.67	0.67	0.67	0.68	0.75	0.75		0.15			0.15	
Capacity (*c*), veh/h	250	1132	1122	413	1271	1240		275			246	
Volume-to-Capacity Ratio (*X*)	0.141	0.407	0.407	0.148	0.648	0.655		0.428			0.668	
Available Capacity (c_a), veh/h	250	1132	1122	421	1271	1240		527			480	
Back of Queue (*Q*), veh/ln (95th percentile)	0.9	9.8	9.7	1.4	2.0	2.0		5.4			8.1	
Queue Storage Ratio (*RQ*) (95th percentile)	0.19	0.16	0.15	0.75	0.09	0.08		0.14			0.21	
Uniform Delay (d_1), s/veh	10.6	9.9	10.0	13.3	0.5	0.5		42.8			45.7	
Incremental Delay (d_2), s/veh	1.1	1.0	1.0	0.1	1.7	1.8		1.1			3.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	11.7	11.0	11.0	13.4	2.2	2.3		43.8			48.8	
Level of Service (LOS)	B	B	B	B	A	A		D			D	
Approach Delay, s/veh / LOS	11.0		B	2.6		A	43.8		D	48.8		D
Intersection Delay, s/veh / LOS	9.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.3	A	2.1	B	0.7	A	0.8	A

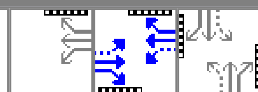
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Lowell Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

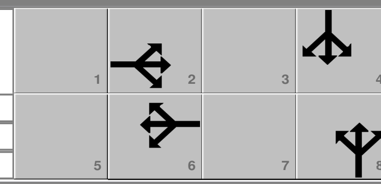


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1650	30	110	1120	90	20	20	80	130	40	50

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	53	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.7	63.3	22.9	0.0	0.0	0.0
Yellow	3.0	3.6	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		68.9	7.7	76.6		28.4		28.4
Change Period, (*Y+Rc*), s		5.6	3.0	5.6		5.5		5.5
Max Allow Headway (*MAH*), s		0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (*gs*), s			4.6			9.3		21.6
Green Extension Time (*ge*), s		0.0	0.3	0.0		1.5		1.3
Phase Call Probability			0.96			1.00		1.00
Max Out Probability			0.00			0.00		0.00

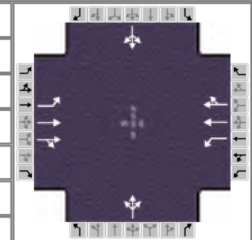
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	82	867	865	111	621	605		129			237	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	436	1698	1687	1617	1698	1653		1569			1252	
Queue Service Time (*gs*), s	10.0	40.3	40.6	2.6	19.8	19.2		0.0			12.0	
Cycle Queue Clearance Time (*gc*), s	22.7	40.3	40.6	2.6	19.8	19.2		7.3			19.6	
Green Ratio (*g/C*)	0.60	0.60	0.60	0.67	0.68	0.68		0.22			0.22	
Capacity (*c*), veh/h	283	1024	1017	199	1148	1118		383			328	
Volume-to-Capacity Ratio (*X*)	0.292	0.847	0.850	0.559	0.541	0.542		0.337			0.721	
Available Capacity (*ca*), veh/h	283	1024	1017	555	1148	1118		619			548	
Back of Queue (*Q*), veh/ln (95th percentile)	2.0	19.1	19.2	3.3	10.3	9.6		5.1			10.2	
Queue Storage Ratio (*RQ*) (95th percentile)	0.43	0.30	0.30	1.72	0.43	0.40		0.13			0.26	
Uniform Delay (*d1*), s/veh	13.1	12.9	13.0	21.1	8.8	8.4		34.9			40.4	
Incremental Delay (*d2*), s/veh	1.8	6.2	6.4	1.5	1.1	1.2		0.5			3.0	
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	14.9	19.2	19.4	22.6	10.0	9.5		35.5			43.4	
Level of Service (LOS)	B	B	B	C	A	A		D			D	
Approach Delay, s/veh / LOS	19.1	B		10.8	B		35.5	D		43.4	D	
Intersection Delay, s/veh / LOS	18.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	2.0	B	1.7	A	0.7	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:47:40 PM

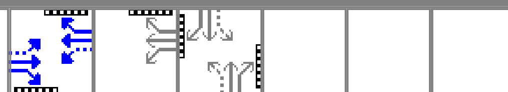
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Lowell Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

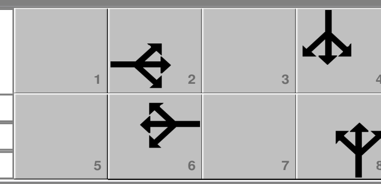


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	760	20	60	1490	110	20	40	40	70	30	40

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	95	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	69.1	6.0	15.8	0.0	0.0	0.0
Yellow	3.6	3.0	3.5	0.0	0.0	0.0
Red	2.0	0.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		74.7	9.0	83.7		21.3		21.3
Change Period, ($Y+R_c$), s		5.6	5.6	5.6		5.5		5.5
Max Allow Headway (*MAH*), s		0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s			2.0			9.0		14.9
Green Extension Time (g_e), s		0.0	1.6	0.0		1.1		1.0
Phase Call Probability			0.85			1.00		1.00
Max Out Probability			1.00			0.00		0.00

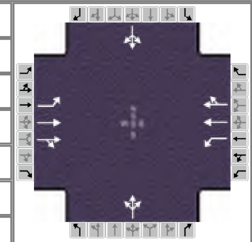
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	461	457	65	870	862		118			165	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	268	1698	1683	1617	1698	1657		1572			1325	
Queue Service Time (g_s), s	7.6	14.8	14.8	0.0	6.7	6.5		0.0			5.8	
Cycle Queue Clearance Time (g_c), s	13.9	14.8	14.8	0.0	6.7	6.5		7.0			12.9	
Green Ratio (*g/C*)	0.66	0.66	0.66	0.67	0.74	0.74		0.15			0.15	
Capacity (*c*), veh/h	228	1119	1108	413	1264	1233		277			250	
Volume-to-Capacity Ratio (*X*)	0.155	0.412	0.412	0.157	0.688	0.699		0.425			0.659	
Available Capacity (c_a), veh/h	228	1119	1108	422	1264	1233		582			533	
Back of Queue (*Q*), veh/ln (95th percentile)	0.9	9.4	9.4	1.5	2.4	2.4		5.1			7.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.20	0.15	0.15	0.77	0.10	0.10		0.13			0.20	
Uniform Delay (d_1), s/veh	11.9	9.8	9.8	13.3	0.7	0.7		40.9			43.6	
Incremental Delay (d_2), s/veh	1.4	1.1	1.1	0.1	1.8	1.9		1.0			2.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	13.3	10.9	10.9	13.4	2.5	2.6		41.9			46.5	
Level of Service (LOS)	B	B	B	B	A	A		D			D	
Approach Delay, s/veh / LOS	11.0		B	2.9		A	41.9		D	46.5		D
Intersection Delay, s/veh / LOS	9.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.3	A	2.1	B	0.7	A	0.8	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:44:46 PM

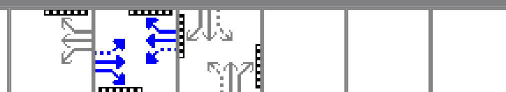
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Lowell Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

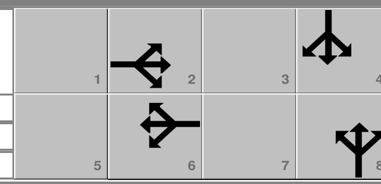


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1650	30	110	1120	90	20	20	80	130	40	50

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	55	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.9	67.1	24.0	0.0	0.0	0.0
Yellow	3.0	3.6	3.5	0.0	0.0	0.0
Red	0.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		72.7	7.9	80.5		29.5		29.5
Change Period, ($Y+R_c$), s		5.6	3.0	5.6		5.5		5.5
Max Allow Headway (*MAH*), s		0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s			4.8			9.7		22.7
Green Extension Time (g_e), s		0.0	0.3	0.0		1.4		1.2
Phase Call Probability			0.97			1.00		1.00
Max Out Probability			0.00			0.00		0.01

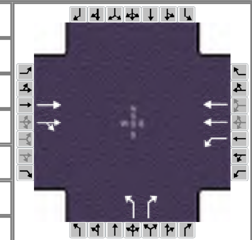
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	82	860	858	118	657	642		129			237	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	407	1698	1687	1617	1698	1653		1569			1243	
Queue Service Time (g_s), s	11.1	39.8	40.2	2.8	22.8	22.0		0.0			12.8	
Cycle Queue Clearance Time (g_c), s	27.5	39.8	40.2	2.8	22.8	22.0		7.7			20.7	
Green Ratio (g/C)	0.61	0.61	0.61	0.67	0.68	0.68		0.22			0.22	
Capacity (*c*), veh/h	259	1035	1028	205	1156	1126		381			323	
Volume-to-Capacity Ratio (*X*)	0.316	0.831	0.834	0.576	0.568	0.570		0.339			0.732	
Available Capacity (c_a), veh/h	259	1035	1028	392	1156	1126		550			482	
Back of Queue (*Q*), veh/ln (95th percentile)	2.3	18.6	18.7	3.6	11.7	10.8		5.4			10.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.47	0.30	0.30	1.89	0.49	0.45		0.14			0.27	
Uniform Delay (d_1), s/veh	14.3	12.3	12.3	21.1	9.6	9.0		36.6			42.5	
Incremental Delay (d_2), s/veh	2.3	5.7	5.8	1.5	1.2	1.2		0.5			3.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	16.6	18.0	18.1	22.5	10.8	10.2		37.1			45.7	
Level of Service (LOS)	B	B	B	C	B	B		D			D	
Approach Delay, s/veh / LOS	18.0		B	11.5		B	37.1		D	45.7		D
Intersection Delay, s/veh / LOS	17.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	2.0	B	1.7	A	0.7	A	0.9	A

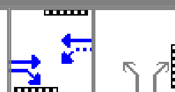
 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:50:43 PM

HCS 2010 Signalized Intersection Results Summary

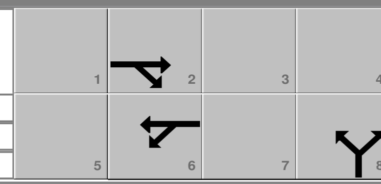
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Jessica Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		750	30	30	1520		110		60			



Signal Information										
Cycle, s	110.0	Reference Phase	2							
Offset, s	29	Reference Point	Begin	Green	87.8	11.0	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		6.0		9.0		
Phase Duration, s		93.4		93.4		16.6		
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		
Queue Clearance Time (g_s), s						10.3		
Green Extension Time (g_e), s		0.0		0.0		0.7		
Phase Call Probability						1.00		
Max Out Probability						0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		462	456	31	1563		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1675	583	1617		1681		1496			
Queue Service Time (g_s), s		18.9	4.5	0.3	4.3		8.3		4.9			
Cycle Queue Clearance Time (g_c), s		18.9	4.5	20.6	4.3		8.3		4.9			
Green Ratio (*g/C*)		0.80	0.80	0.80	0.80		0.10		0.10			
Capacity (*c*), veh/h		1356	1337	430	2581		168		149			
Volume-to-Capacity Ratio (*X*)		0.341	0.341	0.072	0.606		0.771		0.472			
Available Capacity (c_a), veh/h		1356	1337	430	2581		602		536			
Back of Queue (*Q*), veh/ln (95th percentile)		2.1	2.1	0.3	1.3		6.8		3.5			
Queue Storage Ratio (*RQ*) (95th percentile)		0.06	0.05	0.07	0.02		1.73		0.18			
Uniform Delay (d_1), s/veh		1.4	1.4	3.1	0.4		48.3		46.8			
Incremental Delay (d_2), s/veh		0.7	0.7	0.2	0.8		7.3		2.3			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		2.1	2.1	3.3	1.2		55.6		49.1			
Level of Service (LOS)		A	A	A	A		E		D			

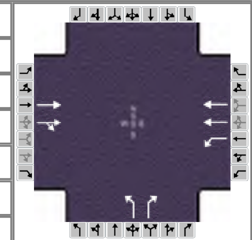
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	2.1	A	1.2	A	53.3	D	0.0	
Intersection Delay, s/veh / LOS	5.4				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	2.9	C	2.7	B
Bicycle LOS Score / LOS	1.2	A	2.0	A		F		

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:38:32 PM

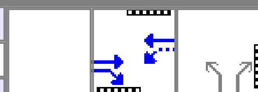
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Jessica Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

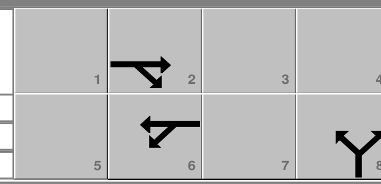


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		1720	120	80	1110		60		40			

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	27	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	87.8	6.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



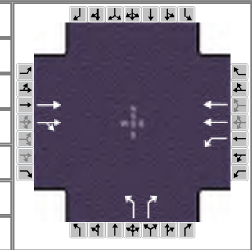
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		6.0		9.0		
Phase Duration, s		93.4		93.4		11.6		
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		
Max Allow Headway (MAH), s		0.0		0.0		4.3		
Queue Clearance Time (g_s), s						6.0		
Green Extension Time (g_e), s		0.0		0.0		0.3		
Phase Call Probability						0.96		
Max Out Probability						0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		949	947	81	1129		65		43			
Adjusted Saturation Flow Rate (s), veh/h/ln		1698	1659	229	1617		1681		1496			
Queue Service Time (g_s), s		51.0	7.6	36.7	9.9		4.0		2.9			
Cycle Queue Clearance Time (g_c), s		51.0	7.6	87.8	9.9		4.0		2.9			
Green Ratio (g/C)		0.84	0.84	0.84	0.84		0.06		0.06			
Capacity (c), veh/h		1420	1387	148	2704		96		85			
Volume-to-Capacity Ratio (X)		0.668	0.682	0.548	0.417		0.672		0.503			
Available Capacity (c_a), veh/h		1420	1387	148	2704		391		348			
Back of Queue (Q), veh/ln (95th percentile)		2.2	2.3	4.5	3.6		3.3		2.2			
Queue Storage Ratio (RQ) (95th percentile)		0.06	0.06	1.19	0.06		0.85		0.11			
Uniform Delay (d_1), s/veh		0.6	0.5	35.3	2.4		48.5		48.1			
Incremental Delay (d_2), s/veh		1.6	1.8	11.4	0.4		7.9		4.5			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		2.2	2.3	46.7	2.8		56.4		52.6			
Level of Service (LOS)		A	A	D	A		E		D			
Approach Delay, s/veh / LOS	2.3		A	5.7		A	54.9		D	0.0		
Intersection Delay, s/veh / LOS	5.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	2.9	C	2.7	B
Bicycle LOS Score / LOS	2.1	B	1.5	A		F		

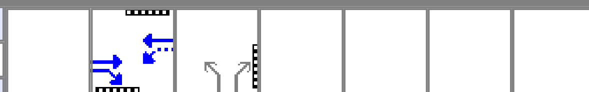
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Jessica Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

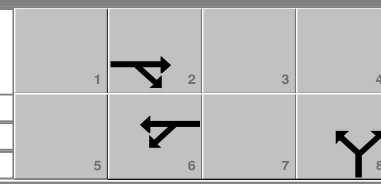


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		750	30	30	1520		110		60			

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	32	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	83.2	10.6	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		6.0		9.0		
Phase Duration, s		88.8		88.8		16.2		
Change Period, (*Y+Rc*), s		5.6		5.6		5.6		
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		
Queue Clearance Time (g_s), s						9.9		
Green Extension Time (g_e), s		0.0		0.0		0.7		
Phase Call Probability						1.00		
Max Out Probability						0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		462	456	33	1651		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1675	583	1617		1681		1496			
Queue Service Time (g_s), s		20.4	4.6	0.3	4.4		7.9		4.7			
Cycle Queue Clearance Time (g_c), s		20.4	4.6	22.3	4.4		7.9		4.7			
Green Ratio (*g/C*)		0.79	0.79	0.79	0.79		0.10		0.10			
Capacity (*c*), veh/h		1345	1327	416	2561		170		151			
Volume-to-Capacity Ratio (*X*)		0.343	0.343	0.078	0.644		0.762		0.467			
Available Capacity (c_a), veh/h		1345	1327	416	2561		695		618			
Back of Queue (*Q*), veh/ln (95th percentile)		2.1	2.1	0.3	1.3		6.5		3.3			
Queue Storage Ratio (*RQ*) (95th percentile)		0.06	0.05	0.08	0.02		1.64		0.17			
Uniform Delay (d_1), s/veh		1.5	1.5	3.6	0.4		46.0		44.5			
Incremental Delay (d_2), s/veh		0.7	0.7	0.2	0.8		6.9		2.2			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		2.2	2.1	3.8	1.2		52.8		46.8			
Level of Service (LOS)		A	A	A	A		D		D			

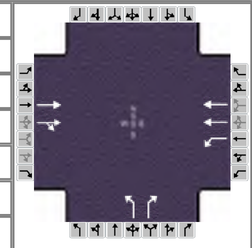
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	2.2	A	1.3	A	50.7	D	0.0	
Intersection Delay, s/veh / LOS	5.1				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	2.9	C	2.7	B
Bicycle LOS Score / LOS	1.2	A	2.0	A		F		

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:44:46 PM

HCS 2010 Signalized Intersection Results Summary

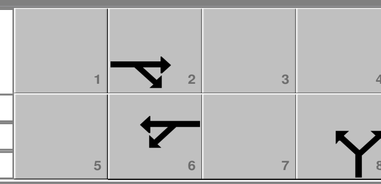
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Jessica Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		1720	120	80	1110		60		40			

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	28	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	92.6	6.2	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		6.0		9.0		
Phase Duration, s		98.2		98.2		11.8		
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		
Max Allow Headway (MAH), s		0.0		0.0		4.3		
Queue Clearance Time (g_s), s						6.1		
Green Extension Time (g_e), s		0.0		0.0		0.3		
Phase Call Probability						0.96		
Max Out Probability						0.00		

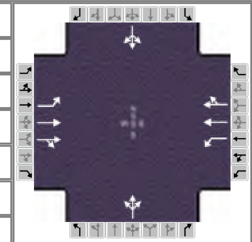
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		941	938	86	1192		65		43			
Adjusted Saturation Flow Rate (s), veh/h/ln		1698	1659	232	1617		1681		1496			
Queue Service Time (g_s), s		52.4	7.3	40.0	11.2		4.1		3.1			
Cycle Queue Clearance Time (g_c), s		52.4	7.3	92.6	11.2		4.1		3.1			
Green Ratio (g/C)		0.84	0.84	0.84	0.84		0.06		0.06			
Capacity (c), veh/h		1429	1396	150	2721		95		85			
Volume-to-Capacity Ratio (X)		0.659	0.672	0.573	0.438		0.678		0.508			
Available Capacity (c_a), veh/h		1429	1396	150	2721		388		345			
Back of Queue (Q), veh/ln (95th percentile)		2.2	2.2	5.0	4.3		3.5		2.3			
Queue Storage Ratio (RQ) (95th percentile)		0.06	0.06	1.31	0.07		0.89		0.11			
Uniform Delay (d_1), s/veh		0.5	0.5	36.4	2.5		50.9		50.4			
Incremental Delay (d_2), s/veh		1.6	1.7	12.0	0.4		8.1		4.6			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		2.1	2.2	48.4	2.9		59.0		55.0			
Level of Service (LOS)		A	A	D	A		E		E			
Approach Delay, s/veh / LOS	2.2		A	6.0		A	57.4		E	0.0		
Intersection Delay, s/veh / LOS	5.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	2.9	C	2.7	B
Bicycle LOS Score / LOS	2.1	B	1.5	A		F		

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:50:43 PM

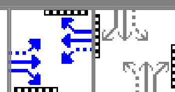
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Blauvelt Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

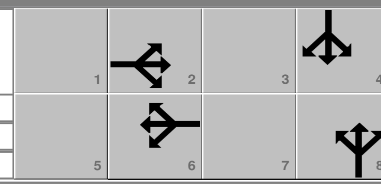


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	720	10	20	1580	30	10	10	30	30	10	20

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	15	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	91.6	7.2	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



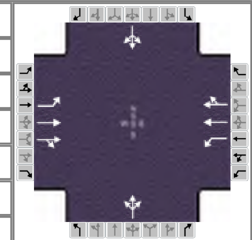
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		97.2		97.2		12.8		12.8
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						5.8		6.9
Green Extension Time (g_e), s		0.0		0.0		0.5		0.5
Phase Call Probability						0.98		0.98
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	12	430	428	21	837	834		59			71	
Adjusted Saturation Flow Rate (s), veh/h/ln	284	1698	1690	616	1698	1687		1606			1524	
Queue Service Time (g_s), s	0.1	0.2	0.2	0.8	20.2	20.3		0.0			1.4	
Cycle Queue Clearance Time (g_c), s	22.2	0.2	0.2	1.6	20.2	20.3		3.8			4.9	
Green Ratio (g/C)	0.83	0.83	0.83	0.83	0.83	0.83		0.07			0.07	
Capacity (c), veh/h	248	1415	1408	575	1415	1405		144			148	
Volume-to-Capacity Ratio (X)	0.047	0.304	0.304	0.036	0.592	0.594		0.409			0.476	
Available Capacity (c_a), veh/h	248	1415	1408	575	1415	1405		711			694	
Back of Queue (Q), veh/ln (95th percentile)	0.1	0.4	0.4	0.1	9.0	9.0		3.0			3.6	
Queue Storage Ratio (RQ) (95th percentile)	0.03	0.01	0.01	0.04	0.23	0.24		0.15			0.18	
Uniform Delay (d_1), s/veh	2.8	0.1	0.1	2.2	3.8	3.8		49.9			50.3	
Incremental Delay (d_2), s/veh	0.3	0.5	0.5	0.1	1.4	1.4		1.9			2.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	3.1	0.5	0.5	2.3	5.1	5.2		51.7			52.6	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	0.6		A	5.1		A	51.7		D	52.6		D
Intersection Delay, s/veh / LOS	5.9						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	2.1	B	0.6	A	0.6	A

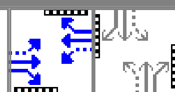
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Blauvelt Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

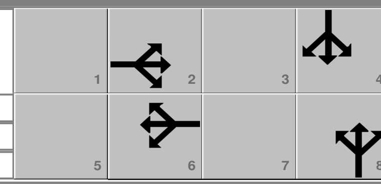


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	50	1760	90	60	1070	40	20	10	30	50	20	40

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	22	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	83.4	10.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



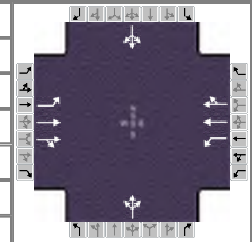
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		89.0		89.0		16.0		16.0
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						6.0		9.7
Green Extension Time (g_e), s		0.0		0.0		0.7		0.7
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	51	952	950	61	570	562		65			118	
Adjusted Saturation Flow Rate (s), veh/h/ln	477	1698	1669	227	1698	1676		1533			1539	
Queue Service Time (g_s), s	1.3	10.9	11.5	12.7	10.4	10.4		0.0			4.1	
Cycle Queue Clearance Time (g_c), s	13.3	10.9	11.5	25.9	10.4	10.4		4.0			7.7	
Green Ratio (g/C)	0.79	0.79	0.79	0.79	0.79	0.79		0.10			0.10	
Capacity (c), veh/h	398	1349	1325	221	1349	1331		198			202	
Volume-to-Capacity Ratio (X)	0.129	0.706	0.717	0.277	0.422	0.422		0.326			0.584	
Available Capacity (c_a), veh/h	398	1349	1325	221	1349	1331		702			706	
Back of Queue (Q), veh/ln (95th percentile)	0.3	2.1	2.1	1.3	5.0	5.0		2.9			5.6	
Queue Storage Ratio (RQ) (95th percentile)	0.06	0.04	0.04	0.35	0.13	0.13		0.15			0.29	
Uniform Delay (d_1), s/veh	2.3	1.0	1.0	7.8	3.1	3.1		44.4			46.0	
Incremental Delay (d_2), s/veh	0.1	0.4	0.4	2.8	0.9	0.9		1.0			2.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	2.4	1.4	1.5	10.6	4.0	4.0		45.3			48.6	
Level of Service (LOS)	A	A	A	B	A	A		D			D	
Approach Delay, s/veh / LOS	1.5		A	4.3		A	45.3		D	48.6		D
Intersection Delay, s/veh / LOS	5.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.2	B	1.5	A	0.6	A	0.7	A

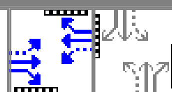
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Blauvelt Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

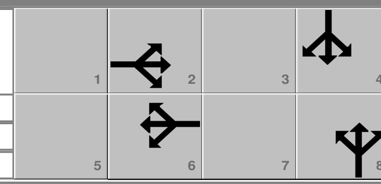


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	720	10	20	1580	30	10	10	30	30	10	20

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	17	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	86.9	6.9	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		92.5		92.5		12.5		12.5
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						5.6		6.6
Green Extension Time (g_e), s		0.0		0.0		0.5		0.5
Phase Call Probability						0.98		0.98
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	430	428	22	880	878		59			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	261	1698	1690	616	1698	1687		1603			1538	
Queue Service Time (g_s), s	0.1	0.3	0.3	0.8	21.2	21.5		0.0			1.3	
Cycle Queue Clearance Time (g_c), s	24.6	0.3	0.3	1.7	21.2	21.5		3.6			4.6	
Green Ratio (*g/C*)	0.83	0.83	0.83	0.83	0.83	0.83		0.07			0.07	
Capacity (*c*), veh/h	227	1406	1399	574	1406	1396		146			152	
Volume-to-Capacity Ratio (*X*)	0.052	0.306	0.306	0.038	0.626	0.629		0.402			0.464	
Available Capacity (c_a), veh/h	227	1406	1399	574	1406	1396		716			700	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	0.4	0.4	0.1	8.9	8.9		2.8			3.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.03	0.01	0.01	0.04	0.23	0.23		0.14			0.17	
Uniform Delay (d_1), s/veh	3.6	0.1	0.1	2.1	3.8	3.8		47.6			47.9	
Incremental Delay (d_2), s/veh	0.4	0.5	0.5	0.1	1.5	1.5		1.8			2.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	4.0	0.6	0.6	2.2	5.3	5.4		49.4			50.1	
Level of Service (LOS)	A	A	A	A	A	A		D			D	

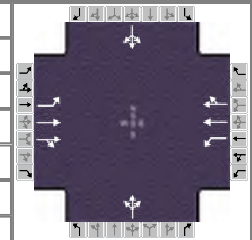
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.6	A	5.3	A	49.4	D	50.1	D
Intersection Delay, s/veh / LOS	5.9				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	2.1	B	0.6	A	0.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:44:46 PM

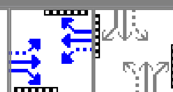
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Blauvelt Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

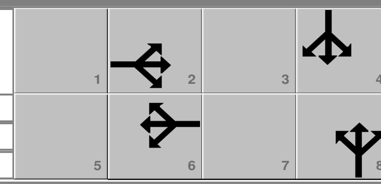


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	50	1760	90	60	1070	40	20	10	30	50	20	40

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	23	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	88.0	10.8	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		93.6		93.6		16.4		16.4
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						6.2		10.2
Green Extension Time (g_e), s		0.0		0.0		0.7		0.7
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	51	944	942	64	600	592		65			118	
Adjusted Saturation Flow Rate (s), veh/h/ln	450	1698	1669	231	1698	1676		1521			1528	
Queue Service Time (g_s), s	0.7	13.0	13.2	14.5	11.3	11.3		0.0			4.4	
Cycle Queue Clearance Time (g_c), s	14.5	13.0	13.2	31.2	11.3	11.3		4.2			8.2	
Green Ratio (g/C)	0.80	0.80	0.80	0.80	0.80	0.80		0.10			0.10	
Capacity (c), veh/h	376	1358	1335	215	1358	1341		193			198	
Volume-to-Capacity Ratio (X)	0.136	0.695	0.706	0.299	0.442	0.442		0.334			0.597	
Available Capacity (c_a), veh/h	376	1358	1335	215	1358	1341		670			673	
Back of Queue (Q), veh/ln (95th percentile)	0.2	2.7	2.6	1.6	5.4	5.4		3.1			6.0	
Queue Storage Ratio (RQ) (95th percentile)	0.05	0.05	0.05	0.41	0.14	0.14		0.16			0.30	
Uniform Delay (d_1), s/veh	1.8	1.3	1.3	9.1	3.1	3.1		46.6			48.3	
Incremental Delay (d_2), s/veh	0.1	0.4	0.5	3.2	0.9	0.9		1.0			2.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	1.9	1.8	1.8	12.3	4.0	4.0		47.6			51.2	
Level of Service (LOS)	A	A	A	B	A	A		D			D	

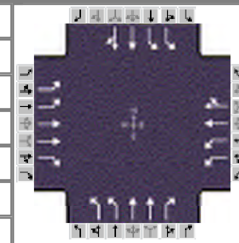
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	1.8	A	4.5	A	47.6	D	51.2	D
Intersection Delay, s/veh / LOS	5.4				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.2	B	1.5	A	0.6	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:50:43 PM

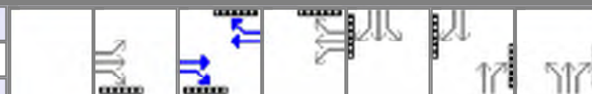
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Cliff Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

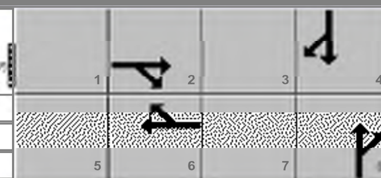


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	400	140	310	1090	210	150	400	180	160	370	140

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	107	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.8	28.2	16.8	8.7	5.8	9.8
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	2.0	2.1	2.0	2.0	2.1	2.0



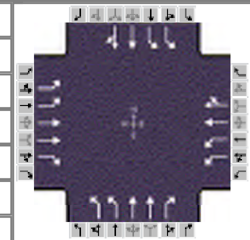
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	12.4	46.4	22.4	56.4	15.4	26.9	14.3	25.8
Change Period, ($Y+R_c$), s	5.6	5.7	5.7	5.7	5.7	5.7	5.6	5.7
Max Allow Headway (*MAH*), s	4.3	0.0	4.3	0.0	4.1	4.1	4.2	4.2
Queue Clearance Time (g_s), s	6.5		12.6		7.7	16.3	8.2	18.7
Green Extension Time (g_e), s	0.4	0.0	4.9	0.0	2.0	2.3	0.6	1.4
Phase Call Probability	0.98		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.00		0.66		0.17	0.06	0.00	0.16

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	471	0	322	672	643	176	471	0	188	273	259
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1615	1616	1664	1481	1616	1748	1637
Queue Service Time (g_s), s	4.5	10.4	0.0	10.6	35.8	36.2	5.7	14.3	0.0	6.2	16.4	16.7
Cycle Queue Clearance Time (g_c), s	4.5	10.4	0.0	10.6	35.8	36.2	5.7	14.3	0.0	6.2	16.4	16.7
Green Ratio (*g/C*)	0.06	0.37	0.37	0.15	0.46	0.46	0.09	0.19	0.19	0.08	0.18	0.18
Capacity (*c*), veh/h	195	1195	532	478	782	744	284	640	285	257	320	300
Volume-to-Capacity Ratio (*X*)	0.662	0.394	0.000	0.674	0.860	0.865	0.621	0.735	0.000	0.732	0.855	0.866
Available Capacity (c_a), veh/h	679	1195	532	637	782	744	500	863	384	616	443	415
Back of Queue (*Q*), veh/ln (95th percentile)	3.6	7.0	0.0	7.3	19.9	19.4	4.2	9.6	0.0	4.7	12.2	11.9
Queue Storage Ratio (*RQ*) (95th percentile)	0.54	0.25	0.00	1.09	0.39	0.38	0.62	0.28	0.00	1.59	0.54	0.53
Uniform Delay (d_1), s/veh	53.7	21.0	0.0	44.0	18.6	18.7	46.8	38.3	0.0	48.0	40.2	40.3
Incremental Delay (d_2), s/veh	3.7	0.9	0.0	1.3	9.5	10.3	2.2	2.2	0.0	4.0	11.3	13.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	57.4	21.9	0.0	45.4	28.2	29.0	49.0	40.5	0.0	52.0	51.5	53.4
Level of Service (LOS)	E	C		D	C	C	D	D		D	D	D
Approach Delay, s/veh / LOS	29.5	C		31.9	C		42.9	D		52.3	D	
Intersection Delay, s/veh / LOS	37.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	3.0	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	2.0	B	1.0	A	1.1	A

HCS 2010 Signalized Intersection Results Summary

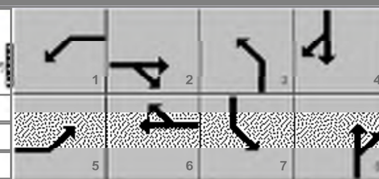
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cliff Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	220	1180	200	240	680	210	210	520	360	360	530	160

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	105	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.1	22.6	10.3	15.3	3.8	9.2
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	2.0	2.1	2.0	2.0	2.1	2.0



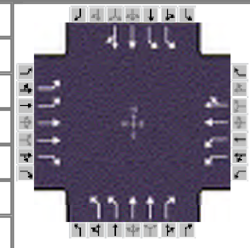
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	15.7	44.0	15.9	44.1	14.8	24.2	20.9	30.4
Change Period, (*Y*+R_c), s	5.6	5.7	5.7	5.7	5.7	5.7	5.6	5.7
Max Allow Headway (*MAH*), s	4.3	0.0	4.3	0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	9.6		10.0		9.2	19.4	14.1	23.2
Green Extension Time (g_e), s	0.5	0.0	0.2	0.0	0.0	0.0	1.2	1.4
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.20		1.00		1.00	1.00	0.04	0.75

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1269	65	245	472	434	226	559	194	387	368	344
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1562	1616	1664	1481	1616	1748	1627
Queue Service Time (g_s), s	7.6	38.3	2.5	8.0	23.3	23.3	7.2	17.4	12.7	12.1	21.1	21.2
Cycle Queue Clearance Time (g_c), s	7.6	38.3	2.5	8.0	23.3	23.3	7.2	17.4	12.7	12.1	21.1	21.2
Green Ratio (*g/C*)	0.10	0.36	0.36	0.10	0.37	0.37	0.09	0.18	0.18	0.15	0.23	0.23
Capacity (*c*), veh/h	303	1179	525	304	621	571	279	588	262	471	411	382
Volume-to-Capacity Ratio (*X*)	0.780	1.076	0.123	0.807	0.759	0.760	0.808	0.952	0.740	0.822	0.896	0.900
Available Capacity (c_a), veh/h	490	1179	525	308	621	571	279	588	262	756	473	441
Back of Queue (*Q*), veh/ln (95th percentile)	5.3	28.6	1.6	6.7	14.5	13.6	6.1	13.6	8.3	8.4	15.6	15.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.79	1.03	0.24	1.01	0.29	0.27	0.90	0.40	1.69	2.86	0.69	0.67
Uniform Delay (d_1), s/veh	43.2	27.2	17.0	46.4	21.9	21.8	45.6	39.7	4.9	41.0	34.8	34.9
Incremental Delay (d_2), s/veh	3.0	45.4	0.3	13.2	7.7	8.4	16.0	25.6	10.6	4.0	17.8	19.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	46.2	72.6	17.3	59.6	29.6	30.2	61.6	65.3	15.5	45.0	52.6	54.3
Level of Service (LOS)	D	F	B	E	C	C	E	E	B	D	D	D
Approach Delay, s/veh / LOS	66.4	E		36.2	D		54.6	D		50.5	D	
Intersection Delay, s/veh / LOS	53.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	3.0	C	3.3	C
Bicycle LOS Score / LOS	1.8	A	1.5	A	1.3	A	1.4	A

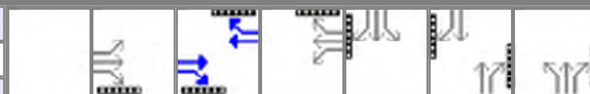
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Cliff Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

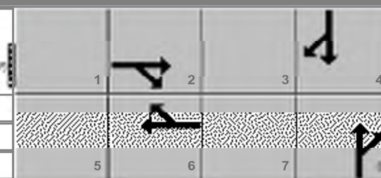


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	400	140	310	1090	210	150	400	180	160	370	140

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	101	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.6	25.8	16.3	8.2	5.5	8.9
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	2.0	2.1	2.0	2.0	2.1	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	4.0	2.0	3.0	2.0	4.0
Phase Duration, s	12.2	43.6	21.9	53.4	14.5	25.7	13.8	25.0
Change Period, ($Y+R_c$), s	5.6	5.7	5.7	5.7	5.7	5.7	5.6	5.7
Max Allow Headway (*MAH*), s	4.3	0.0	4.3	0.0	4.1	4.1	4.2	4.2
Queue Clearance Time (g_s), s	6.3		12.7		7.5	15.7	7.9	17.9
Green Extension Time (g_e), s	0.4	0.0	3.8	0.0	1.3	1.8	0.3	1.4
Phase Call Probability	0.98		1.00		0.99	1.00	1.00	1.00
Max Out Probability	0.00		0.92		0.77	0.27	0.76	0.21

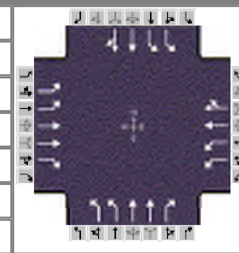
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	471	0	338	706	677	176	471	0	188	273	259
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1615	1616	1664	1481	1616	1748	1637
Queue Service Time (g_s), s	4.3	9.9	0.0	10.7	38.9	39.7	5.5	13.7	0.0	5.9	15.7	15.9
Cycle Queue Clearance Time (g_c), s	4.3	9.9	0.0	10.7	38.9	39.7	5.5	13.7	0.0	5.9	15.7	15.9
Green Ratio (*g/C*)	0.06	0.36	0.36	0.15	0.45	0.45	0.08	0.19	0.19	0.08	0.18	0.18
Capacity (*c*), veh/h	197	1168	520	485	771	733	270	633	282	252	321	301
Volume-to-Capacity Ratio (*X*)	0.657	0.403	0.000	0.698	0.916	0.924	0.655	0.743	0.000	0.747	0.851	0.862
Available Capacity (c_a), veh/h	629	1168	520	547	771	733	381	748	333	385	439	411
Back of Queue (*Q*), veh/ln (95th percentile)	3.4	6.7	0.0	7.3	22.2	21.9	4.1	9.3	0.0	4.5	11.7	11.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.51	0.24	0.00	1.10	0.44	0.43	0.59	0.27	0.00	1.52	0.52	0.51
Uniform Delay (d_1), s/veh	51.1	20.1	0.0	42.1	19.7	19.9	45.2	36.8	0.0	46.0	38.3	38.4
Incremental Delay (d_2), s/veh	3.6	1.0	0.0	2.5	13.8	15.3	2.7	3.3	0.0	4.4	11.2	13.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	54.6	21.1	0.0	44.6	33.6	35.2	47.9	40.2	0.0	50.4	49.5	51.4
Level of Service (LOS)	D	C		D	C	D	D	D		D	D	D
Approach Delay, s/veh / LOS	28.3	C		36.4	D		42.3	D		50.4	D	
Intersection Delay, s/veh / LOS	38.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	3.0	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	2.0	B	1.0	A	1.1	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:39:33 AM

HCS 2010 Signalized Intersection Results Summary

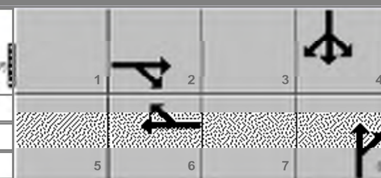
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cliff Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	220	1180	200	240	680	210	210	520	360	360	530	160

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	109	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	10.6	23.4	12.3	12.6	7.5	9.9
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
Red	2.0	2.1	2.0	2.0	2.1	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	3.0	2.0	4.0	2.0	3.0	1.2	4.0
Phase Duration, s	16.2	45.3	17.9	47.0	15.5	28.7	18.2	31.4
Change Period, (*Y*+*R*c), s	5.6	5.7	5.7	5.7	5.7	5.7	5.6	5.7
Max Allow Headway (*MAH*), s	4.3	0.0	4.3	0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (*g*s), s	10.0		10.7		9.5	19.2	14.0	24.3
Green Extension Time (*g*e), s	0.6	0.0	1.4	0.0	0.3	1.7	0.0	1.4
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.11		1.00		1.00	1.00	1.00	0.76

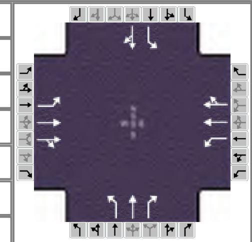
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1269	65	258	496	456	226	559	194	387	368	344
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1562	1616	1664	1481	1616	1748	1627
Queue Service Time (*g*s), s	8.0	39.5	2.6	8.7	25.7	25.7	7.5	17.2	12.6	12.0	22.1	22.3
Cycle Queue Clearance Time (*g*c), s	8.0	39.5	2.6	8.7	25.7	25.7	7.5	17.2	12.6	12.0	22.1	22.3
Green Ratio (*g/C*)	0.10	0.36	0.36	0.11	0.38	0.38	0.09	0.21	0.21	0.20	0.23	0.23
Capacity (*c*), veh/h	301	1162	517	347	637	586	287	693	309	504	409	380
Volume-to-Capacity Ratio (*X*)	0.785	1.092	0.125	0.743	0.778	0.778	0.786	0.807	0.627	0.769	0.900	0.904
Available Capacity (*c*a), veh/h	504	1162	517	380	637	586	295	698	311	504	468	436
Back of Queue (*Q*), veh/ln (95th percentile)	5.6	30.9	1.7	6.8	15.8	14.8	6.2	11.6	7.8	8.7	16.3	15.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.83	1.12	0.25	1.02	0.31	0.29	0.91	0.34	1.59	2.95	0.73	0.70
Uniform Delay (*d*1), s/veh	45.5	29.1	18.4	47.4	22.3	22.2	47.5	37.7	10.9	38.5	36.6	36.7
Incremental Delay (*d*2), s/veh	3.2	51.4	0.3	6.3	8.2	8.9	12.9	6.9	3.9	7.1	18.6	20.4
Initial Queue Delay (*d*3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	48.6	80.5	18.7	53.7	30.5	31.1	60.3	44.6	14.9	45.6	55.2	57.0
Level of Service (LOS)	D	F	B	D	C	C	E	D	B	D	E	E
Approach Delay, s/veh / LOS	73.2	E		35.6	D		42.3	D		52.4	D	
Intersection Delay, s/veh / LOS	52.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.0	C	3.0	C	3.3	C
Bicycle LOS Score / LOS	1.8	A	1.5	A	1.3	A	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:42:06 AM

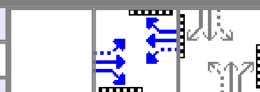
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Fairfax Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

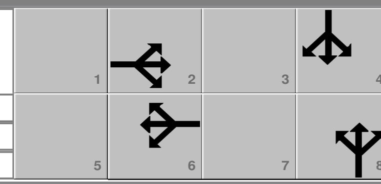


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	30	600	50	60	1290	30	160	40	20	30	30	30

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	99	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	77.4	21.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		5.0		6.0
Phase Duration, s		83.0		83.0		27.0		27.0
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						21.4		6.9
Green Extension Time (g_e), s		0.0		0.0		0.0		1.2
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	35	387	377	64	707	702	188	47	24	35	71	
Adjusted Saturation Flow Rate (s), veh/h/ln	366	1698	1652	673	1698	1684	1324	1765	1496	1353	1619	
Queue Service Time (g_s), s	4.9	9.9	10.0	1.6	12.1	12.0	15.3	2.4	1.4	2.4	4.0	
Cycle Queue Clearance Time (g_c), s	17.0	9.9	10.0	12.5	12.1	12.0	19.4	2.4	1.4	4.9	4.0	
Green Ratio (g/C)	0.70	0.70	0.70	0.70	0.70	0.70	0.19	0.19	0.19	0.19	0.19	
Capacity (c), veh/h	283	1195	1162	478	1195	1185	274	343	291	299	315	
Volume-to-Capacity Ratio (X)	0.125	0.324	0.325	0.134	0.591	0.592	0.686	0.137	0.081	0.118	0.224	
Available Capacity (c_a), veh/h	283	1195	1162	478	1195	1185	274	343	291	299	315	
Back of Queue (Q), veh/ln (95th percentile)	0.8	6.7	6.5	0.5	4.6	4.5	9.4	1.9	1.0	1.5	2.9	
Queue Storage Ratio (RQ) (95th percentile)	0.22	0.23	0.23	0.14	0.17	0.16	1.59	0.10	0.32	0.76	0.15	
Uniform Delay (d_1), s/veh	10.4	6.5	6.5	3.6	2.9	2.8	45.5	36.7	36.3	38.7	37.3	
Incremental Delay (d_2), s/veh	0.9	0.7	0.7	0.3	1.0	1.0	6.9	0.2	0.1	0.2	0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	11.2	7.2	7.2	3.8	3.8	3.8	52.4	36.8	36.4	38.9	37.7	
Level of Service (LOS)	B	A	A	A	A	A	D	D	D	D	D	

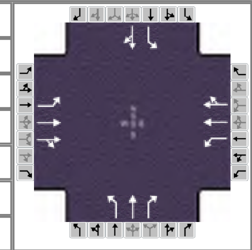
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	7.4	A	3.8	A	48.1	D	38.1	D
Intersection Delay, s/veh / LOS	10.6				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.1	A	1.8	A	0.9	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:38:32 PM

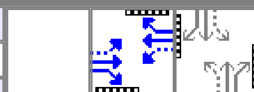
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Fairfax Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

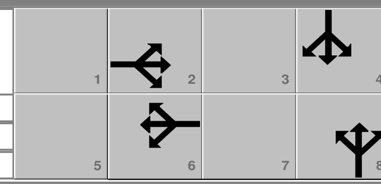


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	20	1490	150	70	920	60	70	30	60	50	100	30

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	85	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	78.4	15.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



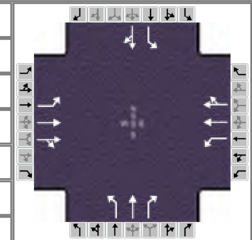
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		5.0		6.0
Phase Duration, s		84.0		84.0		21.0		21.0
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						16.3		10.1
Green Extension Time (g_e), s		0.0		0.0		0.0		0.7
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.61

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	22	887	877	73	516	505	75	32	65	54	140	
Adjusted Saturation Flow Rate (s), veh/h/ln	530	1698	1644	260	1698	1661	1244	1765	1496	1371	1694	
Queue Service Time (g_s), s	0.5	15.7	16.1	14.8	8.7	8.8	6.3	1.7	4.0	3.7	8.1	
Cycle Queue Clearance Time (g_c), s	9.7	15.7	16.1	32.8	8.7	8.8	14.3	1.7	4.0	5.4	8.1	
Green Ratio (g/C)	0.75	0.75	0.75	0.75	0.75	0.75	0.15	0.15	0.15	0.15	0.15	
Capacity (c), veh/h	419	1268	1227	221	1268	1240	156	259	219	248	249	
Volume-to-Capacity Ratio (X)	0.051	0.699	0.714	0.329	0.407	0.407	0.484	0.125	0.294	0.217	0.562	
Available Capacity (c_a), veh/h	419	1268	1227	221	1268	1240	156	259	219	248	249	
Back of Queue (Q), veh/ln (95th percentile)	0.1	5.8	5.7	1.8	4.4	4.4	3.7	1.3	2.8	2.3	6.4	
Queue Storage Ratio (RQ) (95th percentile)	0.04	0.20	0.20	0.48	0.16	0.16	0.62	0.07	0.93	1.18	0.32	
Uniform Delay (d_1), s/veh	2.4	2.3	2.2	11.1	3.2	3.3	48.3	38.9	40.0	41.3	41.7	
Incremental Delay (d_2), s/veh	0.2	2.4	2.6	2.1	0.5	0.5	2.3	0.2	0.7	0.4	2.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	2.5	4.7	4.8	13.1	3.7	3.8	50.7	39.2	40.7	41.7	44.5	
Level of Service (LOS)	A	A	A	B	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	4.7		A	4.4		A	44.8		D	43.8		D
Intersection Delay, s/veh / LOS	9.1						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.0	A	1.4	A	0.8	A	0.8	A

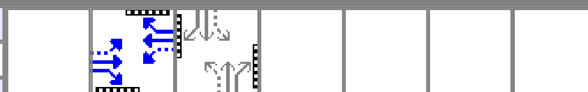
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Fairfax Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

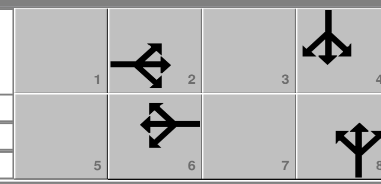


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	30	600	50	60	1290	30	160	40	20	30	30	30

Signal Information				
Cycle, s	105.0	Reference Phase	2
Offset, s	102	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	73.0	20.8	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		5.0		6.0
Phase Duration, s		78.6		78.6		26.4		26.4
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						20.5		6.7
Green Extension Time (g_e), s		0.0		0.0		0.3		1.2
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.00

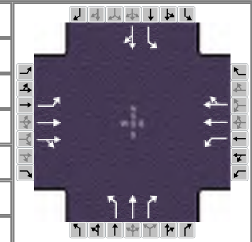
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	35	387	377	67	735	730	188	47	24	35	71	
Adjusted Saturation Flow Rate (s), veh/h/ln	347	1698	1652	673	1698	1684	1324	1765	1496	1353	1619	
Queue Service Time (g_s), s	5.7	10.5	10.6	1.2	11.0	10.9	14.6	2.3	1.3	2.3	3.8	
Cycle Queue Clearance Time (g_c), s	16.3	10.5	10.6	13.0	11.0	10.9	18.5	2.3	1.3	4.7	3.8	
Green Ratio (g/C)	0.70	0.70	0.70	0.70	0.70	0.70	0.20	0.20	0.20	0.20	0.20	
Capacity (c), veh/h	274	1181	1149	470	1181	1171	282	349	296	306	320	
Volume-to-Capacity Ratio (X)	0.129	0.328	0.328	0.142	0.622	0.623	0.669	0.135	0.080	0.115	0.220	
Available Capacity (c_a), veh/h	274	1181	1149	470	1181	1171	302	376	319	327	345	
Back of Queue (Q), veh/ln (95th percentile)	0.9	7.3	7.1	0.4	3.7	3.6	8.9	1.8	0.9	1.4	2.8	
Queue Storage Ratio (RQ) (95th percentile)	0.24	0.25	0.25	0.11	0.13	0.13	1.50	0.09	0.30	0.71	0.14	
Uniform Delay (d_1), s/veh	11.4	7.3	7.4	2.9	2.3	2.3	43.1	34.7	34.3	36.7	35.3	
Incremental Delay (d_2), s/veh	0.9	0.7	0.7	0.2	0.9	0.9	5.1	0.2	0.1	0.2	0.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	12.3	8.0	8.1	3.1	3.2	3.1	48.2	34.9	34.4	36.8	35.7	
Level of Service (LOS)	B	A	A	A	A	A	D	C	C	D	D	
Approach Delay, s/veh / LOS	8.2	A		3.2	A		44.5	D		36.0	D	
Intersection Delay, s/veh / LOS	9.9						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.1	A	1.8	A	0.9	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:44:46 PM

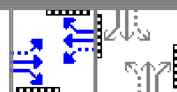
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Fairfax Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

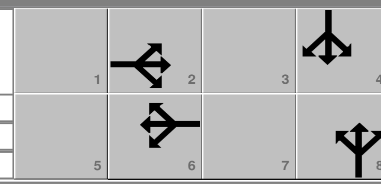


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1490	150	70	920	60	70	30	60	50	100	30

Signal Information				
Cycle, s	110.0	Reference Phase	2	
Offset, s	88	Reference Point	Begin	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	



Green	83.4	15.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		5.0		6.0
Phase Duration, s		89.0		89.0		21.0		21.0
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						17.1		10.5
Green Extension Time (g_e), s		0.0		0.0		0.0		0.6
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.75

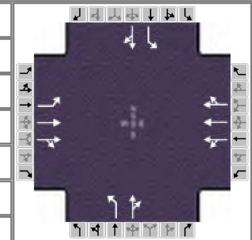
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	887	877	75	532	521	75	32	65	54	140	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	514	1698	1644	260	1698	1661	1244	1765	1496	1371	1694	
Queue Service Time (g_s), s	0.6	16.7	17.2	15.2	8.7	8.7	6.6	1.8	4.3	3.9	8.5	
Cycle Queue Clearance Time (g_c), s	9.6	16.7	17.2	36.1	8.7	8.7	15.1	1.8	4.3	5.7	8.5	
Green Ratio (*g/C*)	0.76	0.76	0.76	0.76	0.76	0.76	0.14	0.14	0.14	0.14	0.14	
Capacity (*c*), veh/h	414	1287	1246	218	1287	1259	143	247	209	235	237	
Volume-to-Capacity Ratio (*X*)	0.052	0.689	0.704	0.345	0.413	0.413	0.525	0.131	0.308	0.228	0.589	
Available Capacity (c_a), veh/h	414	1287	1246	218	1287	1259	143	247	209	235	237	
Back of Queue (*Q*), veh/ln (95th percentile)	0.1	6.2	6.0	2.0	4.3	4.2	4.0	1.4	2.9	2.5	6.9	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.21	0.21	0.52	0.15	0.15	0.67	0.07	0.99	1.25	0.35	
Uniform Delay (d_1), s/veh	2.4	2.5	2.4	11.2	2.9	2.9	51.4	41.4	42.5	43.9	44.3	
Incremental Delay (d_2), s/veh	0.2	2.2	2.5	2.2	0.5	0.5	3.5	0.2	0.8	0.5	3.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	2.6	4.7	4.9	13.4	3.4	3.4	54.9	41.7	43.3	44.4	48.1	
Level of Service (LOS)	A	A	A	B	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	4.8	A		4.1	A		48.1	D		47.1	D	
Intersection Delay, s/veh / LOS	9.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	2.0	A	1.4	A	0.8	A	0.8	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:50:43 PM

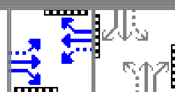
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Franklin Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_BestCase.xus				
Project Description	2035 NB AM				

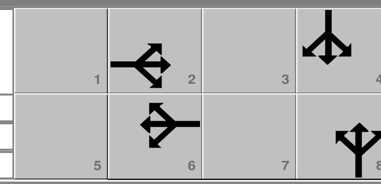


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	650	40	10	1420	50	20	10	10	20	10	70

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	106	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	87.9	10.9	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		8.0		6.0		6.0
Phase Duration, s		93.5		93.5		16.5		16.5
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						10.8		8.5
Green Extension Time (g_e), s		0.0		0.0		0.4		0.4
Phase Call Probability						0.99		0.99
Max Out Probability						0.01		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	410	402	567	521	512	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	308	1698	1663	1680	1545	1516	1297	1619		1382	1525	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	8.4	8.4	2.0	1.5		1.7	6.5	
Cycle Queue Clearance Time (g_c), s	11.3	0.0	0.0	8.3	8.4	8.4	8.8	1.5		3.5	6.5	
Green Ratio (*g/C*)	0.80	0.80	0.80	0.80	0.80	0.80	0.10	0.10		0.10	0.10	
Capacity (*c*), veh/h	289	1359	1331	1378	1236	1213	112	159		179	149	
Volume-to-Capacity Ratio (*X*)	0.244	0.302	0.302	0.412	0.422	0.422	0.210	0.148		0.131	0.630	
Available Capacity (c_a), veh/h	289	1359	1331	1378	1236	1213	237	315		313	297	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	0.4	0.4	4.1	3.8	3.7	1.2	1.1		1.1	4.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.01	0.01	0.14	0.13	0.13	0.41	0.06		0.38	0.24	
Uniform Delay (d_1), s/veh	0.5	0.0	0.0	2.2	2.2	2.2	52.1	45.4		47.1	47.7	
Incremental Delay (d_2), s/veh	2.0	0.6	0.6	0.7	0.8	0.8	0.9	0.4		0.3	4.3	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	2.5	0.6	0.6	2.9	3.0	3.0	53.0	45.8		47.5	52.0	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	0.7	A		3.0	A		49.4	D		51.1	D	
Intersection Delay, s/veh / LOS	5.2						A					

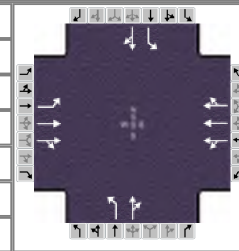
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.9	C	3.2	C
Bicycle LOS Score / LOS	1.2	A	1.4	A	0.6	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:38:32 PM

HCS 2010 Signalized Intersection Results Summary

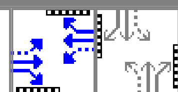
General Information			
Agency	HDR		
Analyst	GHM	Analysis Date	Oct 10, 2014
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak
Intersection	10th St & Franklin Ave	Analysis Year	2035
File Name	2035_NB_10th_St_PM_BestCase.xus		
Project Description	2035 NB PM		

Intersection Information	
Duration, h	0.25
Area Type	Other
PHF	0.93
Analysis Period	1> 4:30

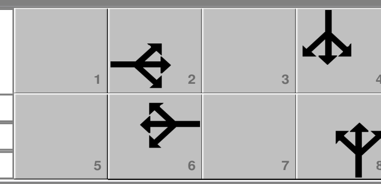


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1600	20	20	960	40	40	10	20	40	10	60

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	89	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	82.8	11.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



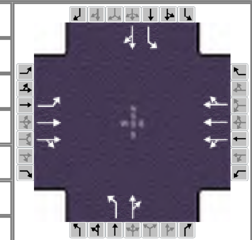
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		8.0		6.0		6.0
Phase Duration, s		88.4		88.4		16.6		16.6
Change Period, (*Y+Rc*), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (*gs*), s						10.8		7.6
Green Extension Time (*ge*), s		0.0		0.0		0.7		0.7
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	872	870	341	366	359	43	32		43	75	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	518	1698	1691	1420	1545	1514	1319	1576		1371	1529	
Queue Service Time (*gs*), s	0.0	0.0	0.0	0.0	6.7	6.8	3.4	2.0		3.1	4.9	
Cycle Queue Clearance Time (*gc*), s	7.7	0.0	0.0	5.4	6.7	6.8	8.8	2.0		5.6	4.9	
Green Ratio (*g/C*)	0.79	0.79	0.79	0.79	0.79	0.79	0.10	0.10		0.10	0.10	
Capacity (*c*), veh/h	449	1345	1339	1161	1224	1199	134	159		175	155	
Volume-to-Capacity Ratio (*X*)	0.192	0.648	0.650	0.293	0.299	0.299	0.321	0.203		0.246	0.487	
Available Capacity (*ca*), veh/h	449	1345	1339	1161	1224	1199	458	546		512	530	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	1.6	1.6	3.1	3.4	3.4	2.1	1.4		2.0	3.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.04	0.04	0.11	0.12	0.12	0.70	0.07		0.67	0.18	
Uniform Delay (*d1*), s/veh	0.3	0.0	0.0	2.8	2.9	3.0	49.0	43.3		46.1	44.6	
Incremental Delay (*d2*), s/veh	0.9	2.4	2.5	0.6	0.6	0.6	1.4	0.6		0.7	2.4	
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	1.2	2.4	2.5	3.4	3.5	3.5	50.4	43.9		46.8	47.0	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	2.4	A		3.5	A		47.6	D		46.9	D	
Intersection Delay, s/veh / LOS	5.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.9	C	3.2	C
Bicycle LOS Score / LOS	2.0	A	1.1	A	0.6	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:47:40 PM

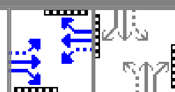
HCS 2010 Signalized Intersection Results Summary



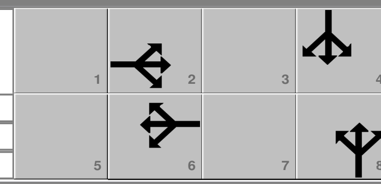
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Franklin Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_10th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	650	40	10	1420	50	20	10	10	20	10	70

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	106	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	83.4	10.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



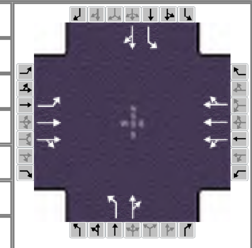
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		8.0		6.0		6.0
Phase Duration, s		89.0		89.0		16.0		16.0
Change Period, (*Y+R*c), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (*g*s), s						10.3		8.2
Green Extension Time (*g*e), s		0.0		0.0		0.2		0.3
Phase Call Probability						0.99		0.99
Max Out Probability						0.58		0.13

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	410	402	587	539	529	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	292	1698	1663	1680	1545	1516	1297	1619		1382	1525	
Queue Service Time (*g*s), s	0.0	0.0	0.0	0.0	8.3	8.2	1.9	1.4		1.7	6.2	
Cycle Queue Clearance Time (*g*c), s	11.5	0.0	0.0	8.1	8.3	8.2	8.3	1.4		3.2	6.2	
Green Ratio (*g/C*)	0.79	0.79	0.79	0.79	0.79	0.79	0.10	0.10		0.10	0.10	
Capacity (*c*), veh/h	278	1350	1322	1371	1228	1205	117	159		184	150	
Volume-to-Capacity Ratio (*X*)	0.254	0.304	0.304	0.428	0.439	0.439	0.202	0.148		0.128	0.627	
Available Capacity (*c*a), veh/h	278	1350	1322	1371	1228	1205	179	237		250	224	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	0.4	0.4	3.9	3.6	3.5	1.1	1.0		1.1	4.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.01	0.01	0.13	0.13	0.12	0.38	0.05		0.36	0.23	
Uniform Delay (*d*1), s/veh	0.6	0.0	0.0	2.1	2.1	2.1	49.6	43.3		44.9	45.5	
Incremental Delay (*d*2), s/veh	2.2	0.6	0.6	0.7	0.9	0.9	0.8	0.4		0.3	4.3	
Initial Queue Delay (*d*3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	2.7	0.6	0.6	2.8	3.0	2.9	50.4	43.7		45.2	49.7	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	0.8	A		2.9	A		47.1	D		48.8	D	
Intersection Delay, s/veh / LOS	5.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.9	C	3.2	C
Bicycle LOS Score / LOS	1.2	A	1.4	A	0.6	A	0.7	A

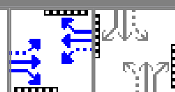
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Franklin Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

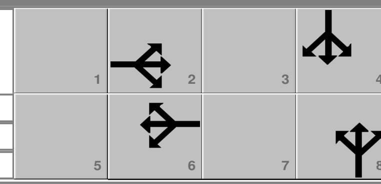


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	80	1600	20	20	960	40	40	10	20	40	10	60

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	89	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	87.4	11.4	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



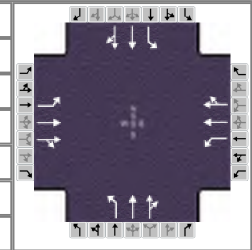
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		8.0		6.0		6.0
Phase Duration, s		93.0		93.0		17.0		17.0
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (MAH), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						11.2		7.9
Green Extension Time (g_e), s		0.0		0.0		0.7		0.7
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	86	872	870	349	377	370	43	32		43	75	
Adjusted Saturation Flow Rate (s), veh/h/ln	503	1698	1691	1412	1545	1514	1319	1576		1371	1529	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	7.4	7.4	3.5	2.1		3.3	5.1	
Cycle Queue Clearance Time (g_c), s	8.2	0.0	0.0	5.9	7.4	7.4	9.2	2.1		5.9	5.1	
Green Ratio (g/C)	0.79	0.79	0.79	0.79	0.79	0.79	0.10	0.10		0.10	0.10	
Capacity (c), veh/h	438	1356	1350	1162	1234	1208	129	157		170	153	
Volume-to-Capacity Ratio (X)	0.197	0.643	0.645	0.300	0.306	0.306	0.333	0.205		0.253	0.493	
Available Capacity (c_a), veh/h	438	1356	1350	1162	1234	1208	470	564		524	548	
Back of Queue (Q), veh/ln (95th percentile)	0.2	1.6	1.6	3.4	3.8	3.8	2.2	1.5		2.1	3.7	
Queue Storage Ratio (RQ) (95th percentile)	0.01	0.04	0.04	0.12	0.13	0.13	0.74	0.08		0.71	0.19	
Uniform Delay (d_1), s/veh	0.3	0.0	0.0	2.9	3.1	3.1	51.5	45.5		48.4	46.9	
Incremental Delay (d_2), s/veh	1.0	2.4	2.4	0.6	0.6	0.6	1.5	0.6		0.8	2.5	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	1.3	2.4	2.4	3.5	3.6	3.7	53.0	46.1		49.2	49.3	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	2.3	A		3.6	A		50.1	D		49.3	D	
Intersection Delay, s/veh / LOS	5.7						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.9	C	3.2	C
Bicycle LOS Score / LOS	2.0	A	1.1	A	0.6	A	0.7	A

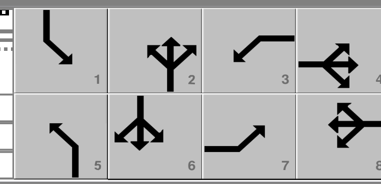
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	E 6th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_E_6th_St_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	220	130	250	510	270	120	680	180	150	450	120

Signal Information										
Cycle, s	110.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	8.3	35.4	4.0	4.0	1.0	23.1
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	3.6	4.0	4.0	4.0	3.6
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	1.5	2.0	2.0	2.0	1.5



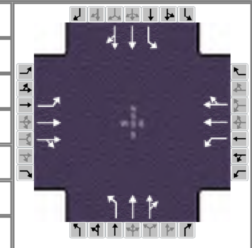
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.2	4.0	1.3	4.0
Phase Duration, s	10.0	28.2	17.0	35.2	14.3	54.8	10.0	50.4
Change Period, ($Y+R_c$), s	6.0	5.1	6.0	5.1	6.0	5.1	6.0	6.0
Max Allow Headway (*MAH*), s	4.2	4.1	4.1	4.1	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	6.0	12.4	13.0	25.4	7.9		2.0	
Green Extension Time (g_e), s	0.0	4.8	0.0	4.7	0.5	0.0	0.7	0.0
Phase Call Probability	0.92	1.00	1.00	1.00	0.99		1.00	
Max Out Probability	1.00	0.00	1.00	0.00	0.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	82	182	172	294	399	370	141	460	442	176	310	298
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1605	1681	1765	1631	1681	1765	1695	1681	1765	1685
Queue Service Time (g_s), s	4.0	10.0	10.4	11.0	23.3	23.4	5.9	21.2	21.3	0.0	14.0	14.1
Cycle Queue Clearance Time (g_c), s	4.0	10.0	10.4	11.0	23.3	23.4	5.9	21.2	21.3	0.0	14.0	14.1
Green Ratio (*g/C*)	0.25	0.21	0.21	0.33	0.27	0.27	0.42	0.45	0.45	0.34	0.40	0.40
Capacity (*c*), veh/h	158	371	338	354	483	447	347	797	765	273	713	680
Volume-to-Capacity Ratio (*X*)	0.520	0.491	0.509	0.831	0.824	0.827	0.407	0.577	0.577	0.646	0.435	0.438
Available Capacity (c_a), veh/h	158	929	845	354	1041	962	965	797	765	273	713	680
Back of Queue (*Q*), veh/ln (95th percentile)	3.4	7.9	7.6	7.5	15.6	14.7	4.3	14.3	13.9	8.8	10.2	9.9
Queue Storage Ratio (*RQ*) (95th percentile)	0.57	0.20	0.19	0.69	0.40	0.37	0.62	0.36	0.35	1.49	0.26	0.25
Uniform Delay (d_1), s/veh	35.4	38.2	38.4	34.8	37.5	37.5	22.0	22.4	22.4	40.2	23.7	23.7
Incremental Delay (d_2), s/veh	3.0	1.0	1.2	15.4	3.6	4.0	0.8	3.0	3.2	5.2	1.9	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	38.5	39.2	39.6	50.2	41.1	41.5	22.8	25.4	25.5	45.3	25.6	25.8
Level of Service (LOS)	D	D	D	D	D	D	C	C	C	D	C	C
Approach Delay, s/veh / LOS	39.2	D		43.7	D		25.1	C		30.1	C	
Intersection Delay, s/veh / LOS	34.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.9	C	3.0	C	2.9	C
Bicycle LOS Score / LOS	0.8	A	1.4	A	1.3	A	1.1	A

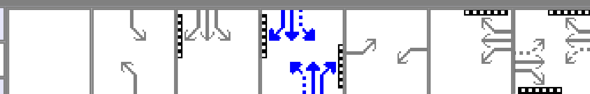
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	E 6th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_E_6th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

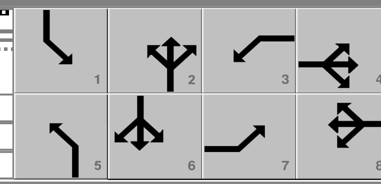


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	150	570	220	200	380	200	200	610	320	370	880	110

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.9	5.8	42.9	4.0	3.0	34.2
Yellow	4.0	0.0	3.6	4.0	0.0	3.6
Red	2.0	0.0	1.5	2.0	0.0	1.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	39.3	13.0	42.3	18.9	48.0	24.7	53.8
Change Period, ($Y+R_c$), s	6.0	5.1	6.0	5.1	6.0	5.1	6.0	5.1
Max Allow Headway (MAH), s	4.2	4.2	4.1	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	6.0	30.5	9.0	18.9	12.1		20.7	
Green Extension Time (g_e), s	0.0	3.6	0.0	5.6	0.8	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	0.58	1.00	0.09	0.00		1.00	

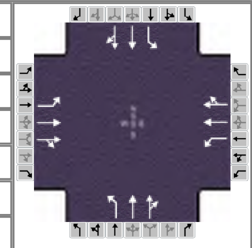
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	161	421	387	215	279	260	215	428	398	398	500	492
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1618	1681	1765	1618	1681	1765	1638	1681	1765	1735
Queue Service Time (g_s), s	4.0	28.4	28.5	7.0	16.5	16.9	10.1	26.3	26.4	18.7	30.2	30.2
Cycle Queue Clearance Time (g_c), s	4.0	28.4	28.5	7.0	16.5	16.9	10.1	26.3	26.4	18.7	30.2	30.2
Green Ratio (g/C)	0.31	0.27	0.27	0.33	0.30	0.30	0.45	0.34	0.34	0.51	0.39	0.39
Capacity (c), veh/h	238	482	442	182	525	481	306	606	562	397	687	676
Volume-to-Capacity Ratio (X)	0.679	0.873	0.875	1.182	0.533	0.541	0.702	0.707	0.709	1.002	0.728	0.728
Available Capacity (c_a), veh/h	238	549	504	182	592	542	909	606	562	397	687	676
Back of Queue (Q), veh/ln (95th percentile)	6.3	20.3	19.1	14.3	11.6	11.0	7.6	18.2	17.2	18.2	20.2	20.0
Queue Storage Ratio (RQ) (95th percentile)	1.07	0.52	0.48	1.32	0.29	0.28	1.11	0.46	0.44	3.09	0.51	0.51
Uniform Delay (d_1), s/veh	43.5	43.3	43.4	42.6	36.7	36.8	26.4	35.6	35.6	26.4	32.5	32.5
Incremental Delay (d_2), s/veh	7.5	13.2	14.4	124.2	0.8	1.0	2.9	6.8	7.4	45.8	6.6	6.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	51.0	56.5	57.8	166.8	37.5	37.7	29.4	42.4	43.0	72.1	39.1	39.3
Level of Service (LOS)	D	E	E	F	D	D	C	D	D	F	D	D
Approach Delay, s/veh / LOS	56.1	E		74.4	E		40.0	D		48.6	D	
Intersection Delay, s/veh / LOS	52.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	2.9	C	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.3	A	1.1	A	1.3	A	1.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:56:02 PM

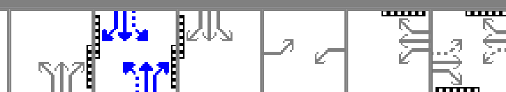
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	E 6th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_E_6th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

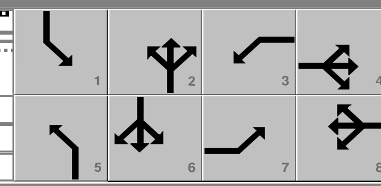


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	70	220	130	250	510	270	120	680	180	150	450	120

Signal Information				
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.3	35.4	4.0	4.0	1.0	23.1
Yellow	4.0	3.6	4.0	4.0	4.0	3.6
Red	2.0	1.5	2.0	2.0	2.0	1.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.2	4.0	1.3	4.0
Phase Duration, s	10.0	28.2	17.0	35.2	14.3	54.8	10.0	50.4
Change Period, ($Y+R_c$), s	6.0	5.1	6.0	5.1	6.0	5.1	6.0	6.0
Max Allow Headway (MAH), s	4.2	4.1	4.1	4.1	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	6.0	12.4	13.0	25.4	7.9		2.0	
Green Extension Time (g_e), s	0.0	4.8	0.0	4.7	0.5	0.0	0.7	0.0
Phase Call Probability	0.92	1.00	1.00	1.00	0.99		1.00	
Max Out Probability	1.00	0.00	1.00	0.00	0.00		1.00	

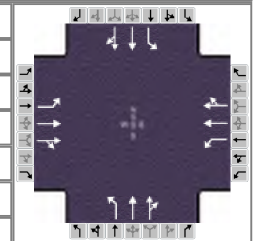
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	82	182	172	294	399	370	141	460	442	176	310	298
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1605	1681	1765	1631	1681	1765	1695	1681	1765	1685
Queue Service Time (g_s), s	4.0	10.0	10.4	11.0	23.3	23.4	5.9	21.2	21.3	0.0	14.0	14.1
Cycle Queue Clearance Time (g_c), s	4.0	10.0	10.4	11.0	23.3	23.4	5.9	21.2	21.3	0.0	14.0	14.1
Green Ratio (g/C)	0.25	0.21	0.21	0.33	0.27	0.27	0.42	0.45	0.45	0.34	0.40	0.40
Capacity (c), veh/h	158	371	338	354	483	447	347	797	765	273	713	680
Volume-to-Capacity Ratio (X)	0.520	0.491	0.509	0.831	0.824	0.827	0.407	0.577	0.577	0.646	0.435	0.438
Available Capacity (c_a), veh/h	158	929	845	354	1041	962	965	797	765	273	713	680
Back of Queue (Q), veh/ln (95th percentile)	3.4	7.9	7.6	7.5	15.6	14.7	4.3	14.3	13.9	8.8	10.2	9.9
Queue Storage Ratio (RQ) (95th percentile)	0.57	0.20	0.19	0.69	0.40	0.37	0.62	0.36	0.35	1.49	0.26	0.25
Uniform Delay (d_1), s/veh	35.4	38.2	38.4	34.8	37.5	37.5	22.0	22.4	22.4	40.2	23.7	23.7
Incremental Delay (d_2), s/veh	3.0	1.0	1.2	15.4	3.6	4.0	0.8	3.0	3.2	5.2	1.9	2.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	38.5	39.2	39.6	50.2	41.1	41.5	22.8	25.4	25.5	45.3	25.6	25.8
Level of Service (LOS)	D	D	D	D	D	D	C	C	C	D	C	C
Approach Delay, s/veh / LOS	39.2	D		43.7	D		25.1	C		30.1	C	
Intersection Delay, s/veh / LOS	34.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.9	C	3.0	C	2.9	C
Bicycle LOS Score / LOS	0.8	A	1.4	A	1.3	A	1.1	A

 HCS 2010™ Streets Version 6.50 Generated: 5/17/2016 3:55:15 PM

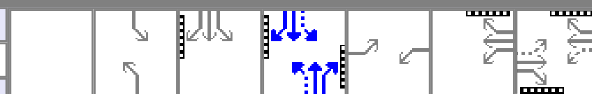
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	E 6th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_E_6th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

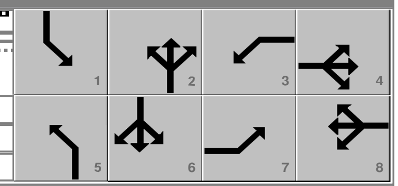


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	570	220	200	380	200	200	610	320	370	880	110

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	13.8	3.0	35.9	4.0	1.0	33.0
Yellow	4.0	4.0	3.6	4.0	4.0	3.6
Red	2.0	2.0	1.5	2.0	2.0	1.5



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	7	4	3	8	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	38.1	17.0	45.1	19.8	41.0	28.9	50.0
Change Period, ($Y+R_c$), s	6.0	5.1	6.0	5.1	6.0	5.1	6.0	5.1
Max Allow Headway (*MAH*), s	4.2	4.2	4.1	4.2	4.2	0.0	4.2	0.0
Queue Clearance Time (g_s), s	6.0	30.9	13.0	18.3	13.0		24.3	
Green Extension Time (g_e), s	0.0	2.1	0.0	5.7	0.8	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	1.00	1.00	0.08	0.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	161	421	387	215	279	260	215	428	398	398	500	492
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1618	1681	1765	1618	1681	1765	1638	1681	1765	1735
Queue Service Time (g_s), s	4.0	28.8	28.9	11.0	16.0	16.3	11.0	28.6	28.6	22.3	31.7	31.7
Cycle Queue Clearance Time (g_c), s	4.0	28.8	28.9	11.0	16.0	16.3	11.0	28.6	28.6	22.3	31.7	31.7
Green Ratio (*g/C*)	0.30	0.26	0.26	0.37	0.32	0.32	0.40	0.29	0.29	0.49	0.36	0.36
Capacity (*c*), veh/h	261	466	427	228	565	518	295	507	470	404	634	624
Volume-to-Capacity Ratio (*X*)	0.618	0.903	0.905	0.944	0.494	0.503	0.730	0.845	0.847	0.986	0.789	0.789
Available Capacity (c_a), veh/h	261	493	452	228	592	542	846	507	470	404	634	624
Back of Queue (*Q*), veh/ln (95th percentile)	5.7	21.4	20.1	11.9	11.2	10.6	8.3	20.9	19.8	19.5	21.6	21.3
Queue Storage Ratio (*RQ*) (95th percentile)	0.96	0.54	0.51	1.10	0.28	0.27	1.20	0.53	0.50	3.30	0.55	0.54
Uniform Delay (d_1), s/veh	41.7	44.4	44.5	34.4	34.3	34.4	29.8	41.9	42.0	32.3	35.8	35.8
Incremental Delay (d_2), s/veh	4.3	19.2	20.8	44.2	0.7	0.8	3.5	15.8	17.0	40.9	9.6	9.8
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	46.1	63.6	65.3	78.7	35.0	35.2	33.3	57.8	58.9	73.2	45.4	45.6
Level of Service (LOS)	D	E	E	E	C	D	C	E	E	E	D	D
Approach Delay, s/veh / LOS	61.4	E		47.5	D		53.2	D		53.4	D	
Intersection Delay, s/veh / LOS	54.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	2.9	C	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.3	A	1.1	A	1.3	A	1.6	A

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E 6th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 6th St
North/South Street: Lowell Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	20	310	30	110	610	30
Peak-Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Hourly Flow Rate, HFR	23	364	35	129	717	35
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L	TR		L	TR	
Upstream Signal?		No			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	20	20	70	40	40	30
Peak Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Hourly Flow Rate, HFR	23	23	82	47	47	35
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	23	129		128			129	
C(m) (vph)	826	1160		161			100	
v/c	0.03	0.11		0.80			1.29	
95% queue length	0.09	0.37		5.17			9.00	
Control Delay	9.5	8.5		81.9			264.9	
LOS	A	A		F			F	
Approach Delay				81.9			264.9	
Approach LOS				F			F	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E 6th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 6th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	20	310	30	110	610	30
Peak-Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Peak-15 Minute Volume	6	91	9	32	179	9
Hourly Flow Rate, HFR	23	364	35	129	717	35
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L	TR		L	TR	
Upstream Signal?		No			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	20	20	70	40	40	30
Peak Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Peak-15 Minute Volume	6	6	21	12	12	9
Hourly Flow Rate, HFR	23	23	82	47	47	35
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	47	30	1300
	Through	510	1800	3	14	47	30	1300

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2	2	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog			510	0

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	14	0
Cycle Length, C (sec)	47	47
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.298	0.000
g(q1)	9.4	0.0
g(q2)	3.7	0.0
g(q)	13.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha			0.550	
beta			0.645	
Travel time, t(a) (sec)			29.478	
Smoothing Factor, F			0.087	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			1253	0
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			5.1	0.0
Proportion time blocked, p	0.000		0.109	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.109
p(dom)	0.109
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.891		
p(4)	1.000		
p(7)	0.891		
p(8)	0.891		
p(9)	1.000		
p(10)	0.891		
p(11)	0.891		
p(12)	0.891		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	752	399	1462	1438	382	1472	1437	734
s	1500	1500	1500	1500	1500	1500	1500	1500
Px	0.891	1.000	0.891	0.891	1.000	0.891	0.891	0.891
V c,u,x	661	399	1457	1430	382	1469	1429	640
C r,x	927	1160	108	135	665	106	135	475
C plat,x	826	1160	96	120	665	94	120	423

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500	1500	1500	1500	1500	1500	1500	1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	382	734
Potential Capacity	665	423
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	665	423
Probability of Queue free St.	0.88	0.92

Step 2: LT from Major St.	4	1
Conflicting Flows	399	752
Potential Capacity	1160	826
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1160	826
Probability of Queue free St.	0.89	0.97
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1438	1437
Potential Capacity	120	120
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.86	0.86
Movement Capacity	104	104
Probability of Queue free St.	0.78	0.55

Step 4: LT from Minor St.	7	10
Conflicting Flows	1462	1472
Potential Capacity	96	94
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.47	0.67
Maj. L, Min T Adj. Imp Factor.	0.58	0.75
Cap. Adj. factor due to Impeding mvmnt	0.54	0.65
Movement Capacity	51	62

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1438	1437
Potential Capacity	120	120
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.86	0.86
Movement Capacity	104	104

Result for 2 stage process:		
a		
y		
C t	104	104
Probability of Queue free St.	0.78	0.55

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1462	1472
Potential Capacity	96	94
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.47	0.67
Maj. L, Min T Adj. Imp Factor.	0.58	0.75
Cap. Adj. factor due to Impeding mvmnt	0.54	0.65
Movement Capacity	51	62

Results for Two-stage process:		
a		
y		
C t	51	62

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	23	23	82	47	47	35
Movement Capacity (vph)	51	104	665	62	104	423
Shared Lane Capacity (vph)		161			100	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	51	104	665	62	104	423
Volume	23	23	82	47	47	35
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		161			100	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	23	129		128			129	
C(m) (vph)	826	1160		161			100	
v/c	0.03	0.11		0.80			1.29	
95% queue length	0.09	0.37		5.17			9.00	
Control Delay	9.5	8.5		81.9			264.9	
LOS	A	A		F			F	
Approach Delay				81.9			264.9	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	0.89
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	9.5	8.5
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E 6th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 6th St
North/South Street: Lowell Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	30	770	70	200	460	30
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	32	827	75	215	494	32
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L	TR		L	TR	
Upstream Signal?		No			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	20	120	50	20	20
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	32	21	129	53	21	21
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	32	215		182			95	
C(m) (vph)	1029	754		79			21	
v/c	0.03	0.29		2.30			4.52	
95% queue length	0.10	1.18		16.91			12.18	
Control Delay	8.6	11.7		709.0			1958	
LOS	A	B		F			F	
Approach Delay				709.0			1958	
Approach LOS				F			F	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E 6th St & Lowell Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E 6th St
North/South Street: Lowell Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	30	770	70	200	460	30
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	8	207	19	54	124	8
Hourly Flow Rate, HFR	32	827	75	215	494	32
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	1	0	1	1	0
Configuration	L	TR		L	TR	
Upstream Signal?		No			Yes	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	30	20	120	50	20	20
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	8	5	32	13	5	5
Hourly Flow Rate, HFR	32	21	129	53	21	21
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn	0	1800	3	0	61	30	1300
	Through	380	1800	3	19	61	30	1300

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		2	2	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	2	2	2	2	2	2	2	2
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog			380	0

Total Saturation Flow Rate, s (vph)	1800	1800
Arrival Type	3	3
Effective Green, g (sec)	19	0
Cycle Length, C (sec)	61	61
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.311	0.000
g(q1)	8.9	0.0
g(q2)	2.4	0.0
g(q)	11.2	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha			0.550	
beta			0.645	
Travel time, t(a) (sec)			29.478	
Smoothing Factor, F			0.087	
Proportion of conflicting flow, f			1.000	1.000
Max platooned flow, V(c,max)			1155	0
Min platooned flow, V(c,min)			1000	1000
Duration of blocked period, t(p)			4.8	0.0
Proportion time blocked, p	0.000		0.079	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.079
p(dom)	0.079
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.921		
p(4)	1.000		
p(7)	0.921		
p(8)	0.921		
p(9)	1.000		
p(10)	0.921		
p(11)	0.921		
p(12)	0.921		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	526	902	1889	1884	864	1944	1906	510
s	1500	1500	1500	1500	1500	1500	1500	1500
Px	0.921	1.000	0.921	0.921	1.000	0.921	0.921	0.921
V c,u,x	443	902	1922	1917	864	1982	1941	425
C r,x	1117	754	51	67	354	46	65	629
C plat,x	1029	754	47	62	354	42	60	579

Two-Stage Process

7 8 10 11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500	1500	1500	1500	1500	1500	1500	1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	864	510
Potential Capacity	354	579
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	354	579
Probability of Queue free St.	0.64	0.96

Step 2: LT from Major St.	4	1
Conflicting Flows	902	526
Potential Capacity	754	1029
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	754	1029
Probability of Queue free St.	0.71	0.97
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	1884	1906
Potential Capacity	62	60
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.69	0.69
Movement Capacity	43	42
Probability of Queue free St.	0.51	0.50

Step 4: LT from Minor St.	7	10
Conflicting Flows	1889	1944
Potential Capacity	47	42
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.35	0.35
Maj. L, Min T Adj. Imp Factor.	0.47	0.48
Cap. Adj. factor due to Impeding mvmnt	0.46	0.31
Movement Capacity	22	13

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1884	1906
Potential Capacity	62	60
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.69	0.69
Movement Capacity	43	42

Result for 2 stage process:		
a		
y		
C t	43	42
Probability of Queue free St.	0.51	0.50

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	1889	1944
Potential Capacity	47	42
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.35	0.35
Maj. L, Min T Adj. Imp Factor.	0.47	0.48
Cap. Adj. factor due to Impeding mvmnt	0.46	0.31
Movement Capacity	22	13

Results for Two-stage process:		
a		
y		
C t	22	13

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	32	21	129	53	21	21
Movement Capacity (vph)	22	43	354	13	42	579
Shared Lane Capacity (vph)		79			21	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	22	43	354	13	42	579
Volume	32	21	129	53	21	21
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		79			21	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

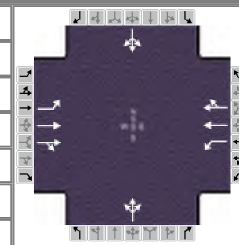
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L		LTR			LTR	
v (vph)	32	215		182			95	
C(m) (vph)	1029	754		79			21	
v/c	0.03	0.29		2.30			4.52	
95% queue length	0.10	1.18		16.91			12.18	
Control Delay	8.6	11.7		709.0			1958	
LOS	A	B		F			F	
Approach Delay				709.0			1958	
Approach LOS				F			F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	0.71
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.6	11.7
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

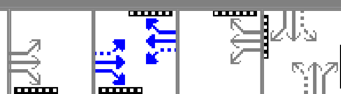
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Rice St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Rice_St_AM_BestCase.xus				
Project Description	2035 NB AM				

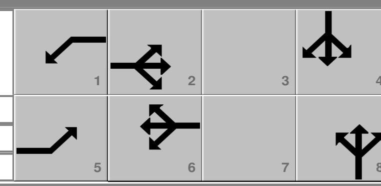


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	200	740	70	100	1540	50	60	100	50	10	20	80

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	131	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	17.5	63.6	7.5	28.5	0.0	0.0
Yellow	5.0	5.0	5.0	5.0	0.0	0.0
Red	2.0	2.0	2.0	2.0	0.0	0.0



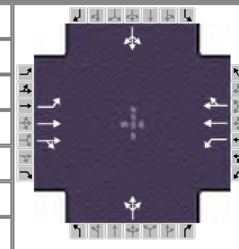
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.2	4.0	1.3	4.0		8.0		8.0
Phase Duration, s	24.5	95.1	14.5	85.1		35.5		35.5
Change Period, ($Y+R_c$), s	7.0	7.0	7.0	7.0		7.0		7.0
Max Allow Headway (*MAH*), s	3.0	0.0	3.0	0.0		4.3		4.3
Queue Clearance Time (g_s), s	17.1		2.0			26.9		13.0
Green Extension Time (g_e), s	0.4	0.0	5.5	0.0		1.5		1.5
Phase Call Probability	1.00		0.99			1.00		1.00
Max Out Probability	0.00		0.01			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	229	470	456	118	918	952		247			129	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1714	1698	1646	1714	1634	1679		1419			1476	
Queue Service Time (g_s), s	15.1	11.6	13.1	0.0	78.0	78.0		13.8			0.0	
Cycle Queue Clearance Time (g_c), s	15.1	11.6	13.1	0.0	78.0	78.0		24.9			11.0	
Green Ratio (g/C)	0.57	0.61	0.61	0.48	0.54	0.54		0.20			0.20	
Capacity (*c*), veh/h	256	1031	999	396	879	904		311			317	
Volume-to-Capacity Ratio (*X*)	0.892	0.456	0.456	0.297	1.044	1.054		0.795			0.408	
Available Capacity (c_a), veh/h	1491	1031	999	851	879	904		827			805	
Back of Queue (*Q*), veh/ln (95th percentile)	13.1	5.7	6.3	4.7	51.1	53.6		14.2			7.6	
Queue Storage Ratio (*RQ*) (95th percentile)	1.31	0.07	0.07	0.47	1.34	1.40		0.72			0.20	
Uniform Delay (d_1), s/veh	54.1	6.2	7.3	25.0	33.5	33.5		57.2			51.2	
Incremental Delay (d_2), s/veh	2.8	0.9	1.0	0.2	42.5	45.2		4.6			0.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	56.9	7.2	8.2	25.1	76.0	78.7		61.8			52.1	
Level of Service (LOS)	E	A	A	C	F	F		E			D	
Approach Delay, s/veh / LOS	17.4	B		74.2	E		61.8	E		52.1	D	
Intersection Delay, s/veh / LOS	53.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.5	A	2.1	B	0.9	A	0.7	A

HCS 2010 Signalized Intersection Results Summary

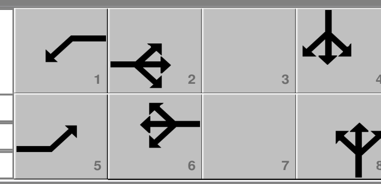
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Rice_St_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	130	1060	150	80	1220	20	80	40	80	60	120	100

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	68	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.2	53.5	4.9	33.3	0.0	0.0
Yellow	5.0	5.0	5.0	5.0	0.0	0.0
Red	2.0	2.0	2.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.3	4.0	1.2	4.0		8.0		8.0
Phase Duration, s	11.9	72.5	12.2	72.7		40.3		40.3
Change Period, (*Y+Rc*), s	7.0	7.0	7.0	7.0		7.0		7.0
Max Allow Headway (*MAH*), s	3.0	0.0	3.0	0.0		4.4		4.4
Queue Clearance Time (*gs*), s	2.0		5.4			31.4		28.2
Green Extension Time (*ge*), s	1.1	0.0	0.1	0.0		2.2		2.2
Phase Call Probability	0.99		0.95			1.00		1.00
Max Out Probability	1.00		0.00			0.00		0.00

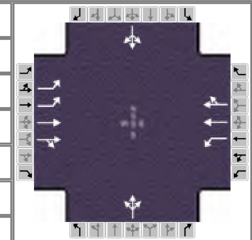
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	126	599	574	86	668	665		215			301	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1714	1698	1624	1714	1698	1688		940			1363	
Queue Service Time (*gs*), s	0.0	29.9	29.3	3.4	38.3	38.3		2.3			0.0	
Cycle Queue Clearance Time (*gc*), s	0.0	29.9	29.3	3.4	38.3	38.3		29.4			26.2	
Green Ratio (*g/C*)	0.45	0.52	0.52	0.49	0.53	0.53		0.27			0.27	
Capacity (*c*), veh/h	216	893	854	226	897	891		289			395	
Volume-to-Capacity Ratio (*X*)	0.583	0.671	0.672	0.381	0.745	0.746		0.745			0.761	
Available Capacity (*ca*), veh/h	217	893	854	794	897	891		605			737	
Back of Queue (*Q*), veh/ln (95th percentile)	6.2	14.6	13.5	2.4	22.0	21.9		11.1			14.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.62	0.17	0.16	0.24	0.58	0.57		0.56			0.37	
Uniform Delay (*d1*), s/veh	47.6	18.3	17.3	21.9	23.0	23.0		44.0			43.0	
Incremental Delay (*d2*), s/veh	1.4	2.2	2.3	0.4	5.6	5.7		3.8			3.1	
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	49.0	20.4	19.6	22.3	28.6	28.6		47.8			46.0	
Level of Service (LOS)	D	C	B	C	C	C		D			D	
Approach Delay, s/veh / LOS	22.8	C		28.2	C		47.8	D		46.0	D	
Intersection Delay, s/veh / LOS	29.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.2	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.7	A	1.7	A	0.8	A	1.0	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:13:14 AM

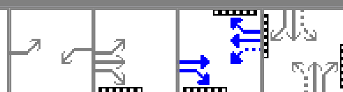
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Rice St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Rice_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

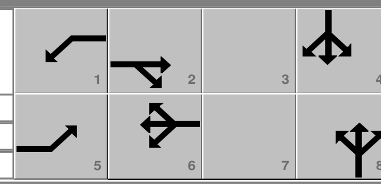


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	200	740	70	100	1540	50	60	100	50	10	20	80

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	146	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.6	6.5	86.5	29.4	0.0	0.0
Yellow	5.0	0.0	5.0	5.0	0.0	0.0
Red	2.0	0.0	2.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	4.0	1.1	4.0		8.0		8.0
Phase Duration, s	20.1	99.9	13.6	93.5		36.4		36.4
Change Period, ($Y+R_c$), s	7.0	7.0	7.0	7.0		7.0		7.0
Max Allow Headway (MAH), s	3.0	0.0	3.0	0.0		4.3		4.3
Queue Clearance Time (g_s), s	12.6		6.5			28.1		13.4
Green Extension Time (g_e), s	0.5	0.0	0.2	0.0		1.4		1.5
Phase Call Probability	1.00		0.99			1.00		1.00
Max Out Probability	0.00		0.00			0.00		0.00

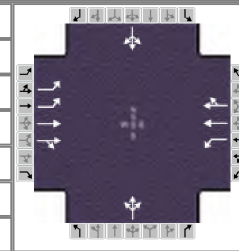
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	223	458	444	118	918	952		247			129	
Adjusted Saturation Flow Rate (s), veh/h/ln	1570	1698	1646	1617	1634	1679		1406			1472	
Queue Service Time (g_s), s	10.6	13.0	13.7	4.5	81.5	83.3		14.5			0.0	
Cycle Queue Clearance Time (g_c), s	10.6	13.0	13.7	4.5	81.5	83.3		26.1			11.4	
Green Ratio (g/C)	0.09	0.62	0.62	0.62	0.58	0.58		0.20			0.20	
Capacity (c), veh/h	275	1052	1020	424	942	968		307			315	
Volume-to-Capacity Ratio (X)	0.810	0.435	0.435	0.278	0.975	0.984		0.805			0.411	
Available Capacity (c_a), veh/h	1710	1052	1020	941	942	968		496			494	
Back of Queue (Q), veh/ln (95th percentile)	7.1	6.3	6.5	2.8	45.6	47.9		14.7			7.8	
Queue Storage Ratio (RQ) (95th percentile)	0.75	0.07	0.08	0.30	1.19	1.26		0.75			0.21	
Uniform Delay (d_1), s/veh	71.8	7.4	7.9	12.0	30.7	31.1		59.4			53.0	
Incremental Delay (d_2), s/veh	1.3	0.8	0.8	0.1	23.9	25.4		5.0			0.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	73.1	8.2	8.7	12.2	54.6	56.5		64.3			53.9	
Level of Service (LOS)	E	A	A	B	D	E		E			D	
Approach Delay, s/veh / LOS	21.2		C	53.0		D	64.3		E	53.9		D
Intersection Delay, s/veh / LOS	43.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.6	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.5	A	2.1	B	0.9	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:11:35 AM

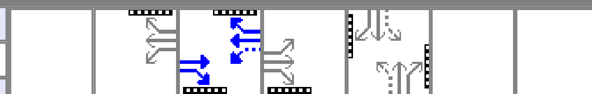
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Rice_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

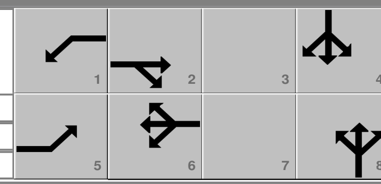


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	130	1060	150	80	1220	20	80	40	80	60	120	100

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	68	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.5	51.3	6.8	33.3	0.0	0.0
Yellow	5.0	5.0	5.0	5.0	0.0	0.0
Red	2.0	2.0	2.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	4.0	1.2	4.0		8.0		8.0
Phase Duration, s	13.8	72.2	12.5	70.8		40.3		40.3
Change Period, (*Y+R*c), s	7.0	7.0	7.0	7.0		7.0		7.0
Max Allow Headway (*MAH*), s	3.0	0.0	3.0	0.0		4.4		4.4
Queue Clearance Time (g_s), s	6.9		5.7			31.4		28.2
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0		2.2		2.2
Phase Call Probability	0.99		0.95			1.00		1.00
Max Out Probability	1.00		0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	126	599	574	86	668	665		215			301	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1624	1617	1698	1688		940			1363	
Queue Service Time (g_s), s	4.9	30.2	29.6	3.7	39.5	39.6		2.3			0.0	
Cycle Queue Clearance Time (g_c), s	4.9	30.2	29.6	3.7	39.5	39.6		29.4			26.2	
Green Ratio (*g/C*)	0.05	0.52	0.52	0.47	0.51	0.51		0.27			0.27	
Capacity (*c*), veh/h	172	889	850	212	871	866		289			395	
Volume-to-Capacity Ratio (*X*)	0.733	0.674	0.675	0.406	0.767	0.768		0.745			0.761	
Available Capacity (c_a), veh/h	172	889	850	744	871	866		605			737	
Back of Queue (*Q*), veh/ln (95th percentile)	3.8	14.8	13.7	2.5	22.9	22.8		11.1			14.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.39	0.17	0.16	0.26	0.60	0.60		0.56			0.37	
Uniform Delay (d_1), s/veh	57.9	18.7	17.7	23.1	24.5	24.5		44.0			43.0	
Incremental Delay (d_2), s/veh	7.3	2.2	2.3	0.5	6.4	6.5		3.8			3.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	65.2	20.9	20.0	23.5	30.9	31.0		47.8			46.0	
Level of Service (LOS)	E	C	B	C	C	C		D			D	
Approach Delay, s/veh / LOS	24.8	C		30.5	C		47.8	D		46.0	D	
Intersection Delay, s/veh / LOS	30.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.6	B	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.7	A	1.7	A	0.8	A	1.0	A

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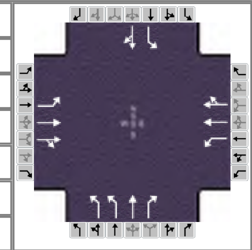
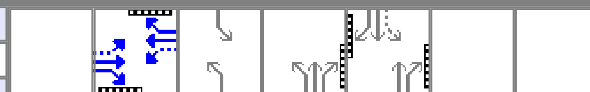
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Rice St & I-229 NB / Clevel	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Rice_St_AM_BestCase.xus				
Project Description	2035 NB AM				

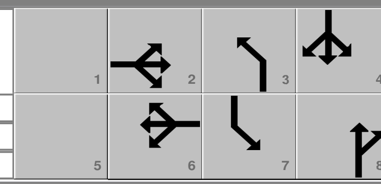


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	100	410	200	240	1270	170	320	300	500	100	50	250

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	126	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	80.0	6.0	6.6	24.4	0.0	0.0
Yellow	5.0	5.0	5.0	5.0	0.0	0.0
Red	2.0	2.0	2.0	2.0	0.0	0.0



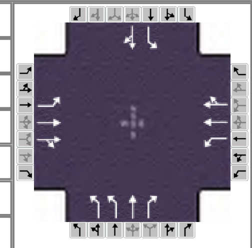
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6	3	8	7	4
Case Number		6.0		6.0	2.0	3.0	1.1	4.0
Phase Duration, s		87.0		87.0	26.6	45.0	13.0	31.4
Change Period, ($Y+R_c$), s		7.0		7.0	7.0	7.0	7.0	7.0
Max Allow Headway (MAH), s		0.0		0.0	3.2	4.3	4.1	4.3
Queue Clearance Time (g_s), s					18.7	40.0	8.0	19.8
Green Extension Time (g_e), s		0.0		0.0	0.9	0.0	0.0	1.9
Phase Call Probability					1.00	1.00	0.99	1.00
Max Out Probability					0.00	1.00	1.00	0.94

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	118	320	300	270	711	879	376	353	441	118	188	
Adjusted Saturation Flow Rate (s), veh/h/ln	314	1636	1514	819	1352	1650	1601	1763	1557	1558	1467	
Queue Service Time (g_s), s	30.9	12.8	13.8	4.9	46.1	50.5	16.7	26.8	38.0	6.0	17.8	
Cycle Queue Clearance Time (g_c), s	80.0	12.8	13.8	36.5	46.1	50.5	16.7	26.8	38.0	6.0	17.8	
Green Ratio (g/C)	0.55	0.55	0.55	0.55	0.55	0.55	0.14	0.26	0.26	0.21	0.17	
Capacity (c), veh/h	117	902	835	424	746	911	433	462	408	154	247	
Volume-to-Capacity Ratio (X)	1.009	0.355	0.359	0.637	0.953	0.965	0.869	0.764	1.081	0.763	0.763	
Available Capacity (c_a), veh/h	117	902	835	424	746	911	861	462	408	154	247	
Back of Queue (Q), veh/ln (95th percentile)	11.3	8.0	8.1	2.5	3.3	3.8	11.3	18.6	31.8	4.7	11.9	
Queue Storage Ratio (RQ) (95th percentile)	1.13	0.20	0.20	0.25	0.04	0.04	1.14	0.47	3.18	0.49	0.39	
Uniform Delay (d_1), s/veh	62.5	13.5	14.7	5.1	3.7	3.6	61.4	49.4	53.5	55.9	57.5	
Incremental Delay (d_2), s/veh	83.1	1.0	1.1	0.7	3.7	3.9	2.1	7.4	68.1	19.9	13.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (d), s/veh	145.6	14.5	15.8	5.8	7.5	7.5	63.6	56.8	121.6	75.8	70.7	
Level of Service (LOS)	F	B	B	A	A	A	E	E	F	E	E	
Approach Delay, s/veh / LOS	36.0	D		7.2	A		83.4	F		72.7	E	
Intersection Delay, s/veh / LOS	39.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.5	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.1	A	2.1	B	2.4	B	1.0	A

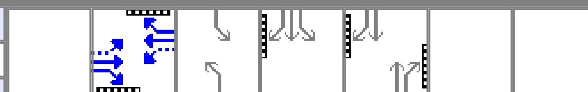
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & I-229 NB / Clevel	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Rice_St_PM_BestCase.xus				
Project Description	2035 NB PM				

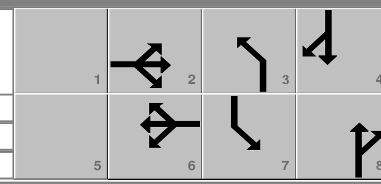


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	140	950	500	330	1020	50	300	90	110	280	100	130

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	73.0	15.1	5.9	10.0	0.0	0.0
Yellow	5.0	5.0	0.0	5.0	0.0	0.0
Red	2.0	2.0	0.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6	3	8	7	4
Case Number		6.0		6.0	2.0	3.0	2.0	4.0
Phase Duration, s		80.0		80.0	22.1	17.0	28.0	22.8
Change Period, (*Y+R*c), s		7.0		7.0	7.0	7.0	7.0	7.0
Max Allow Headway (*MAH*), s		0.0		0.0	3.2	4.2	4.1	4.2
Queue Clearance Time (g_s), s					14.5	9.1	23.0	17.7
Green Extension Time (g_e), s		0.0		0.0	0.6	0.1	0.0	0.0
Phase Call Probability					1.00	1.00	1.00	1.00
Max Out Probability					0.00	1.00	1.00	1.00

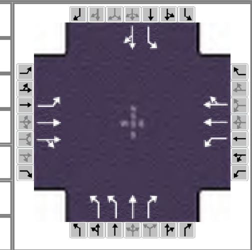
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	134	644	591	355	570	564	323	97	82	301	191	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	486	1635	1491	464	1720	1701	1581	1675	1450	1618	1520	
Queue Service Time (g_s), s	13.8	28.0	26.8	15.7	5.5	5.3	12.5	7.1	6.9	21.0	15.7	
Cycle Queue Clearance Time (g_c), s	20.8	28.0	26.8	73.1	5.5	5.3	12.5	7.1	6.9	21.0	15.7	
Green Ratio (*g/C*)	0.58	0.58	0.58	0.58	0.58	0.58	0.12	0.08	0.08	0.17	0.13	
Capacity (*c*), veh/h	321	956	872	226	1006	994	382	133	115	272	192	
Volume-to-Capacity Ratio (*X*)	0.417	0.674	0.678	1.572	0.567	0.567	0.843	0.728	0.710	1.108	0.997	
Available Capacity (c_a), veh/h	321	956	872	226	1006	994	658	134	116	272	193	
Back of Queue (*Q*), veh/ln (95th percentile)	2.7	13.5	11.5	38.7	2.5	2.4	8.8	6.6	5.6	22.3	14.3	
Queue Storage Ratio (*RQ*) (95th percentile)	0.27	0.34	0.29	3.87	0.03	0.03	0.89	0.17	0.56	2.34	0.47	
Uniform Delay (d_1), s/veh	9.6	12.0	10.8	21.8	1.8	1.7	53.8	56.2	56.1	52.0	54.6	
Incremental Delay (d_2), s/veh	3.2	3.1	3.5	269.8	1.4	1.4	2.0	17.9	18.1	86.7	63.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	12.8	15.1	14.3	291.5	3.1	3.1	55.8	74.1	74.2	138.7	118.3	
Level of Service (LOS)	B	B	B	F	A	A	E	E	E	F	F	
Approach Delay, s/veh / LOS	14.5	B		71.9	E		62.3	E		130.8	F	
Intersection Delay, s/veh / LOS	57.8						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	2.3	B	2.9	C	3.1	C
Bicycle LOS Score / LOS	1.8	A	1.7	A	1.3	A	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:13:14 AM

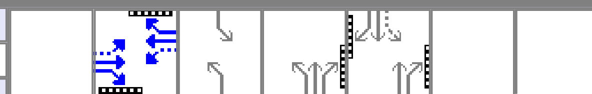
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Rice St & I-229 NB / Clevel	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Rice_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

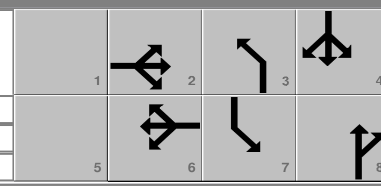


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	100	410	200	240	1270	170	320	300	500	100	50	250

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	124	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	86.0	6.0	7.1	22.9	0.0	0.0
Yellow	5.0	5.0	5.0	5.0	0.0	0.0
Red	2.0	2.0	2.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6	3	8	7	4
Case Number		6.0		6.0	2.0	3.0	1.1	4.0
Phase Duration, s		93.0		93.0	27.1	44.0	13.0	29.9
Change Period, ($Y+R_c$), s		7.0		7.0	7.0	7.0	7.0	7.0
Max Allow Headway (*MAH*), s		0.0		0.0	3.2	4.3	4.1	4.3
Queue Clearance Time (g_s), s					19.3	39.0	8.0	20.7
Green Extension Time (g_e), s		0.0		0.0	0.8	0.0	0.0	1.0
Phase Call Probability					1.00	1.00	0.99	1.00
Max Out Probability					0.00	1.00	1.00	1.00

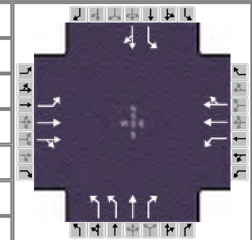
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	118	320	300	282	742	920	376	353	441	118	188	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	276	1637	1515	777	1360	1660	1604	1767	1531	1559	1469	
Queue Service Time (g_s), s	31.1	12.5	13.4	6.0	49.2	55.4	17.3	28.2	37.0	6.0	18.7	
Cycle Queue Clearance Time (g_c), s	86.0	12.5	13.4	39.3	49.2	55.4	17.3	28.2	37.0	6.0	18.7	
Green Ratio (*g/C*)	0.57	0.57	0.57	0.57	0.57	0.57	0.13	0.25	0.25	0.19	0.15	
Capacity (*c*), veh/h	105	939	869	425	780	952	430	436	378	139	224	
Volume-to-Capacity Ratio (*X*)	1.117	0.341	0.345	0.665	0.952	0.967	0.875	0.810	1.168	0.846	0.840	
Available Capacity (c_a), veh/h	105	939	869	425	780	952	727	436	378	139	224	
Back of Queue (*Q*), veh/ln (95th percentile)	12.8	7.8	7.9	3.1	4.9	5.8	11.7	20.0	36.0	5.9	13.1	
Queue Storage Ratio (*RQ*) (95th percentile)	1.34	0.20	0.20	0.33	0.06	0.07	1.19	0.51	3.66	0.62	0.43	
Uniform Delay (d_1), s/veh	64.9	12.5	13.5	5.0	3.8	3.7	63.7	53.2	56.5	60.4	61.8	
Incremental Delay (d_2), s/veh	119.9	0.9	1.0	1.8	7.4	7.9	3.1	10.9	100.6	35.7	23.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	184.8	13.4	14.6	6.8	11.3	11.6	66.9	64.1	157.1	96.2	85.5	
Level of Service (LOS)	F	B	B	A	B	B	E	E	F	F	F	
Approach Delay, s/veh / LOS	41.2		D	10.8		B	100.0		F	89.6		F
Intersection Delay, s/veh / LOS	47.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.5	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.1	A	2.1	B	2.4	B	1.0	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:11:35 AM

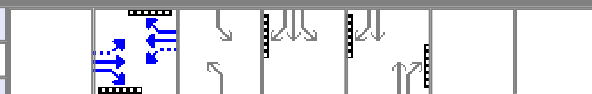
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & I-229 NB / Clevel	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Rice_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

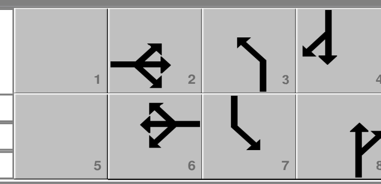


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	140	950	500	330	1020	50	300	90	110	280	100	130

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	75	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	73.0	15.1	5.9	10.0	0.0	0.0
Yellow	5.0	5.0	0.0	5.0	0.0	0.0
Red	2.0	2.0	0.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6	3	8	7	4
Case Number		6.0		6.0	2.0	3.0	2.0	4.0
Phase Duration, s		80.0		80.0	22.1	17.0	28.0	22.8
Change Period, (Y+R_c), s		7.0		7.0	7.0	7.0	7.0	7.0
Max Allow Headway (*MAH*), s		0.0		0.0	3.2	4.2	4.1	4.2
Queue Clearance Time (g_s), s					14.5	9.1	23.0	17.7
Green Extension Time (g_e), s		0.0		0.0	0.6	0.1	0.0	0.0
Phase Call Probability					1.00	1.00	1.00	1.00
Max Out Probability					0.00	1.00	1.00	1.00

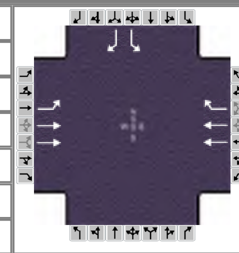
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	134	644	591	355	570	564	323	97	82	301	191	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	458	1635	1491	438	1720	1701	1581	1675	1422	1618	1520	
Queue Service Time (g_s), s	14.9	28.0	26.8	14.4	5.1	4.9	12.5	7.1	7.0	21.0	15.7	
Cycle Queue Clearance Time (g_c), s	21.5	28.0	26.8	73.1	5.1	4.9	12.5	7.1	7.0	21.0	15.7	
Green Ratio (*g/C*)	0.58	0.58	0.58	0.58	0.58	0.58	0.12	0.08	0.08	0.17	0.13	
Capacity (*c*), veh/h	308	956	872	216	1006	994	382	133	113	272	192	
Volume-to-Capacity Ratio (*X*)	0.435	0.674	0.678	1.641	0.567	0.567	0.843	0.728	0.725	1.108	0.997	
Available Capacity (c_a), veh/h	308	956	872	216	1006	994	658	134	114	272	193	
Back of Queue (*Q*), veh/ln (95th percentile)	2.8	13.5	11.5	40.4	2.3	2.2	8.8	6.6	5.7	22.3	14.3	
Queue Storage Ratio (*RQ*) (95th percentile)	0.29	0.34	0.29	4.23	0.03	0.03	0.89	0.17	0.58	2.34	0.47	
Uniform Delay (d_1), s/veh	9.5	12.0	10.8	21.6	1.6	1.5	53.8	56.2	56.2	52.0	54.6	
Incremental Delay (d_2), s/veh	3.6	3.1	3.5	299.8	1.3	1.3	2.0	17.9	20.2	86.7	63.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	13.2	15.1	14.3	321.4	2.9	2.8	55.8	74.1	76.4	138.7	118.3	
Level of Service (LOS)	B	B	B	F	A	A	E	E	E	F	F	
Approach Delay, s/veh / LOS	14.5	B		78.8	E		62.7	E		130.8	F	
Intersection Delay, s/veh / LOS	60.5						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	2.3	B	2.9	C	3.1	C
Bicycle LOS Score / LOS	1.8	A	1.7	A	1.3	A	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:14:41 AM

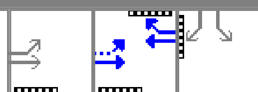
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Rice St & I-229 SB	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Rice_St_AM_BestCase.xus				
Project Description	2035 NB AM				

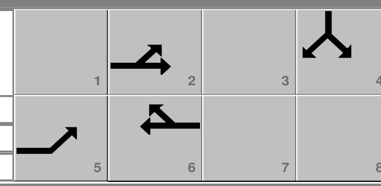


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	110	580			1370	470				130		80

Signal Information				
Cycle, s	145.0	Reference Phase	2
Offset, s	11	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.3	105.1	16.6	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	10.3	122.4		112.1				22.6
Change Period, ($Y+R_c$), s	5.0	7.0		7.0				6.0
Max Allow Headway (MAH), s	4.1	0.0		0.0				4.2
Queue Clearance Time (g_s), s	4.9							15.8
Green Extension Time (g_e), s	0.4	0.0		0.0				0.8
Phase Call Probability	0.99							1.00
Max Out Probability	0.00							0.00

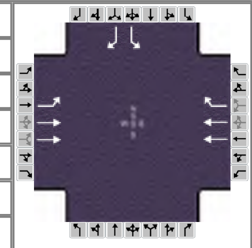
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (v), veh/h	129	682			1563	536				153		94
Adjusted Saturation Flow Rate (s), veh/h/ln	1562	1611			1749	1587				1572		1405
Queue Service Time (g_s), s	2.9	7.8			15.6	3.5				13.8		9.2
Cycle Queue Clearance Time (g_c), s	2.9	7.8			15.6	3.5				13.8		9.2
Green Ratio (g/C)	0.77	0.80			0.72	0.72				0.11		0.11
Capacity (c), veh/h	218	2564			2535	1150				180		161
Volume-to-Capacity Ratio (X)	0.594	0.266			0.617	0.466				0.848		0.584
Available Capacity (c_a), veh/h	423	2564			2535	1150				390		349
Back of Queue (Q), veh/ln (95th percentile)	1.8	4.0			4.5	1.3				10.0		6.1
Queue Storage Ratio (RQ) (95th percentile)	0.38	0.03			0.11	0.03				0.87		0.16
Uniform Delay (d_1), s/veh	7.9	3.7			3.0	0.9				62.9		60.9
Incremental Delay (d_2), s/veh	2.5	0.2			0.3	0.3				10.4		3.3
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (d), s/veh	10.4	4.0			3.3	1.2				73.3		64.2
Level of Service (LOS)	B	A			A	A				E		E

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	5.0	A	2.8	A	0.0		69.9	E
Intersection Delay, s/veh / LOS	8.6				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.6	A	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	2.3	B				F

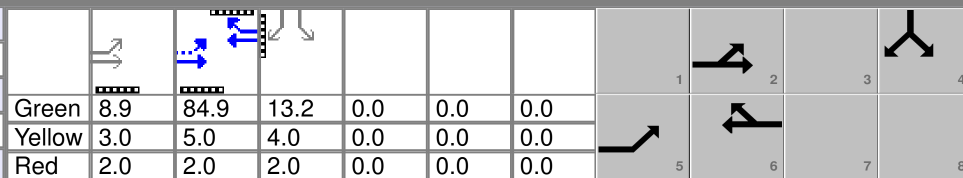
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & I-229 SB	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Rice_St_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	580			1370	470				130		80

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	111	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.9	84.9	13.2	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	13.9	105.8		91.9				19.2
Change Period, ($Y+R_c$), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (g_s), s	7.8							13.0
Green Extension Time (g_e), s	1.0	0.0		0.0				0.2
Phase Call Probability	1.00							1.00
Max Out Probability	0.00							1.00

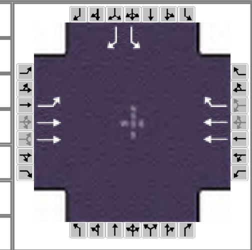
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	266	1401			1161	398				140		86
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1604	1698			1663	1527				1559		1393
Queue Service Time (g_s), s	5.8	22.4			23.4	12.7				11.0		7.4
Cycle Queue Clearance Time (g_c), s	5.8	22.4			23.4	12.7				11.0		7.4
Green Ratio (*g/C*)	0.77	0.79			0.68	0.68				0.11		0.11
Capacity (*c*), veh/h	325	2684			2259	1037				165		147
Volume-to-Capacity Ratio (*X*)	0.817	0.522			0.514	0.384				0.848		0.584
Available Capacity (c_a), veh/h	824	2684			2259	1037				200		178
Back of Queue (*Q*), veh/ln (95th percentile)	9.5	11.5			12.5	6.6				9.1		4.8
Queue Storage Ratio (*RQ*) (95th percentile)	1.99	0.09			0.31	0.16				0.80		0.13
Uniform Delay (d_1), s/veh	16.5	6.5			11.5	7.5				54.9		53.3
Incremental Delay (d_2), s/veh	4.0	0.6			0.6	0.8				23.9		3.6
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	20.5	7.1			12.0	8.2				78.8		56.9
Level of Service (LOS)	C	A			B	A				E		E
Approach Delay, s/veh / LOS	9.2	A		11.1	B		0.0			70.5	E	
Intersection Delay, s/veh / LOS	14.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.6	A	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	2.1	B				F

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:13:14 AM

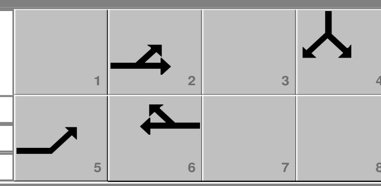
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Rice St & I-229 SB	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Rice_St_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	110	580			1370	470				130		80

Signal Information										
Cycle, s	150.0	Reference Phase	2							
Offset, s	0	Reference Point	Begin	Green	5.4	109.6	17.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	10.4	127.0		116.6				23.0
Change Period, ($Y+R_c$), s	5.0	7.0		7.0				6.0
Max Allow Headway (MAH), s	4.1	0.0		0.0				4.2
Queue Clearance Time (g_s), s	5.0							16.3
Green Extension Time (g_e), s	0.4	0.0		0.0				0.7
Phase Call Probability	1.00							1.00
Max Out Probability	0.00							0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (v), veh/h	129	682			1612	553				153		94
Adjusted Saturation Flow Rate (s), veh/h/ln	1564	1615			1749	1508				1574		1407
Queue Service Time (g_s), s	3.0	7.9			17.8	4.3				14.3		9.5
Cycle Queue Clearance Time (g_c), s	3.0	7.9			17.8	4.3				14.3		9.5
Green Ratio (g/C)	0.78	0.80			0.73	0.73				0.11		0.11
Capacity (c), veh/h	207	2584			2554	1101				179		160
Volume-to-Capacity Ratio (X)	0.624	0.264			0.631	0.502				0.856		0.589
Available Capacity (c_a), veh/h	578	2584			2554	1101				325		291
Back of Queue (Q), veh/ln (95th percentile)	3.0	4.1			5.0	1.5				10.3		6.4
Queue Storage Ratio (RQ) (95th percentile)	0.63	0.03			0.13	0.39				0.90		0.17
Uniform Delay (d_1), s/veh	10.2	3.7			3.3	0.9				65.3		63.2
Incremental Delay (d_2), s/veh	3.0	0.2			0.3	0.4				11.0		3.4
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (d), s/veh	13.2	3.9			3.6	1.3				76.3		66.6
Level of Service (LOS)	B	A			A	A				E		E

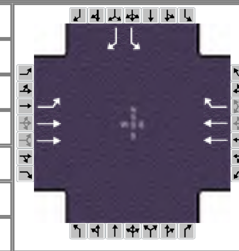
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	5.4	A	3.0	A	0.0		72.6	E
Intersection Delay, s/veh / LOS	8.9				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.6	A	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	2.3	B				F

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:11:35 AM

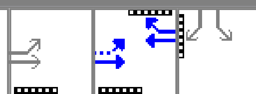
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & I-229 SB	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Rice_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

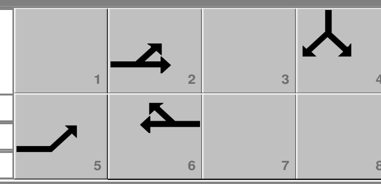


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	580			1370	470				130		80

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	111	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.9	84.9	13.2	0.0	0.0	0.0
Yellow	3.0	5.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



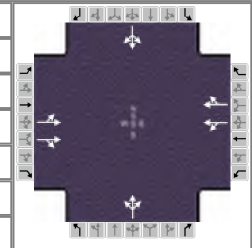
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6				4
Case Number	1.0	4.0		7.3				9.0
Phase Duration, s	13.9	105.8		91.9				19.2
Change Period, (Y+R_c), s	5.0	7.0		7.0				6.0
Max Allow Headway (*MAH*), s	4.1	0.0		0.0				4.2
Queue Clearance Time (g_s), s	7.9							13.0
Green Extension Time (g_e), s	1.0	0.0		0.0				0.2
Phase Call Probability	1.00							1.00
Max Out Probability	0.00							1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16				7		14
Adjusted Flow Rate (*v*), veh/h	266	1401			1161	398				140		86
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1604	1698			1663	1441				1559		1393
Queue Service Time (g_s), s	5.9	23.0			23.4	13.8				11.0		7.4
Cycle Queue Clearance Time (g_c), s	5.9	23.0			23.4	13.8				11.0		7.4
Green Ratio (*g/C*)	0.77	0.79			0.68	0.68				0.11		0.11
Capacity (*c*), veh/h	325	2684			2258	978				165		147
Volume-to-Capacity Ratio (*X*)	0.817	0.522			0.514	0.407				0.848		0.584
Available Capacity (c_a), veh/h	824	2684			2258	978				200		178
Back of Queue (*Q*), veh/ln (95th percentile)	9.5	12.0			12.5	6.7				9.1		4.8
Queue Storage Ratio (*RQ*) (95th percentile)	1.98	0.09			0.31	1.76				0.80		0.13
Uniform Delay (d_1), s/veh	16.5	6.8			11.4	7.6				54.9		53.3
Incremental Delay (d_2), s/veh	4.0	0.6			0.6	0.9				23.9		3.6
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay (*d*), s/veh	20.5	7.4			12.0	8.5				78.8		56.9
Level of Service (LOS)	C	A			B	A				E		E
Approach Delay, s/veh / LOS	9.5	A		11.1	B		0.0			70.5	E	
Intersection Delay, s/veh / LOS	14.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	0.6	A	2.2	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	2.1	B				F

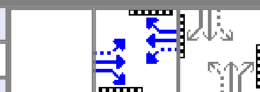
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Rice St & Wayland Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Rice_St_AM_BestCase.xus				
Project Description	2035 NB AM				

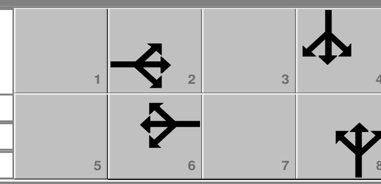


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	600	10	20	1390	40	20	10	40	50	10	10

Signal Information			
Cycle, s	145.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	124.6	9.8	0.0	0.0	0.0	0.0
Yellow	3.9	3.0	0.0	0.0	0.0	0.0
Red	1.2	2.5	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		129.7		129.7		15.3		15.3
Change Period, (Y+R_c), s		5.1		5.1		5.5		5.5
Max Allow Headway (MAH), s		0.0		0.0		4.2		4.2
Queue Clearance Time (g_s), s						5.8		9.6
Green Extension Time (g_e), s		0.0		0.0		0.4		0.4
Phase Call Probability						0.99		0.99
Max Out Probability						0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	369		360	866		792		45			76	
Adjusted Saturation Flow Rate (s), veh/h/ln	1569		1536	1663		1529		1559			1443	
Queue Service Time (g_s), s	0.0		6.2	0.0		25.6		0.0			4.2	
Cycle Queue Clearance Time (g_c), s	5.6		6.2	24.8		25.6		3.8			7.6	
Green Ratio (g/C)	0.86		0.86	0.86		0.86		0.07			0.07	
Capacity (c), veh/h	1375		1321	1455		1315		142			141	
Volume-to-Capacity Ratio (X)	0.269		0.273	0.595		0.602		0.314			0.544	
Available Capacity (c_a), veh/h	1375		1321	1455		1315		749			725	
Back of Queue (Q), veh/ln (95th percentile)	2.5		2.5	11.0		10.5		3.0			5.3	
Queue Storage Ratio (RQ) (95th percentile)	0.07		0.07	0.08		0.08		0.30			0.54	
Uniform Delay (d_1), s/veh	1.8		1.9	3.8		3.9		64.9			66.6	
Incremental Delay (d_2), s/veh	0.5		0.5	1.4		1.6		1.2			3.3	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (d), s/veh	2.3		2.4	5.2		5.5		66.1			69.9	
Level of Service (LOS)	A		A	A		A		E			E	

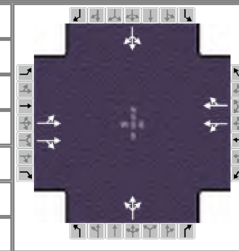
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	2.3	A	5.4	A	66.1	E	69.9	E
Intersection Delay, s/veh / LOS	7.5				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.7	B	2.7	B
Bicycle LOS Score / LOS	1.1	A	1.9	A	0.6	A	0.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:09:28 AM

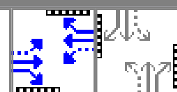
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & Wayland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Rice_St_PM_BestCase.xus				
Project Description	2035 NB PM				

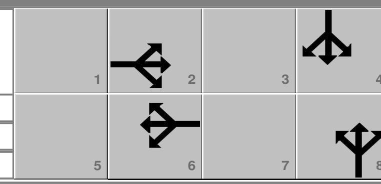


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	30	1380	40	90	780	150	30	10	100	70	10	30

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	107.9	6.5	0.0	0.0	0.0	0.0
Yellow	3.9	3.0	0.0	0.0	0.0	0.0
Red	1.2	2.5	0.0	0.0	0.0	0.0



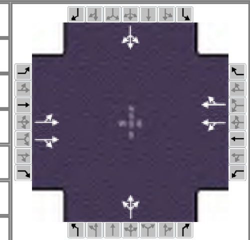
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		113.0		113.0		12.0		12.0
Change Period, ($Y+R_c$), s		5.1		5.1		5.5		5.5
Max Allow Headway (MAH), s		0.0		0.0		4.1		4.1
Queue Clearance Time (g_s), s						5.5		8.5
Green Extension Time (g_e), s		0.0		0.0		0.0		0.0
Phase Call Probability						0.99		0.99
Max Out Probability						1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	801		754	454		793		43			99	
Adjusted Saturation Flow Rate (s), veh/h/ln	1597		1531	813		1484		1473			1482	
Queue Service Time (g_s), s	0.0		16.6	14.4		22.4		0.0			3.0	
Cycle Queue Clearance Time (g_c), s	15.3		16.6	31.0		22.4		3.5			6.5	
Green Ratio (g/C)	0.86		0.86	0.86		0.86		0.05			0.05	
Capacity (c), veh/h	1408		1322	738		1281		127			128	
Volume-to-Capacity Ratio (X)	0.569		0.570	0.616		0.619		0.339			0.774	
Available Capacity (c_a), veh/h	1408		1322	738		1281		127			128	
Back of Queue (Q), veh/ln (95th percentile)	5.6		5.6	3.5		8.1		2.5			7.3	
Queue Storage Ratio (RQ) (95th percentile)	0.16		0.16	0.03		0.06		0.25			0.74	
Uniform Delay (d_1), s/veh	2.2		2.3	3.3		3.2		57.8			59.9	
Incremental Delay (d_2), s/veh	1.7		1.8	3.3		1.9		1.6			25.0	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (d), s/veh	3.9		4.1	6.6		5.1		59.3			85.0	
Level of Service (LOS)	A		A	A		A		E			F	
Approach Delay, s/veh / LOS	4.0		A	5.6		A	59.3		E	85.0		F
Intersection Delay, s/veh / LOS	8.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	B	2.7	B	2.7	B
Bicycle LOS Score / LOS	1.8	A	1.4	A	0.6	A	0.7	A

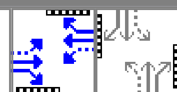
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Rice St & Wayland Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Rice_St_AM_WorstCase.xus				
Project Description	2035 NB AM				

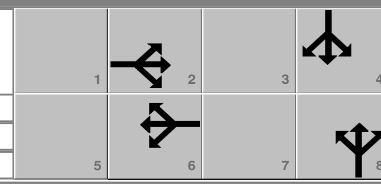


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	600	10	20	1390	40	20	10	40	50	10	10

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	129.4	10.0	0.0	0.0	0.0	0.0
Yellow	3.9	3.0	0.0	0.0	0.0	0.0
Red	1.2	2.5	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		134.5		134.5		15.5		15.5
Change Period, (*Y+Rc*), s		5.1		5.1		5.5		5.5
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		4.2
Queue Clearance Time (*gs*), s						6.0		9.7
Green Extension Time (*ge*), s		0.0		0.0		0.4		0.4
Phase Call Probability						0.99		0.99
Max Out Probability						0.00		0.00

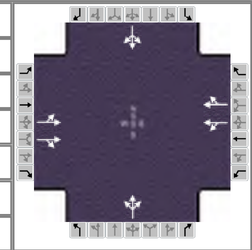
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	368		361	891		815		45			76	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1559		1536	1662		1529		1558			1461	
Queue Service Time (*gs*), s	0.0		6.3	0.0		24.3		0.0			4.7	
Cycle Queue Clearance Time (*gc*), s	5.7		6.3	23.5		24.3		4.0			7.7	
Green Ratio (*g/C*)	0.86		0.86	0.86		0.86		0.07			0.07	
Capacity (*c*), veh/h	1370		1325	1458		1319		140			140	
Volume-to-Capacity Ratio (*X*)	0.269		0.272	0.611		0.617		0.318			0.547	
Available Capacity (*ca*), veh/h	1370		1325	1458		1319		1172			1134	
Back of Queue (*Q*), veh/ln (95th percentile)	2.5		2.5	9.4		8.9		3.1			5.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.07		0.07	0.07		0.07		0.31			0.55	
Uniform Delay (*d1*), s/veh	1.8		1.8	3.2		3.2		67.2			68.9	
Incremental Delay (*d2*), s/veh	0.5		0.5	1.5		1.6		1.3			3.3	
Initial Queue Delay (*d3*), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	2.3		2.4	4.6		4.9		68.4			72.2	
Level of Service (LOS)	A		A	A		A		E			E	
Approach Delay, s/veh / LOS	2.3	A		4.7	A		68.4	E		72.2	E	
Intersection Delay, s/veh / LOS	7.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.1	A	1.9	A	0.6	A	0.6	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:11:35 AM

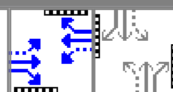
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Rice St & Wayland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Rice_St_PM_WorstCase.xus				
Project Description	2035 NB PM				

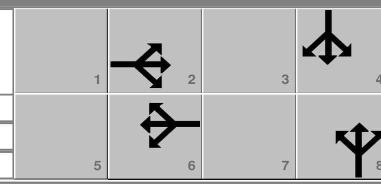


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	30	1380	40	90	780	150	30	10	100	70	10	30

Signal Information			
Cycle, s	125.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	106.9	7.5	0.0	0.0	0.0	0.0
Yellow	3.9	3.0	0.0	0.0	0.0	0.0
Red	1.2	2.5	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		112.0		112.0		13.0		13.0
Change Period, ($Y+R_c$), s		5.1		5.1		5.5		5.5
Max Allow Headway (MAH), s		0.0		0.0		4.1		4.1
Queue Clearance Time (g_s), s						5.5		9.5
Green Extension Time (g_e), s		0.0		0.0		0.1		0.0
Phase Call Probability						0.99		0.99
Max Out Probability						1.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	801		754	450		797		43			99	
Adjusted Saturation Flow Rate (s), veh/h/ln	1597		1531	800		1484		1466			1478	
Queue Service Time (g_s), s	0.0		17.6	16.2		23.5		0.0			4.0	
Cycle Queue Clearance Time (g_c), s	16.2		17.6	33.8		23.5		3.5			7.5	
Green Ratio (g/C)	0.86		0.86	0.86		0.86		0.06			0.06	
Capacity (c), veh/h	1395		1309	720		1269		138			139	
Volume-to-Capacity Ratio (X)	0.574		0.576	0.624		0.628		0.311			0.710	
Available Capacity (c_a), veh/h	1395		1309	720		1269		138			139	
Back of Queue (Q), veh/ln (95th percentile)	6.4		6.3	3.8		8.8		2.5			6.7	
Queue Storage Ratio (RQ) (95th percentile)	0.19		0.18	0.03		0.07		0.25			0.68	
Uniform Delay (d_1), s/veh	2.5		2.6	3.8		3.5		56.8			59.1	
Incremental Delay (d_2), s/veh	1.7		1.8	3.5		2.0		1.3			15.4	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (d), s/veh	4.2		4.4	7.3		5.5		58.1			74.5	
Level of Service (LOS)	A		A	A		A		E			E	
Approach Delay, s/veh / LOS	4.3	A		6.1	A		58.1	E		74.5	E	
Intersection Delay, s/veh / LOS	8.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	B	2.7	B	2.7	B
Bicycle LOS Score / LOS	1.8	A	1.4	A	0.6	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:14:41 AM

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E Benson Rd & Hall Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Hall Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	150	340			1230	200
Peak-Hour Factor, PHF	0.85	0.85			0.85	0.85
Hourly Flow Rate, HFR	176	399			1447	235
Percent Heavy Vehicles	6	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	2			2	0
Configuration	LT	T			T	TR
Upstream Signal?		Yes			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				100		170
Peak Hour Factor, PHF				0.85		0.85
Hourly Flow Rate, HFR				117		199
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0	0	
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	176						316	
C(m) (vph)	359						54	
v/c	0.49						5.85	
95% queue length	2.59						36.04	
Control Delay	24.3						2333	
LOS	C						F	
Approach Delay							2333	
Approach LOS							F	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E Benson Rd & Hall Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Hall Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	150	340			1230	200
Peak-Hour Factor, PHF	0.85	0.85			0.85	0.85
Peak-15 Minute Volume	44	100			362	59
Hourly Flow Rate, HFR	176	399			1447	235
Percent Heavy Vehicles	6	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	2			2	0
Configuration	LT	T			T	TR
Upstream Signal?		Yes			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				100		170
Peak Hour Factor, PHF				0.85		0.85
Peak-15 Minute Volume				29		50
Hourly Flow Rate, HFR				117		199
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1700	3	0	79	40	2000
	Through	370	1700	3	48	79	40	2000
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	0	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1800	
Number of major street through lanes:	2	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		6					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	6					2		2
t(f)	2.3					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	370	0		

Total Saturation Flow Rate, s (vph)	3400	3400
Arrival Type	3	3
Effective Green, g (sec)	48	0
Cycle Length, C (sec)	79	79
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.608	0.000
g(q1)	3.4	0.0
g(q2)	0.4	0.0
g(q)	3.8	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500			
beta	0.667			
Travel time, t(a) (sec)	34.014			
Smoothing Factor, F	0.081			
Proportion of conflicting flow, f	1.000	1.000		
Max platooned flow, V(c,max)	931	0		
Min platooned flow, V(c,min)	2000	2000		
Duration of blocked period, t(p)	0.0	0.0		
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	0.000
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	1.000		
p(11)			
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1682					2115		841
s	3000					3000		3000
Px	1.000					1.000		1.000
V c,u,x	1682					2115		841
C r,x	359					44		363
C plat,x	359					44		363

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					3000	3000		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		841
Potential Capacity		363
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		363
Probability of Queue free St.	1.00	0.45

Step 2: LT from Major St.	4	1
Conflicting Flows		1682
Potential Capacity		359
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		359
Probability of Queue free St.	1.00	0.51
Maj L-Shared Prob Q free St.		0.51

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.51	0.51
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		2115
Potential Capacity		44
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.51	
Maj. L, Min T Adj. Imp Factor.	0.61	
Cap. Adj. factor due to Impeding mvmnt	0.28	0.51
Movement Capacity		22

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.51	0.51
Movement Capacity		

Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		2115
Potential Capacity		44
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.51	
Maj. L, Min T Adj. Imp Factor.	0.61	
Cap. Adj. factor due to Impeding mvmnt	0.28	0.51
Movement Capacity		22

Results for Two-stage process:		
a		
y		
C t		22

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				117		199
Movement Capacity (vph)				22		363
Shared Lane Capacity (vph)					54	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				22		363
Volume				117		199
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					54	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	176						316	
C(m) (vph)	359						54	
v/c	0.49						5.85	
95% queue length	2.59						36.04	
Control Delay	24.3						2333	
LOS	C						F	
Approach Delay							2333	
Approach LOS							F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.51	1.00
v(il), Volume for stream 2 or 5	0	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1800	
P*(oj)	0.51	
d(M,LT), Delay for stream 1 or 4	24.3	
N, Number of major street through lanes	2	
d(rank,1) Delay for stream 2 or 5		

```
                    HCS+: Unsignalized Intersections Release 5.6

_______________________TWO-WAY STOP CONTROL SUMMARY___________________________

Analyst:                 GHM
Agency/Co.:              HDR
Date Performed:          10/10/2014
Analysis Time Period: PM Peak
Intersection:            E Benson Rd & Hall Ave
Jurisdiction:            Sioux Falls, SD
Units: U. S. Customary
Analysis Year:           2035
Project ID:  I-229 MIS
East/West Street:        E Benson Rd
North/South Street:      Hall Ave
Intersection Orientation: EW                Study period (hrs):  0.25

______________________Vehicle Volumes and Adjustments__________________________
Major Street:  Approach        Eastbound               Westbound
               Movement     1      2      3     |  4      5      6
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                      170    1270                   690    100
Peak-Hour Factor, PHF       0.93   0.93                   0.93   0.93
Hourly Flow Rate, HFR       182    1365                   741    107
Percent Heavy Vehicles      6      --     --              --     --
Median Type/Storage         Undivided            /
RT Channelized?
Lanes                          0   2                      2    0
Configuration                   LT T                      T   TR
Upstream Signal?                   Yes                    No
______________________________________________________________________________
Minor Street:  Approach        Northbound              Southbound
               Movement     7      8      9     |  10     11     12
                            L      T      R     |  L      T      R
______________________________________________________________________________
Volume                                             350           150
Peak Hour Factor, PHF                              0.93          0.93
Hourly Flow Rate, HFR                              376           161
Percent Heavy Vehicles                             2             2
Percent Grade (%)                  0                      0
Flared Approach:  Exists?/Storage           /                No     /
Lanes                                                 0        0
Configuration                                             LR
______________________________________________________________________________

__________________Delay, Queue Length, and Level of Service____________________
Approach              EB     WB          Northbound            Southbound
Movement              1      4    |  7      8      9    |  10     11     12
Lane Config           LT          |                     |         LR
______________________________________________________________________________
v (vph)               182                                         537
C(m) (vph)            760                                         89
v/c                   0.24                                        6.03
95% queue length      0.93                                        59.39
Control Delay         11.2                                        2358
LOS                    B                                           F
Approach Delay                                                    2358
Approach LOS                                                       F
______________________________________________________________________________
```

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E Benson Rd & Hall Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Hall Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	170	1270			690	100
Peak-Hour Factor, PHF	0.93	0.93			0.93	0.93
Peak-15 Minute Volume	46	341			185	27
Hourly Flow Rate, HFR	182	1365			741	107
Percent Heavy Vehicles	6	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	2			2	0
Configuration	LT	T			T	TR
Upstream Signal?		Yes			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				350		150
Peak Hour Factor, PHF				0.93		0.93
Peak-15 Minute Volume				94		40
Hourly Flow Rate, HFR				376		161
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1700	3	0	75	40	2000
	Through	1250	1700	3	43	75	40	2000
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	0	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1800	
Sat flow rate, major rt vehicles:	1800	
Number of major street through lanes:	2	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.5		6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		6					2		2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2					6.8		6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	6					2		2
t(f)	2.3					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	1250	0		

Total Saturation Flow Rate, s (vph)	3400	3400
Arrival Type	3	3
Effective Green, g (sec)	43	0
Cycle Length, C (sec)	75	75
Rp (from Exhibit 16-11)	1.000	1.000
Proportion vehicles arriving on green P	0.573	0.000
g(q1)	11.8	0.0
g(q2)	6.8	0.0
g(q)	18.6	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
alpha	0.500			
beta	0.667			
Travel time, t(a) (sec)	34.014			
Smoothing Factor, F	0.081			
Proportion of conflicting flow, f	1.000	1.000		
Max platooned flow, V(c,max)	2694	0		
Min platooned flow, V(c,min)	2000	2000		
Duration of blocked period, t(p)	15.9	0.0		
Proportion time blocked, p	0.211		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.211
p(5)	0.000
p(dom)	0.211
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.789		
p(11)			
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	848					1840		424
s	3000					3000		3000
Px	1.000					0.789		1.000
V c,u,x	848					1529		424
C r,x	760					108		628
C plat,x	760					85		628

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					3000	3000		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		424
Potential Capacity		628
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		628
Probability of Queue free St.	1.00	0.74

Step 2: LT from Major St.	4	1
Conflicting Flows		848
Potential Capacity		760
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		760
Probability of Queue free St.	1.00	0.76
Maj L-Shared Prob Q free St.		0.76

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1840
Potential Capacity		85
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.76	
Maj. L, Min T Adj. Imp Factor.	0.82	
Cap. Adj. factor due to Impeding mvmnt	0.61	0.76
Movement Capacity		65

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		1840
Potential Capacity		85
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.76	
Maj. L, Min T Adj. Imp Factor.	0.82	
Cap. Adj. factor due to Impeding mvmnt	0.61	0.76
Movement Capacity		65
Results for Two-stage process:		
a		
y		
C t		65

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				376		161
Movement Capacity (vph)				65		628
Shared Lane Capacity (vph)					89	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				65		628
Volume				376		161
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					89	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

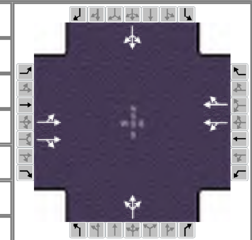
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	182						537	
C(m) (vph)	760						89	
v/c	0.24						6.03	
95% queue length	0.93						59.39	
Control Delay	11.2						2358	
LOS	B						F	
Approach Delay							2358	
Approach LOS							F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.76	1.00
v(il), Volume for stream 2 or 5	0	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1800	
s(i2), Saturation flow rate for stream 3 or 6	1800	
P*(oj)	0.76	
d(M,LT), Delay for stream 1 or 4	11.2	
N, Number of major street through lanes	2	
d(rank,1) Delay for stream 2 or 5		

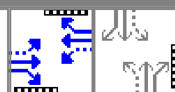
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Benson Rd & Hall Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Benson_Rd_AM_BestCase.xus				
Project Description	2035 NB AM				

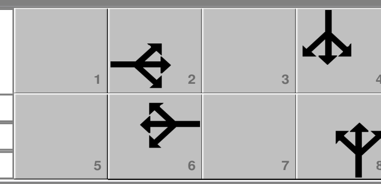


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	150	370	30	50	1230	120	110	150	70	50	10	40

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	107	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	70.0	26.0	0.0	0.0	0.0	0.0
Yellow	5.0	5.0	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



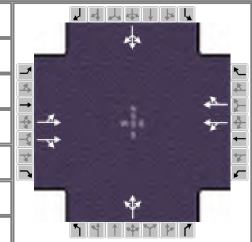
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		77.0		77.0		33.0		33.0
Change Period, ($Y+R_c$), s		7.0		7.0		7.0		7.0
Max Allow Headway (MAH), s		0.0		0.0		4.1		4.1
Queue Clearance Time (g_s), s						28.0		12.6
Green Extension Time (g_e), s		0.0		0.0		0.0		1.6
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.03

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	176		471	860		787		388			118	
Adjusted Saturation Flow Rate (s), veh/h/ln	113		1525	1621		1497		1483			965	
Queue Service Time (g_s), s	25.7		11.7	28.1		44.3		15.4			0.0	
Cycle Queue Clearance Time (g_c), s	70.0		11.7	44.4		44.3		26.0			10.6	
Green Ratio (g/C)	0.64		0.64	0.64		0.64		0.24			0.24	
Capacity (c), veh/h	137		970	1066		953		394			277	
Volume-to-Capacity Ratio (X)	1.285		0.485	0.806		0.826		0.985			0.424	
Available Capacity (c_a), veh/h	137		970	1066		953		394			277	
Back of Queue (Q), veh/ln (95th percentile)	17.7		5.5	22.4		21.4		21.6			4.9	
Queue Storage Ratio (RQ) (95th percentile)	0.16		0.05	0.59		0.56		0.55			0.12	
Uniform Delay (d_1), s/veh	37.9		5.5	15.1		15.3		43.5			35.6	
Incremental Delay (d_2), s/veh	170.4		1.6	6.5		8.1		41.2			0.4	
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (d), s/veh	208.3		7.1	21.6		23.5		84.7			36.0	
Level of Service (LOS)	F		A	C		C		F			D	
Approach Delay, s/veh / LOS	62.0	E		22.5	C		84.7	F		36.0	D	
Intersection Delay, s/veh / LOS	40.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.7	B	2.7	B
Bicycle LOS Score / LOS	1.0	A	1.8	A	1.1	A	0.7	A

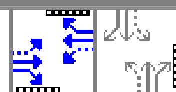
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & Hall Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Benson_Rd_PM_BestCase.xus				
Project Description	2035 NB PM				

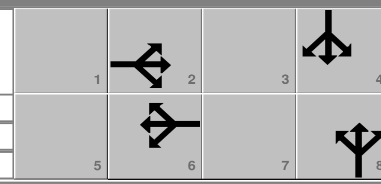


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	1250	100	60	740	40	30	20	60	130	150	150

Signal Information				
Cycle, s	105.0	Reference Phase	2	
Offset, s	101	Reference Point	End	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	



Green	65.0	26.0	0.0	0.0	0.0	0.0
Yellow	5.0	5.0	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



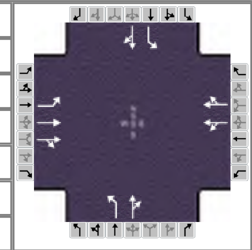
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		72.0		72.0		33.0		33.0
Change Period, (*Y+Rc*), s		7.0		7.0		7.0		7.0
Max Allow Headway (*MAH*), s		0.0		0.0		3.5		3.5
Queue Clearance Time (*gs*), s						8.8		28.0
Green Extension Time (*ge*), s		0.0		0.0		1.5		0.0
Phase Call Probability						1.00		1.00
Max Out Probability						0.00		1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	693		809	220		683		118			462	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1267		1509	470		1528		1201			1474	
Queue Service Time (*gs*), s	21.1		41.1	14.1		32.4		0.0			19.2	
Cycle Queue Clearance Time (*gc*), s	50.8		41.1	52.2		32.4		6.8			26.0	
Green Ratio (*g/C*)	0.62		0.62	0.62		0.62		0.25			0.25	
Capacity (*c*), veh/h	821		934	335		946		341			410	
Volume-to-Capacity Ratio (*X*)	0.843		0.866	0.656		0.722		0.347			1.129	
Available Capacity (*ca*), veh/h	821		934	335		946		341			410	
Back of Queue (*Q*), veh/ln (95th percentile)	11.1		15.6	5.4		16.2		4.5			29.7	
Queue Storage Ratio (*RQ*) (95th percentile)	0.10		0.14	0.14		0.43		0.11			0.76	
Uniform Delay (*d1*), s/veh	11.6		10.8	17.8		13.8		32.1			41.1	
Incremental Delay (*d2*), s/veh	8.7		9.0	9.6		4.8		0.6			84.5	
Initial Queue Delay (*d3*), s/veh	0.0		0.0	0.0		0.0		0.0			0.0	
Control Delay (*d*), s/veh	20.4		19.8	27.4		18.6		32.7			125.6	
Level of Service (LOS)	C		B	C		B		C			F	
Approach Delay, s/veh / LOS	20.0	C		20.7	C		32.7	C		125.6	F	
Intersection Delay, s/veh / LOS	37.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.7	B	2.7	B
Bicycle LOS Score / LOS	1.7	A	1.2	A	0.7	A	1.3	A

HCS 2010 Signalized Intersection Results Summary

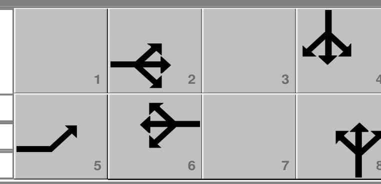
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Benson Rd & Hall Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Benson_Rd_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	370	30	50	1230	120	110	150	70	50	10	40

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	108	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.5	58.1	24.4	0.0	0.0	0.0
Yellow	4.0	5.0	5.0	0.0	0.0	0.0
Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		8.3		6.0		6.0
Phase Duration, s	13.5	78.6		65.1		31.4		31.4
Change Period, (Y+R_c), s	5.0	7.0		7.0		7.0		7.0
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		4.1		4.1
Queue Clearance Time (g_s), s	9.2					17.7		23.5
Green Extension Time (g_e), s	0.0	0.0		0.0		1.4		0.8
Phase Call Probability	1.00					1.00		1.00
Max Out Probability	1.00					0.09		0.87

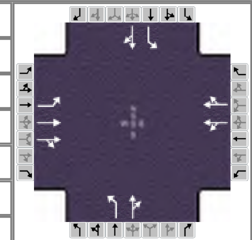
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	176	238	233	860		787	129	259		59	59	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1653	1620		1497	1288	1669		1116	1543	
Queue Service Time (g_s), s	7.2	3.9	3.7	44.9		57.6	9.9	15.7		5.6	3.4	
Cycle Queue Clearance Time (g_c), s	7.2	3.9	3.7	58.0		57.6	13.5	15.7		21.5	3.4	
Green Ratio (g/C)	0.62	0.65	0.65	0.53		0.53	0.22	0.22		0.22	0.22	
Capacity (*c*), veh/h	194	1104	1074	890		790	311	372		153	344	
Volume-to-Capacity Ratio (*X*)	0.909	0.215	0.217	0.967		0.996	0.416	0.696		0.385	0.171	
Available Capacity (c_a), veh/h	195	1104	1074	890		790	352	425		188	393	
Back of Queue (*Q*), veh/ln (95th percentile)	11.3	2.3	2.1	34.2		33.5	5.8	11.1		2.9	2.3	
Queue Storage Ratio (*RQ*) (95th percentile)	2.97	0.02	0.02	0.90		0.88	0.15	0.28		0.73	0.06	
Uniform Delay (d_1), s/veh	36.2	4.4	4.2	25.8		25.9	40.1	39.3		49.3	34.5	
Incremental Delay (d_2), s/veh	37.6	0.4	0.4	23.1		31.2	0.9	4.2		0.6	0.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	73.8	4.8	4.6	48.9		57.1	41.0	43.5		49.9	34.6	
Level of Service (LOS)	E	A	A	D		E	D	D		D	C	
Approach Delay, s/veh / LOS	23.6		C	52.8		D	42.7		D	42.3		D
Intersection Delay, s/veh / LOS	44.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.3	B	2.7	B	2.8	C
Bicycle LOS Score / LOS	1.0	A	1.8	A	1.1	A	0.7	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:20:36 AM

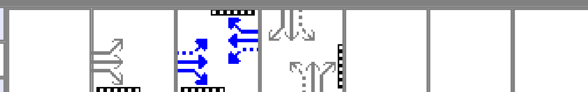
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & Hall Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Benson_Rd_PM_WorstCase.xus				
Project Description	2035 NB PM				

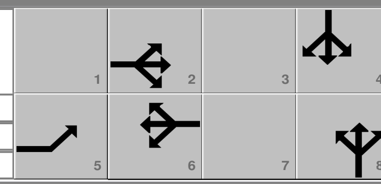


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	50	1250	100	60	740	40	30	20	60	130	150	150

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	92	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.0	57.1	25.0	0.0	0.0	0.0
Yellow	4.0	5.0	5.0	0.0	0.0	0.0
Red	1.0	2.0	2.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6		8		4
Case Number	1.0	4.0		8.3		6.0		6.0
Phase Duration, s	9.0	73.0		64.1		32.0		32.0
Change Period, ($Y+R_c$), s	5.0	7.0		7.0		7.0		7.0
Max Allow Headway (*MAH*), s	3.1	0.0		0.0		3.5		3.5
Queue Clearance Time (g_s), s	3.4					25.2		21.9
Green Extension Time (g_e), s	0.0	0.0		0.0		0.0		0.6
Phase Call Probability	0.79					1.00		1.00
Max Out Probability	1.00					1.00		1.00

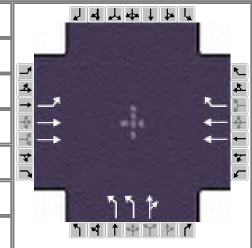
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	54	733	718	366		537	32	86		140	323	
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1654	1025		1523	1053	1555		1306	1619	
Queue Service Time (g_s), s	1.4	23.9	24.2	11.0		26.1	3.2	4.7		10.2	19.9	
Cycle Queue Clearance Time (g_c), s	1.4	23.9	24.2	26.1		26.1	23.2	4.7		14.9	19.9	
Green Ratio (g/C)	0.60	0.63	0.63	0.54		0.54	0.24	0.24		0.24	0.24	
Capacity (c), veh/h	319	1068	1040	597		828	118	370		320	385	
Volume-to-Capacity Ratio (X)	0.168	0.687	0.691	0.613		0.648	0.273	0.233		0.437	0.838	
Available Capacity (c_a), veh/h	336	1068	1040	597		828	119	370		320	385	
Back of Queue (Q), veh/ln (95th percentile)	0.9	10.1	10.0	10.5		14.1	1.6	3.2		5.9	14.3	
Queue Storage Ratio (RQ) (95th percentile)	0.22	0.09	0.09	0.28		0.37	0.04	0.08		1.49	0.36	
Uniform Delay (d_1), s/veh	12.8	8.1	8.2	15.6		16.9	49.2	32.3		38.3	38.1	
Incremental Delay (d_2), s/veh	0.1	3.0	3.1	4.7		3.9	1.2	0.3		0.4	14.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	12.9	11.1	11.3	20.3		20.8	50.4	32.6		38.7	52.2	
Level of Service (LOS)	B	B	B	C		C	D	C		D	D	
Approach Delay, s/veh / LOS	11.3	B		20.6	C		37.5	D		48.1	D	
Intersection Delay, s/veh / LOS	20.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.3	B	2.7	B	2.8	C
Bicycle LOS Score / LOS	1.7	A	1.2	A	0.7	A	1.3	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:24:55 AM

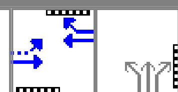
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Benson Rd & I-229 NB Rar	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Benson_Rd_AM_BestCase.xus				
Project Description	2035 NB AM				

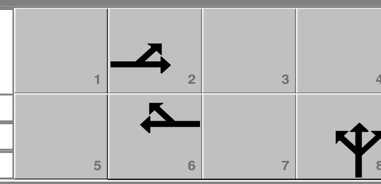


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	80	470			1350	30	1580	0	80			

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	106	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	49.5	49.5	0.0	0.0	0.0	0.0
Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		7.0		10.0		
Phase Duration, s		55.0		55.0		55.0		
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		
Max Allow Headway (MAH), s		0.0		0.0		4.1		
Queue Clearance Time (g_s), s						51.5		
Green Extension Time (g_e), s		0.0		0.0		0.0		
Phase Call Probability						1.00		
Max Out Probability						1.00		

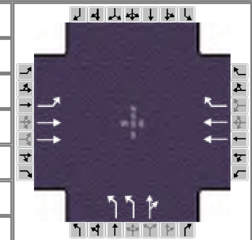
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (v), veh/h	94	553			1588	0	1859	86				
Adjusted Saturation Flow Rate (s), veh/h/ln	308	1617			1617	1439	1278	1439				
Queue Service Time (g_s), s	0.0	13.7			49.5	0.0	49.5	3.8				
Cycle Queue Clearance Time (g_c), s	49.5	13.7			49.5	0.0	49.5	3.8				
Green Ratio (g/C)	0.45	0.45			0.45	0.45	0.45	0.45				
Capacity (c), veh/h	65	1455			1455	648	1150	648				
Volume-to-Capacity Ratio (X)	1.438	0.380			1.092	0.000	1.617	0.133				
Available Capacity (c_a), veh/h	65	1455			1455	648	1150	648				
Back of Queue (Q), veh/ln (95th percentile)	11.8	8.9			27.7	0.0	93.3	2.2				
Queue Storage Ratio (RQ) (95th percentile)	3.08	0.08			0.25	0.00	2.45	0.06				
Uniform Delay (d_1), s/veh	61.9	23.1			18.1	0.0	30.3	17.7				
Incremental Delay (d_2), s/veh	258.0	0.7			47.3	0.0	281.5	0.1				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (d), s/veh	319.9	23.8			65.4	0.0	311.7	17.8				
Level of Service (LOS)	F	C			F		F	B				
Approach Delay, s/veh / LOS	66.8	E		65.4	E		298.8	F		0.0		
Intersection Delay, s/veh / LOS	174.2						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	1.9	A	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.0	A	1.8	A	3.7	D		

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:18:50 AM

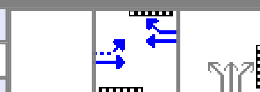
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & I-229 NB Rar	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Benson_Rd_PM_BestCase.xus				
Project Description	2035 NB PM				

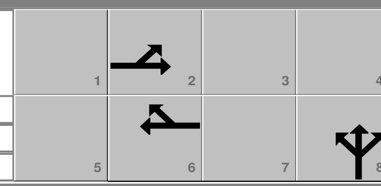


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	170	1050			870	50	360	0	350			

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	10	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	75.2	18.8	0.0	0.0	0.0	0.0
Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		7.0		10.0		
Phase Duration, s		80.7		80.7		24.3		
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		
Queue Clearance Time (g_s), s						16.4		
Green Extension Time (g_e), s		0.0		0.0		2.4		
Phase Call Probability						1.00		
Max Out Probability						0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	182	1126			902	10	387	205				
Adjusted Saturation Flow Rate (*s*), veh/h/ln	586	1617			1617	1439	1456	1439				
Queue Service Time (g_s), s	23.2	18.2			4.6	0.1	13.2	14.4				
Cycle Queue Clearance Time (g_c), s	26.1	18.2			4.6	0.1	13.2	14.4				
Green Ratio (*g/C*)	0.72	0.72			0.72	0.72	0.18	0.18				
Capacity (*c*), veh/h	463	2316			2316	1031	521	257				
Volume-to-Capacity Ratio (*X*)	0.394	0.486			0.389	0.010	0.744	0.798				
Available Capacity (c_a), veh/h	463	2316			2316	1031	1067	528				
Back of Queue (*Q*), veh/ln (95th percentile)	4.4	7.6			1.7	0.0	8.3	9.1				
Queue Storage Ratio (*RQ*) (95th percentile)	1.16	0.07			0.02	0.00	0.22	0.24				
Uniform Delay (d_1), s/veh	14.8	8.1			1.8	1.1	40.8	41.3				
Incremental Delay (d_2), s/veh	0.6	0.2			0.3	0.0	2.1	5.6				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (*d*), s/veh	15.5	8.3			2.0	1.1	43.0	46.9				
Level of Service (LOS)	B	A			A	A	D	D				
Approach Delay, s/veh / LOS	9.3	A		2.0	A		44.3	D		0.0		
Intersection Delay, s/veh / LOS	14.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.6	A	1.3	A	1.5	A		

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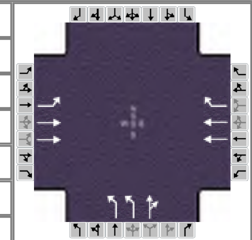
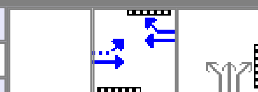
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Benson Rd & I-229 NB Rar	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Benson_Rd_AM_WorstCase.xus				
Project Description	2035 NB AM				

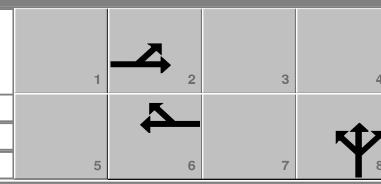


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	80	470			1350	30	1580	0	80			

Signal Information				
Cycle, s	110.0	Reference Phase	2
Offset, s	106	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	49.5	49.5	0.0	0.0	0.0	0.0
Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		7.0		10.0		
Phase Duration, s		55.0		55.0		55.0		
Change Period, ($Y+R_c$), s		5.5		5.5		5.5		
Max Allow Headway (MAH), s		0.0		0.0		4.1		
Queue Clearance Time (g_s), s						51.5		
Green Extension Time (g_e), s		0.0		0.0		0.0		
Phase Call Probability						1.00		
Max Out Probability						1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (v), veh/h	94	553			1588	0	1859	86				
Adjusted Saturation Flow Rate (s), veh/h/ln	308	1617			1617	1439	1278	1439				
Queue Service Time (g_s), s	0.0	13.7			49.5	0.0	49.5	3.8				
Cycle Queue Clearance Time (g_c), s	49.5	13.7			49.5	0.0	49.5	3.8				
Green Ratio (g/C)	0.45	0.45			0.45	0.45	0.45	0.45				
Capacity (c), veh/h	65	1455			1455	648	1150	648				
Volume-to-Capacity Ratio (X)	1.438	0.380			1.092	0.000	1.617	0.133				
Available Capacity (c_a), veh/h	65	1455			1455	648	1150	648				
Back of Queue (Q), veh/ln (95th percentile)	11.8	8.9			30.2	0.0	93.3	2.2				
Queue Storage Ratio (RQ) (95th percentile)	3.08	0.08			0.27	0.00	2.45	0.06				
Uniform Delay (d_1), s/veh	61.9	23.1			23.4	0.0	30.3	17.7				
Incremental Delay (d_2), s/veh	258.0	0.7			44.8	0.0	281.5	0.1				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (d), s/veh	319.9	23.8			68.2	0.0	311.7	17.8				
Level of Service (LOS)	F	C			F		F	B				

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	66.8	E	68.2	E	298.8	F	0.0	
Intersection Delay, s/veh / LOS	175.3				F			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.9	A	1.9	A	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.0	A	1.8	A	3.7	D		

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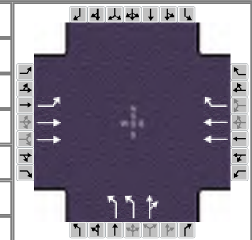
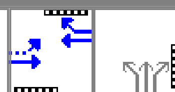
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & I-229 NB Rar	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Benson_Rd_PM_WorstCase.xus				
Project Description	2035 NB PM				

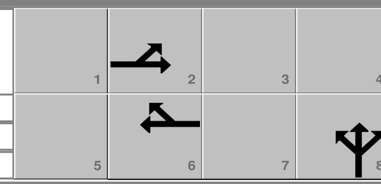


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	170	1050			870	50	360	0	350			

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	102	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	75.1	18.9	0.0	0.0	0.0	0.0
Yellow	3.5	3.5	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		6.0		7.0		10.0		
Phase Duration, s		80.6		80.6		24.4		
Change Period, (Y+R_c), s		5.5		5.5		5.5		
Max Allow Headway (MAH), s		0.0		0.0		4.2		
Queue Clearance Time (g_s), s						16.3		
Green Extension Time (g_e), s		0.0		0.0		2.6		
Phase Call Probability						1.00		
Max Out Probability						0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (v), veh/h	183	1129			935	11	387	205				
Adjusted Saturation Flow Rate (s), veh/h/ln	568	1617			1617	1439	1456	1439				
Queue Service Time (g_s), s	28.6	18.3			10.4	0.1	13.2	14.3				
Cycle Queue Clearance Time (g_c), s	35.1	18.3			10.4	0.1	13.2	14.3				
Green Ratio (g/C)	0.71	0.71			0.71	0.71	0.18	0.18				
Capacity (c), veh/h	417	2311			2311	1029	525	260				
Volume-to-Capacity Ratio (X)	0.439	0.488			0.405	0.010	0.737	0.791				
Available Capacity (c_a), veh/h	417	2311			2311	1029	2398	1186				
Back of Queue (Q), veh/ln (95th percentile)	4.9	7.7			4.8	0.1	8.3	9.1				
Queue Storage Ratio (RQ) (95th percentile)	1.28	0.07			0.04	0.01	0.22	0.24				
Uniform Delay (d_1), s/veh	19.4	8.2			4.8	2.2	40.7	41.1				
Incremental Delay (d_2), s/veh	0.9	0.2			0.4	0.0	2.0	5.4				
Initial Queue Delay (d_3), s/veh	0.0	0.0			0.0	0.0	0.0	0.0				
Control Delay (d), s/veh	20.2	8.4			5.1	2.2	42.7	46.5				
Level of Service (LOS)	C	A			A	A	D	D				
Approach Delay, s/veh / LOS	10.0	B		5.1	A		44.0	D		0.0		
Intersection Delay, s/veh / LOS	15.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	1.9	A	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.6	A	1.3	A	1.5	A		

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HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E Benson Rd & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: I-229 SB Ramps
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume		470	370	280	2650	
Peak-Hour Factor, PHF		0.85	0.85	0.85	0.85	
Hourly Flow Rate, HFR		552	435	329	3117	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume				80	0	140
Peak Hour Factor, PHF				0.85	0.85	0.85
Hourly Flow Rate, HFR				94	0	164
Percent Heavy Vehicles				6	6	6
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				1	1	0
Configuration				L		TR

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L				L		TR
v (vph)		329				94		164
C(m) (vph)		672				1		139
v/c		0.49				94.00		1.18
95% queue length		2.71				14.12		9.56
Control Delay		15.4				48823		195.4
LOS		C				F		F
Approach Delay							17912	
Approach LOS							F	

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E Benson Rd & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: I-229 SB Ramps
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		470	370	280	2650	
Peak-Hour Factor, PHF		0.85	0.85	0.85	0.85	
Peak-15 Minute Volume		138	109	82	779	
Hourly Flow Rate, HFR		552	435	329	3117	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				80	0	140
Peak Hour Factor, PHF				0.85	0.85	0.85
Peak-15 Minute Volume				24	0	41
Hourly Flow Rate, HFR				94	0	164
Percent Heavy Vehicles				6	6	6
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				1	1	0
Configuration				L		TR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	72	40	1950
	Through	730	1800	3	37	72	40	1950
S5	Left-Turn	0	1800	3	0	111	40	1050
	Through	1350	1800	3	11	111	40	1050

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1				7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			6				6	6	6
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00				0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2				6.9	6.6	6.3
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20				3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		6				6	6	6
t(f)		2.3				3.6	4.1	3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	730	0	1350	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	37	0	11	0
Cycle Length, C (sec)	72	72	111	111
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.514	0.000	0.099	0.000
g(q1)	7.1	0.0	37.5	0.0
g(q2)	1.8	0.0	22.5	0.0
g(q)	8.9	0.0	60.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	33.163		17.857	
Smoothing Factor, F	0.083		0.144	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	1935	0	3600	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	5.8	0.0
Proportion time blocked, p	0.000		0.052	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.052
p(dom)	0.052
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	1.000		
p(7)			
p(8)			
p(9)			
p(10)	0.948		
p(11)	0.948		
p(12)	0.948		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		987				4051	4762	1558
s		3000				3000	3000	3000
Px		1.000				0.948	0.948	0.948
V c,u,x		987				4109	4859	1479
C r,x		672				2	1	147
C plat,x		672				2	1	139

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					3000	3000	3000	3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		1558
Potential Capacity		139
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		139
Probability of Queue free St.	1.00	0.00

Step 2: LT from Major St.	4	1
Conflicting Flows	987	
Potential Capacity	672	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	672	
Probability of Queue free St.	0.51	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		4762
Potential Capacity		1
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.51	0.51
Movement Capacity		1
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		4051
Potential Capacity		2
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.51	
Maj. L, Min T Adj. Imp Factor.	0.62	
Cap. Adj. factor due to Impeding mvmnt	0.00	0.51
Movement Capacity		1

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		4762
Potential Capacity		1
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.51	0.51
Movement Capacity		1

Result for 2 stage process:		
a		
y		
C t		1
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		4051
Potential Capacity		2
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.51	
Maj. L, Min T Adj. Imp Factor.	0.62	
Cap. Adj. factor due to Impeding mvmnt	0.00	0.51
Movement Capacity		1
Results for Two-stage process:		
a		
y		
C t		1

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				94	0	164
Movement Capacity (vph)				1	1	139
Shared Lane Capacity (vph)						139

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				1	1	139
Volume				94	0	164
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						139
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L				L		TR
v (vph)		329				94		164
C(m) (vph)		672				1		139
v/c		0.49				94.00		1.18
95% queue length		2.71				14.12		9.56
Control Delay		15.4				48823		195.4
LOS		C				F		F
Approach Delay							17912	
Approach LOS							F	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.51
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		15.4
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E Benson Rd & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: I-229 SB Ramps
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1180	1160	170	1060	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Hourly Flow Rate, HFR		1268	1247	182	1139	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				40	0	70
Peak Hour Factor, PHF				0.93	0.93	0.93
Hourly Flow Rate, HFR				43	0	75
Percent Heavy Vehicles				6	6	6
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				1	1	0
Configuration				L	TR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L				L		TR
v (vph)		182				43		75
C(m) (vph)		139				0		0
v/c		1.31						
95% queue length		11.38						
Control Delay		242.3						
LOS		F				F		F
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E Benson Rd & I-229 SB Ramps
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: I-229 SB Ramps
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		1180	1160	170	1060	
Peak-Hour Factor, PHF		0.93	0.93	0.93	0.93	
Peak-15 Minute Volume		317	312	46	285	
Hourly Flow Rate, HFR		1268	1247	182	1139	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		2	0	1	2	
Configuration		T	TR	L	T	
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				40	0	70
Peak Hour Factor, PHF				0.93	0.93	0.93
Peak-15 Minute Volume				11	0	19
Hourly Flow Rate, HFR				43	0	75
Percent Heavy Vehicles				6	6	6
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
RT Channelized?						
Lanes				1	1	0
Configuration				L		TR

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	77	40	1950
	Through	1370	1800	3	35	77	40	1950
S5	Left-Turn	0	1800	3	0	20	40	1050
	Through	870	1800	3	4	20	40	1050

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			4.1				7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)			6				6	6	6
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.00				0.70	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage		4.2				6.9	6.6	6.3
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20				3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)		6				6	6	6
t(f)		2.3				3.6	4.1	3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	1370	0	870	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	35	0	4	0
Cycle Length, C (sec)	77	77	20	20
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.455	0.000	0.200	0.000
g(q1)	16.0	0.0	3.9	0.0
g(q2)	9.8	0.0	1.2	0.0
g(q)	25.8	0.0	5.1	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	33.163		17.857	
Smoothing Factor, F	0.083		0.144	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3215	0	1969	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	25.6	0.0	0.0	0.0
Proportion time blocked, p	0.333		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.333
p(5)	0.000
p(dom)	0.333
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)	0.667		
p(7)			
p(8)			
p(9)			
p(10)	0.667		
p(11)	0.667		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		2515				2137	4018	570
s		3000				3000	3000	3000
Px		0.667				0.667	0.667	1.000
V c,u,x		2273				1706	4526	570
C r,x		208				79	1	508
C plat,x		139				53	1	508

Two-Stage Process

	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s					3000	3000	3000	3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		570
Potential Capacity		508
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		508
Probability of Queue free St.	1.00	0.85

Step 2: LT from Major St.	4	1
Conflicting Flows	2515	
Potential Capacity	139	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	139	
Probability of Queue free St.	0.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		4018
Potential Capacity		1
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		0
Probability of Queue free St.	1.00	

Step 4: LT from Minor St.	7	10
Conflicting Flows		2137
Potential Capacity		53
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt		0.00
Movement Capacity		0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		4018
Potential Capacity		1
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity		0

Result for 2 stage process:		
a		
y		
C t		0
Probability of Queue free St.	1.00	

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows		2137
Potential Capacity		53
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt		0.00
Movement Capacity		0

Results for Two-stage process:		
a		
y		
C t		0

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				43	0	75
Movement Capacity (vph)				0	0	508
Shared Lane Capacity (vph)						0

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				0	0	508
Volume				43	0	75
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						0
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L				L		TR
v (vph)		182				43		75
C(m) (vph)		139				0		0
v/c		1.31						
95% queue length		11.38						
Control Delay		242.3						
LOS		F				F		F
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		242.3
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E Benson Rd & Potsdam Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Potsdam Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	40	730	50	160	2230	400
Peak-Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Hourly Flow Rate, HFR	47	858	58	188	2623	470
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	10	80	30	30	30
Peak Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Hourly Flow Rate, HFR	35	11	94	35	35	35
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1	1	0	0	1	0
Configuration	L		TR		LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR		LTR	
v (vph)	47	188	35		105		105	
C(m) (vph)	94	750	0		0			
v/c	0.50	0.25						
95% queue length	2.19	0.99						
Control Delay	76.7	11.4						
LOS	F	B	F		F			
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: AM Peak
Intersection: E Benson Rd & Potsdam Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Potsdam Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	40	730	50	160	2230	400
Peak-Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Peak-15 Minute Volume	12	215	15	47	656	118
Hourly Flow Rate, HFR	47	858	58	188	2623	470
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	30	10	80	30	30	30
Peak Hour Factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85
Peak-15 Minute Volume	9	3	24	9	9	9
Hourly Flow Rate, HFR	35	11	94	35	35	35
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		No /
RT Channelized?						
Lanes	1	1	0	0	1	0
Configuration	L		TR		LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1700	3	0	72	40	1425
	Through	730	1700	3	37	72	40	1425
S5	Left-Turn	0	1700	3	0	111	40	1575
	Through	1350	1700	3	11	111	40	1575

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.2	7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		6	6	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.5	6.5	6.2	7.5	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	6	6	2	2	2	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	730	0	1350	0

Total Saturation Flow Rate, s (vph)	3400	3400	3400	3400
Arrival Type	3	3	3	3
Effective Green, g (sec)	37	0	11	0
Cycle Length, C (sec)	72	72	111	111
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.514	0.000	0.099	0.000
g(q1)	7.5	0.0	39.7	0.0
g(q2)	2.1	0.0	26.1	0.0
g(q)	9.6	0.0	65.9	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	24.235		26.786	
Smoothing Factor, F	0.110		0.101	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	2287	0	3397	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	3.7	0.0	2.6	0.0
Proportion time blocked, p	0.052		0.024	

Computation 3-Platoon Event Periods	Result
p(2)	0.052
p(5)	0.024
p(dom)	0.052
p(subo)	0.024
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.976		
p(4)	0.948		
p(7)	0.937		
p(8)	0.937		
p(9)	0.948		
p(10)	0.937		
p(11)	0.937		
p(12)	0.976		

Computation 4 and 5

Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	3093	916	2685	4450	458	3762	4244	1546
s	3000	3000	3000	3000	3000	3000	3000	3000
Px	0.976	0.948	0.937	0.937	0.948	0.937	0.937	0.976
V c,u,x	3095	803	2664	4548	320	3814	4328	1511
C r,x	96	791	11	1	719	1	2	146
C plat,x	94	750	10	1	682	1	2	143

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	3000	3000	3000	3000	3000	3000	3000	3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	458	1546
Potential Capacity	682	143
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	682	143
Probability of Queue free St.	0.86	0.76

Step 2: LT from Major St.	4	1
Conflicting Flows	916	3093
Potential Capacity	750	94
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	750	94
Probability of Queue free St.	0.75	0.50
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	4450	4244
Potential Capacity	1	2
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.37	0.37
Movement Capacity	0	1
Probability of Queue free St.		0.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2685	3762
Potential Capacity	10	1
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	
Maj. L, Min T Adj. Imp Factor.	0.00	
Cap. Adj. factor due to Impeding mvmnt	0.00	
Movement Capacity	0	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

```
Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity
-------------------------------------------------------------------------------
Part 3 - Single Stage
Conflicting Flows                               4450             4244
Potential Capacity                              1                2
Pedestrian Impedance Factor                     1.00             1.00
Cap. Adj. factor due to Impeding mvmnt          0.37             0.37
Movement Capacity                               0                1
-------------------------------------------------------------------------------
Result for 2 stage process:
a
y
C t                                             0                1
Probability of Queue free St.                                    0.00
-------------------------------------------------------------------------------
Step 4: LT from Minor St.                          7                10
-------------------------------------------------------------------------------
Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity
-------------------------------------------------------------------------------
Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity
-------------------------------------------------------------------------------
Part 3 - Single Stage
Conflicting Flows                               2685             3762
Potential Capacity                              10               1
Pedestrian Impedance Factor                     1.00             1.00
Maj. L, Min T Impedance factor                  0.00
Maj. L, Min T Adj. Imp Factor.                  0.00
Cap. Adj. factor due to Impeding mvmnt          0.00
Movement Capacity                               0
-------------------------------------------------------------------------------
Results for Two-stage process:
a
y
C t                                             0
-------------------------------------------------------------------------------

Worksheet 8-Shared Lane Calculations
-------------------------------------------------------------------------------
Movement                              7      8      9     10     11     12
                                      L      T      R      L      T      R
-------------------------------------------------------------------------------
Volume (vph)                         35     11     94     35     35     35
Movement Capacity (vph)              0      0      682           1      143
Shared Lane Capacity (vph)                         0
-------------------------------------------------------------------------------
```

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	0	0	682		1	143
Volume	35	11	94	35	35	35
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			0			
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR		LTR	
v (vph)	47	188	35		105		105	
C(m) (vph)	94	750	0		0			
v/c	0.50	0.25						
95% queue length	2.19	0.99						
Control Delay	76.7	11.4						
LOS	F	B	F		F			
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.50	0.75
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	76.7	11.4
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

TWO-WAY STOP CONTROL SUMMARY

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E Benson Rd & Potsdam Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Potsdam Ave
Intersection Orientation: EW   Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1 L	2 T	3 R	4 L	5 T	6 R
Volume	30	1870	30	80	1000	50
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	32	2010	32	86	1075	53
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume	40	10	140	330	10	60
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Hourly Flow Rate, HFR	43	10	150	354	10	64
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
Lanes	1	1	0	0	1	0
Configuration	L		TR		LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR		LTR	
v (vph)	32	86	43		160		428	
C(m) (vph)	592	271	0		31		0	
v/c	0.05	0.32			5.16			
95% queue length	0.17	1.32			19.24			
Control Delay	11.4	24.3			2128			
LOS	B	C	F		F		F	
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.6

Phone: Fax:
E-Mail:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: GHM
Agency/Co.: HDR
Date Performed: 10/10/2014
Analysis Time Period: PM Peak
Intersection: E Benson Rd & Potsdam Ave
Jurisdiction: Sioux Falls, SD
Units: U. S. Customary
Analysis Year: 2035
Project ID: I-229 MIS
East/West Street: E Benson Rd
North/South Street: Potsdam Ave
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	30	1870	30	80	1000	50
Peak-Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	8	503	8	22	269	13
Hourly Flow Rate, HFR	32	2010	32	86	1075	53
Percent Heavy Vehicles	6	--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	1	2	0	1	2	0
Configuration	L	T	TR	L	T	TR
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	40	10	140	330	10	60
Peak Hour Factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Peak-15 Minute Volume	11	3	38	89	3	16
Hourly Flow Rate, HFR	43	10	150	354	10	64
Percent Heavy Vehicles	2	2	2	2	2	2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	1	1	0	0	1	0
Configuration	L		TR		LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	0	1800	3	0	77	40	1425
	Through	1370	1800	3	35	77	40	1425
S5	Left-Turn	0	1800	3	0	20	40	1575
	Through	870	1800	3	4	20	40	1575

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.5	6.5	6.2	7.5	6.5	6.2
t(c,hv)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)		6	6	2	2	2	2	2	2
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.2	4.2	7.5	6.5	6.2	7.5	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	6	6	2	2	2	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2 V(t)	Movement 2 V(l,prot)	Movement 5 V(t)	Movement 5 V(l,prot)
V prog	1370	0	870	0

Total Saturation Flow Rate, s (vph)	3600	3600	3600	3600
Arrival Type	3	3	3	3
Effective Green, g (sec)	35	0	4	0
Cycle Length, C (sec)	77	77	20	20
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.455	0.000	0.200	0.000
g(q1)	16.0	0.0	3.9	0.0
g(q2)	9.8	0.0	1.2	0.0
g(q)	25.8	0.0	5.1	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.500		0.500	
beta	0.667		0.667	
Travel time, t(a) (sec)	24.235		26.786	
Smoothing Factor, F	0.110		0.101	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	3423	0	1505	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	28.1	0.0	0.0	0.0
Proportion time blocked, p	0.364		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.364
p(5)	0.000
p(dom)	0.364
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	1.000		
p(4)	0.636		
p(7)	0.636		
p(8)	0.636		
p(9)	0.636		
p(10)	0.636		
p(11)	0.636		
p(12)	1.000		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1128	2042	2804	3390	1021	2348	3380	564
s	3000	3000	3000	3000	3000	3000	3000	3000
Px	1.000	0.636	0.636	0.636	0.636	0.636	0.636	1.000
V c,u,x	1128	1493	2692	3614	0	1974	3598	564
C r,x	592	426	10	5	1084	37	5	523
C plat,x	592	271	6	3	689	24	3	523

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	3000	3000	3000	3000	3000	3000	3000	3000
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	1021	564
Potential Capacity	689	523
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	689	523
Probability of Queue free St.	0.78	0.88

Step 2: LT from Major St.	4	1
Conflicting Flows	2042	1128
Potential Capacity	271	592
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	271	592
Probability of Queue free St.	0.68	0.95
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows	3390	3380
Potential Capacity	3	3
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.65	0.65
Movement Capacity	2	2
Probability of Queue free St.	0.00	0.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	2804	2348
Potential Capacity	6	24
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	0.00
Maj. L, Min T Adj. Imp Factor.	0.00	0.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity	0	0

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	3390	3380
Potential Capacity	3	3
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.65	0.65
Movement Capacity	2	2

Result for 2 stage process:		
a		
y		
C t	2	2
Probability of Queue free St.	0.00	0.00

Step 4: LT from Minor St.	7	10

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		

Part 3 - Single Stage		
Conflicting Flows	2804	2348
Potential Capacity	6	24
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.00	0.00
Maj. L, Min T Adj. Imp Factor.	0.00	0.00
Cap. Adj. factor due to Impeding mvmnt	0.00	0.00
Movement Capacity	0	0

Results for Two-stage process:		
a		
y		
C t	0	0

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	43	10	150	354	10	64
Movement Capacity (vph)	0	2	689	0	2	523
Shared Lane Capacity (vph)			31		0	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	0	2	689	0	2	523
Volume	43	10	150	354	10	64
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh			31		0	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

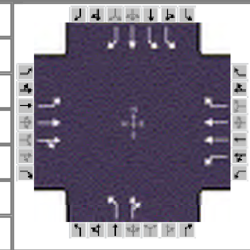
Movement	1	4	7	8	9	10	11	12
Lane Config	L	L	L		TR		LTR	
v (vph)	32	86	43		160		428	
C(m) (vph)	592	271	0		31		0	
v/c	0.05	0.32			5.16			
95% queue length	0.17	1.32			19.24			
Control Delay	11.4	24.3			2128			
LOS	B	C	F		F		F	
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

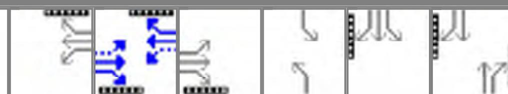
	Movement 2	Movement 5
p(oj)	0.95	0.68
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	11.4	24.3
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS 2010 Signalized Intersection Results Summary

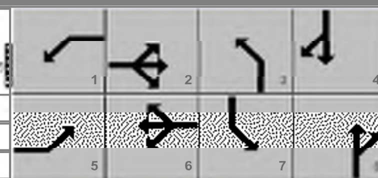
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Benson Rd & Lewis Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Benson_Rd_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	140	730	40	100	1500	300	30	30	50	80	30	120



Signal Information										
Cycle, s	110.0	Reference Phase	2							
Offset, s	45	Reference Point	End	Green	4.7	57.9	5.2	2.9	2.1	11.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.0	1.0	1.0	0.0	2.3



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.3	4.0	1.2	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	10.1	73.8	9.6	73.4	7.5	16.9	9.6	19.0
Change Period, (*Y+R*c), s	6.1	6.1	4.9	5.9	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.3	4.2	4.3
Queue Clearance Time (g_s), s	2.0		4.7		4.3	8.2	5.1	12.1
Green Extension Time (g_e), s	1.0	0.0	0.3	0.0	0.1	1.0	0.2	1.0
Phase Call Probability	0.99		0.94		0.66	1.00	0.94	1.00
Max Out Probability	1.00		0.00		0.00	0.00	0.00	0.00

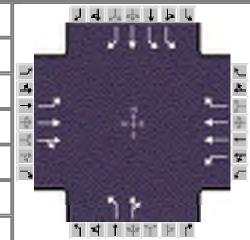
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	165	457	449	91	1366	273	35	94		94	35	141
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1667	1617	1617	1439	1681	1586		1632	1765	1496
Queue Service Time (g_s), s	0.0	17.8	18.2	2.7	31.7	9.6	2.3	6.2		3.1	2.0	10.1
Cycle Queue Clearance Time (g_c), s	0.0	17.8	18.2	2.7	31.7	9.6	2.3	6.2		3.1	2.0	10.1
Green Ratio (*g/C*)	0.54	0.62	0.62	0.59	0.61	0.61	0.03	0.10		0.05	0.12	0.12
Capacity (*c*), veh/h	213	1045	1026	344	1983	883	45	159		150	210	178
Volume-to-Capacity Ratio (*X*)	0.774	0.438	0.438	0.265	0.689	0.310	0.786	0.593		0.628	0.168	0.792
Available Capacity (c_a), veh/h	213	1045	1026	1120	1983	883	510	540		516	634	537
Back of Queue (*Q*), veh/ln (95th percentile)	8.1	10.8	11.0	1.4	12.1	3.1	2.3	4.7		2.5	1.6	6.9
Queue Storage Ratio (*RQ*) (95th percentile)	1.07	0.11	0.11	0.49	0.11	0.46	1.17	0.12		0.16	0.04	0.17
Uniform Delay (d_1), s/veh	40.3	13.7	14.4	12.6	14.8	2.6	53.2	47.4		51.6	43.5	3.1
Incremental Delay (d_2), s/veh	13.0	1.1	1.1	0.0	0.2	0.1	25.2	3.5		4.3	0.4	7.7
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	53.3	14.8	15.4	12.6	15.0	2.7	78.4	50.9		55.8	43.9	10.8
Level of Service (LOS)	D	B	B	B	B	A	E	D		E	D	B
Approach Delay, s/veh / LOS	21.0	C		12.9	B		58.4	E		30.8	C	
Intersection Delay, s/veh / LOS	19.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.6	B	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.4	A	2.3	B	0.7	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:44:17 AM

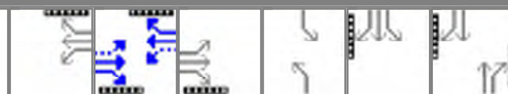
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & Lewis Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Benson_Rd_PM_BestCase.xus				
Project Description	2035 NB PM				

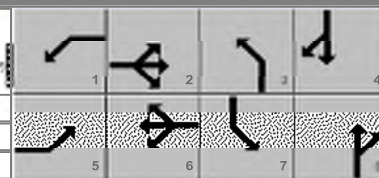


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	80	1370	30	60	770	100	50	40	130	390	40	110

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	95	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.0	38.2	4.9	4.3	7.6	14.9
Yellow	3.9	3.9	3.9	3.6	3.6	3.6
Red	1.0	2.2	1.0	1.0	1.0	2.3



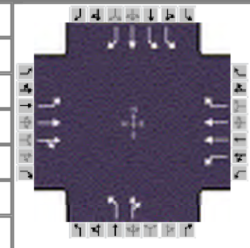
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.3	4.0	1.2	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	9.8	54.1	8.9	53.2	8.9	20.8	21.2	33.0
Change Period, ($Y+R_c$), s	6.1	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (MAH), s	4.1	0.0	4.1	0.0	4.1	4.3	4.2	4.3
Queue Clearance Time (g_s), s	2.0		4.5		5.3	14.0	15.0	8.7
Green Extension Time (g_e), s	1.4	0.0	0.2	0.0	0.1	0.9	1.5	1.3
Phase Call Probability	0.92		0.85		0.79	1.00	1.00	1.00
Max Out Probability	1.00		0.00		0.00	0.11	0.01	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	86	751	747	65	830	108	54	183		419	43	118
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1685	1617	1617	1439	1681	1551		1632	1765	1496
Queue Service Time (g_s), s	0.0	43.9	44.0	2.5	18.6	4.8	3.3	12.0		13.0	1.9	6.7
Cycle Queue Clearance Time (g_c), s	0.0	43.9	44.0	2.5	18.6	4.8	3.3	12.0		13.0	1.9	6.7
Green Ratio (g/C)	0.38	0.46	0.46	0.42	0.45	0.45	0.04	0.14		0.16	0.26	0.26
Capacity (c), veh/h	269	775	769	132	1450	645	70	220		515	456	386
Volume-to-Capacity Ratio (X)	0.318	0.968	0.970	0.492	0.573	0.167	0.768	0.830		0.814	0.094	0.306
Available Capacity (c_a), veh/h	273	775	769	764	1450	645	567	339		883	590	500
Back of Queue (Q), veh/ln (95th percentile)	2.8	15.6	15.3	1.8	10.2	2.8	3.0	8.9		9.3	1.5	4.2
Queue Storage Ratio (RQ) (95th percentile)	0.37	0.15	0.15	0.62	0.09	0.42	1.55	0.23		0.59	0.04	0.11
Uniform Delay (d_1), s/veh	32.4	17.7	17.4	25.8	18.6	5.8	49.8	43.8		42.7	29.6	4.7
Incremental Delay (d_2), s/veh	0.1	8.7	9.1	2.4	1.4	0.5	15.9	9.8		3.2	0.1	0.4
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (d), s/veh	32.5	26.5	26.5	28.2	20.0	6.3	65.8	53.6		45.9	29.7	5.1
Level of Service (LOS)	C	C	C	C	C	A	E	D		D	C	A
Approach Delay, s/veh / LOS	26.8	C		19.1	B		56.4	E		36.4	D	
Intersection Delay, s/veh / LOS	28.2						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.6	B	3.0	C	2.8	C
Bicycle LOS Score / LOS	1.8	A	1.3	A	0.9	A	1.4	A

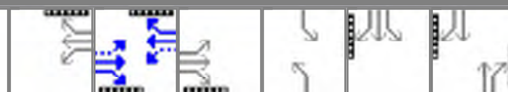
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Benson Rd & Lewis Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Benson_Rd_AM_WorstCase.xus				
Project Description	2035 NB AM				

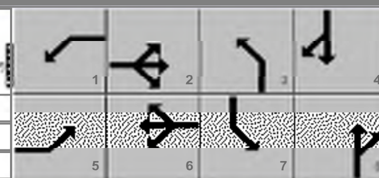


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	140	730	40	100	1500	300	30	30	50	80	30	120

Signal Information				
Cycle, s	110.0	Reference Phase	2
Offset, s	45	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.7	58.0	5.2	2.9	2.1	10.9
Yellow	3.9	3.9	3.9	3.6	0.0	3.6
Red	1.0	2.0	1.0	1.0	0.0	2.3



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.3	4.0	1.2	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	10.1	74.0	9.6	73.5	7.5	16.8	9.6	18.9
Change Period, ($Y+R_c$), s	6.1	6.1	4.9	5.9	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.3	4.2	4.3
Queue Clearance Time (g_s), s	2.0		4.7		4.3	8.2	5.1	12.1
Green Extension Time (g_e), s	1.0	0.0	0.3	0.0	0.1	0.9	0.1	0.9
Phase Call Probability	0.99		0.94		0.66	1.00	0.94	1.00
Max Out Probability	1.00		0.00		0.00	0.00	0.04	0.00

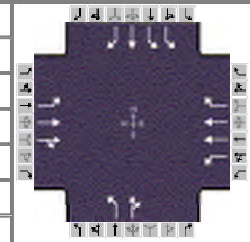
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	165	457	449	91	1366	273	35	94		94	35	141
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1667	1617	1617	1439	1681	1586		1632	1765	1496
Queue Service Time (g_s), s	0.0	17.7	18.2	2.7	31.3	9.5	2.3	6.2		3.1	2.0	10.1
Cycle Queue Clearance Time (g_c), s	0.0	17.7	18.2	2.7	31.3	9.5	2.3	6.2		3.1	2.0	10.1
Green Ratio (g/C)	0.55	0.62	0.62	0.59	0.61	0.61	0.03	0.10		0.05	0.12	0.12
Capacity (c), veh/h	213	1047	1028	346	1988	885	45	157		148	208	177
Volume-to-Capacity Ratio (X)	0.772	0.436	0.436	0.263	0.687	0.309	0.793	0.598		0.637	0.169	0.800
Available Capacity (c_a), veh/h	214	1047	1028	1036	1988	885	373	382		368	458	388
Back of Queue (Q), veh/ln (95th percentile)	8.2	10.8	11.0	1.4	11.8	3.0	2.3	4.7		2.5	1.6	6.9
Queue Storage Ratio (RQ) (95th percentile)	1.07	0.11	0.11	0.48	0.10	0.45	1.17	0.12		0.16	0.04	0.18
Uniform Delay (d_1), s/veh	40.2	13.7	14.3	12.4	14.4	1.5	53.2	47.4		51.6	43.7	2.7
Incremental Delay (d_2), s/veh	12.9	1.1	1.1	0.0	0.2	0.1	26.2	3.6		4.5	0.4	8.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (d), s/veh	53.1	14.8	15.4	12.4	14.6	1.6	79.4	51.0		56.1	44.0	10.7
Level of Service (LOS)	D	B	B	B	B	A	E	D		E	D	B
Approach Delay, s/veh / LOS	20.9		C	12.4		B	58.8		E	30.9		C
Intersection Delay, s/veh / LOS	18.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.6	B	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.4	A	2.3	B	0.7	A	0.9	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 3:12:54 PM

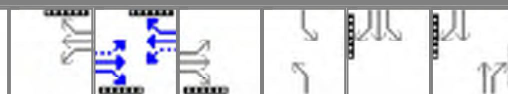
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & Lewis Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Benson_Rd_PM_WorstCase.xus				
Project Description	2035 NB PM				

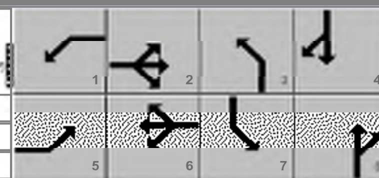


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1370	30	60	770	100	50	40	130	390	40	110

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	98	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.0	38.9	4.9	4.3	7.0	14.8
Yellow	3.9	3.9	3.9	3.6	3.6	3.6
Red	1.0	2.2	1.0	1.0	1.0	2.3



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.3	4.0	1.2	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	9.8	54.8	8.9	54.0	8.9	20.7	20.5	32.3
Change Period, ($Y+R_c$), s	6.1	6.1	4.9	6.1	4.6	5.9	4.6	5.9
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.3	4.2	4.3
Queue Clearance Time (g_s), s	2.0		4.6		5.3	14.0	15.1	8.8
Green Extension Time (g_e), s	1.4	0.0	0.2	0.0	0.1	0.8	0.7	1.3
Phase Call Probability	0.92		0.85		0.79	1.00	1.00	1.00
Max Out Probability	1.00		0.00		0.00	0.21	0.97	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	755	751	66	848	110	54	183		419	43	118
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1685	1617	1617	1439	1681	1551		1632	1765	1496
Queue Service Time (g_s), s	0.0	43.5	43.7	2.6	18.6	5.0	3.3	12.0		13.1	2.0	6.8
Cycle Queue Clearance Time (g_c), s	0.0	43.5	43.7	2.6	18.6	5.0	3.3	12.0		13.1	2.0	6.8
Green Ratio (*g/C*)	0.39	0.46	0.46	0.43	0.46	0.46	0.04	0.14		0.15	0.25	0.25
Capacity (*c*), veh/h	271	788	782	131	1475	656	70	219		494	443	376
Volume-to-Capacity Ratio (*X*)	0.317	0.958	0.960	0.504	0.575	0.168	0.772	0.833		0.849	0.097	0.315
Available Capacity (c_a), veh/h	276	788	782	513	1475	656	455	319		603	556	472
Back of Queue (*Q*), veh/ln (95th percentile)	3.1	18.1	17.8	1.8	10.1	2.9	3.1	9.0		9.9	1.5	4.2
Queue Storage Ratio (*RQ*) (95th percentile)	0.41	0.18	0.18	0.63	0.09	0.43	1.55	0.23		0.63	0.04	0.11
Uniform Delay (d_1), s/veh	31.6	18.4	18.1	25.7	17.8	3.2	49.8	43.9		43.4	30.2	3.5
Incremental Delay (d_2), s/veh	0.2	11.5	11.9	2.6	1.4	0.5	16.3	11.7		9.4	0.1	0.5
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Control Delay (*d*), s/veh	31.9	29.9	30.0	28.3	19.2	3.6	66.2	55.6		52.8	30.3	4.0
Level of Service (LOS)	C	C	C	C	B	A	E	E		D	C	A

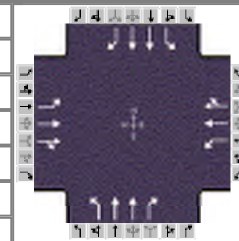
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	30.0	C	18.1	B	58.0	E	41.2	D
Intersection Delay, s/veh / LOS	30.3				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.6	B	3.0	C	2.8	C
Bicycle LOS Score / LOS	1.8	A	1.3	A	0.9	A	1.4	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:46:57 AM

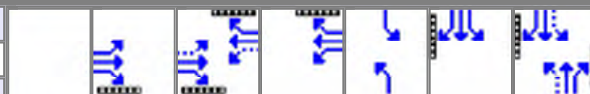
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Benson Rd & Cliff Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Benson_Rd_AM_BestCase.xus				
Project Description	2035 NB AM				

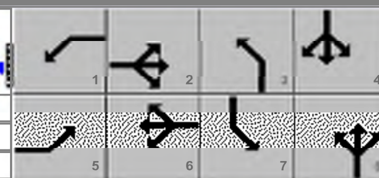


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	100	550	60	80	1300	270	130	260	90	270	350	150

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	43.5	5.5	4.5	7.0	15.5
Yellow	3.0	3.5	3.0	3.0	3.0	3.5
Red	1.0	2.0	1.0	1.0	1.0	2.0

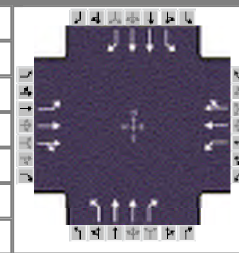


Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.2	4.0	1.3	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	11.0	60.0	9.5	58.5	8.5	21.0	19.5	32.0
Change Period, (Y+R_c), s	4.0	5.5	5.5	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (MAH), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	6.5		2.0		6.5	11.6	17.5	13.8
Green Extension Time (g_e), s	0.0	0.0	1.4	0.0	0.0	1.6	0.0	3.4
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.15

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	118	365	353	75	751	717	153	306	106	318	412	176
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1639	1617	1698	1597	1664	1664	1481	1664	1664	1481
Queue Service Time (g_s), s	4.5	15.2	15.2	0.0	40.0	41.0	4.5	9.6	7.3	15.5	11.8	11.3
Cycle Queue Clearance Time (g_c), s	4.5	15.2	15.2	0.0	40.0	41.0	4.5	9.6	7.3	15.5	11.8	11.3
Green Ratio (g/C)	0.48	0.50	0.50	0.41	0.48	0.48	0.18	0.14	0.14	0.30	0.24	0.24
Capacity (c), veh/h	177	842	813	363	818	769	227	468	208	351	801	356
Volume-to-Capacity Ratio (X)	0.664	0.433	0.434	0.206	0.918	0.932	0.673	0.654	0.509	0.904	0.514	0.495
Available Capacity (c_a), veh/h	177	842	813	363	818	769	227	468	208	351	801	357
Back of Queue (Q), veh/ln (95th percentile)	4.5	10.0	9.8	2.5	14.6	12.8	5.1	7.7	5.3	15.1	8.6	7.9
Queue Storage Ratio (RQ) (95th percentile)	0.58	0.26	0.26	0.44	0.14	0.13	0.43	0.20	0.55	1.93	0.22	0.68
Uniform Delay (d_1), s/veh	25.5	17.8	17.8	24.0	13.4	12.2	43.3	44.7	4.4	35.9	36.2	36.0
Incremental Delay (d_2), s/veh	17.9	1.6	1.7	0.8	12.1	14.3	14.8	7.0	8.6	28.9	2.4	4.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	43.4	19.4	19.5	24.8	25.4	26.5	58.0	51.7	13.0	64.8	38.6	40.9
Level of Service (LOS)	D	B	B	C	C	C	E	D	B	E	D	D
Approach Delay, s/veh / LOS	22.8	C		25.9	C		46.2	D		48.2	D	
Intersection Delay, s/veh / LOS	33.5						C					

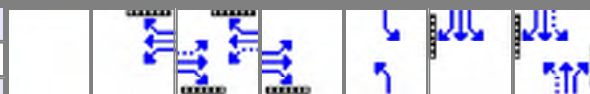
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.9	C	2.9	C	2.8	C
Bicycle LOS Score / LOS	1.2	A	2.1	B	1.0	A	1.2	A

HCS 2010 Signalized Intersection Results Summary

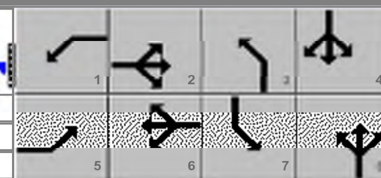


General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & Cliff Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Benson_Rd_PM_BestCase.xus				
Project Description	2035 NB PM				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	130	900	150	190	640	100	120	450	250	330	370	110



Signal Information										
Cycle, s	105.0	Reference Phase	2							
Offset, s	0	Reference Point	Begin	Green	11.0	27.0	4.5	6.0	2.0	27.5
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.0	3.5	3.0	3.0	3.0	3.5
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.0	1.0	1.0	1.0	2.0



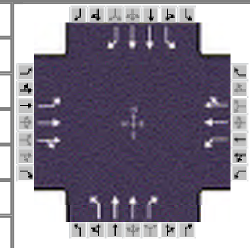
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.3	4.0	1.2	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	8.5	41.0	15.0	47.5	10.0	33.0	16.0	39.0
Change Period, ($Y+R_c$), s	5.5	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (MAH), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	2.0		12.1		8.0	19.2	14.0	11.7
Green Extension Time (g_e), s	0.6	0.0	0.0	0.0	0.0	3.5	0.0	5.4
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	0.51	1.00	0.06

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	140	579	550	205	408	389	129	484	269	355	398	118
Adjusted Saturation Flow Rate (s), veh/h/ln	1617	1698	1613	1617	1698	1618	1664	1664	1481	1664	1664	1481
Queue Service Time (g_s), s	0.0	35.5	35.5	10.1	16.8	16.2	6.0	13.2	17.2	12.0	9.7	6.2
Cycle Queue Clearance Time (g_c), s	0.0	35.5	35.5	10.1	16.8	16.2	6.0	13.2	17.2	12.0	9.7	6.2
Green Ratio (g/C)	0.27	0.34	0.34	0.38	0.40	0.40	0.32	0.26	0.26	0.40	0.32	0.32
Capacity (c), veh/h	259	574	545	238	679	647	345	871	388	354	1062	473
Volume-to-Capacity Ratio (X)	0.540	1.008	1.009	0.860	0.601	0.602	0.374	0.555	0.693	1.001	0.375	0.250
Available Capacity (c_a), veh/h	259	574	545	238	679	647	345	871	388	354	1062	473
Back of Queue (Q), veh/ln (95th percentile)	7.0	27.7	26.7	7.4	9.4	8.6	4.7	9.3	11.4	13.1	7.0	4.0
Queue Storage Ratio (RQ) (95th percentile)	0.91	0.72	0.70	1.30	0.09	0.08	0.40	0.24	1.16	1.68	0.18	0.34
Uniform Delay (d_1), s/veh	37.6	34.8	34.8	21.2	17.8	16.5	26.6	33.5	34.9	31.5	27.7	11.0
Incremental Delay (d_2), s/veh	7.9	39.5	40.8	26.6	3.2	3.4	3.1	2.5	9.8	48.2	1.0	1.3
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	45.5	74.3	75.6	47.9	21.0	19.8	29.7	36.0	44.7	79.7	28.7	12.2
Level of Service (LOS)	D	F	F	D	C	B	C	D	D	F	C	B
Approach Delay, s/veh / LOS	71.7	E		26.0	C		37.7	D		47.2	D	
Intersection Delay, s/veh / LOS	47.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.5	A	1.3	A	1.2	A	1.2	A

HCS 2010 Signalized Intersection Results Summary

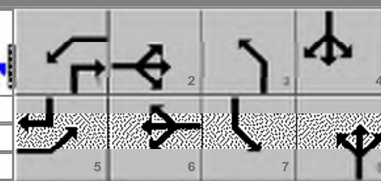
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	Benson Rd & Cliff Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_Benson_Rd_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	100	550	60	80	1300	270	130	260	90	270	350	150

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.0	45.5	5.5	7.5	4.0	15.5
Yellow	3.0	3.5	3.0	3.0	3.0	3.5
Red	1.0	2.0	1.0	1.0	1.0	2.0



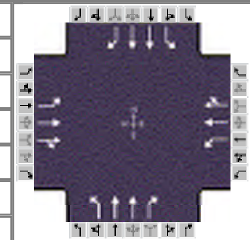
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.2	4.0	1.3	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	9.0	60.0	9.5	60.5	11.5	21.0	19.5	29.0
Change Period, (Y+R_c), s	4.0	5.5	5.5	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (g_s), s	6.5		2.0		9.5	11.6	17.5	14.2
Green Extension Time (g_e), s	0.0	0.0	1.4	0.0	0.0	1.6	0.0	3.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.32

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	118	365	353	75	751	717	153	306	106	318	412	176
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1639	1617	1698	1597	1664	1664	1481	1664	1664	1481
Queue Service Time (g_s), s	4.5	15.2	15.2	0.0	36.7	37.2	7.5	9.6	7.0	15.5	12.2	11.0
Cycle Queue Clearance Time (g_c), s	4.5	15.2	15.2	0.0	36.7	37.2	7.5	9.6	7.0	15.5	12.2	11.0
Green Ratio (*g/C*)	0.48	0.50	0.50	0.43	0.50	0.50	0.21	0.14	0.18	0.30	0.21	0.26
Capacity (*c*), veh/h	166	842	813	363	849	798	247	468	262	351	710	384
Volume-to-Capacity Ratio (*X*)	0.708	0.433	0.434	0.206	0.885	0.898	0.618	0.654	0.404	0.904	0.580	0.460
Available Capacity (c_a), veh/h	166	842	813	363	849	798	247	468	262	351	710	384
Back of Queue (*Q*), veh/ln (95th percentile)	4.7	10.0	9.8	2.5	12.6	11.1	2.0	7.7	4.3	15.1	8.9	7.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.62	0.26	0.26	0.44	0.12	0.11	0.17	0.20	0.44	1.93	0.23	0.66
Uniform Delay (d_1), s/veh	25.5	17.8	17.8	24.0	12.0	10.9	39.1	44.7	2.6	35.9	38.8	34.3
Incremental Delay (d_2), s/veh	22.4	1.6	1.7	0.8	9.0	10.5	11.1	7.0	4.6	28.9	3.4	3.9
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	47.9	19.4	19.5	24.9	21.0	21.4	50.2	51.7	7.1	64.8	42.3	38.2
Level of Service (LOS)	D	B	B	C	C	C	D	D	A	E	D	D
Approach Delay, s/veh / LOS	23.5	C		21.4	C		42.9	D		49.4	D	
Intersection Delay, s/veh / LOS	31.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.9	C	2.9	C	2.8	C
Bicycle LOS Score / LOS	1.2	A	2.1	B	1.0	A	1.2	A

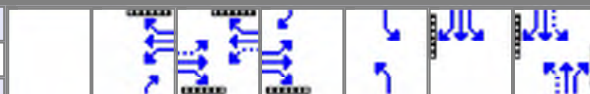
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 3, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	Benson Rd & Cliff Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_Benson_Rd_PM_WorstCase.xus				
Project Description	2035 NB PM				

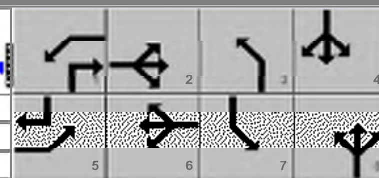


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	130	900	150	190	640	100	120	450	250	330	370	110

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.0	30.5	5.0	6.0	6.0	19.5
Yellow	3.0	3.5	3.0	3.0	3.0	3.5
Red	1.0	2.0	1.0	1.0	1.0	2.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.3	4.0	1.2	4.0	1.1	3.0	1.1	3.0
Phase Duration, s	9.0	45.0	15.0	51.0	10.0	25.0	20.0	35.0
Change Period, (*Y+Rc*), s	5.5	5.5	4.0	5.5	4.0	5.5	4.0	5.5
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0	4.1	4.1	4.1	4.1
Queue Clearance Time (*gs*), s	2.0		11.9		8.0	18.5	18.0	12.3
Green Extension Time (*ge*), s	0.9	0.0	0.0	0.0	0.0	0.6	0.0	5.1
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	0.12

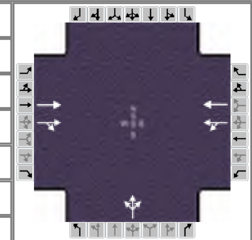
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	140	579	550	208	416	396	129	484	269	355	398	118
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1613	1617	1698	1618	1664	1664	1481	1664	1664	1481
Queue Service Time (*gs*), s	0.0	33.9	33.9	9.9	15.2	14.4	6.0	14.5	16.5	16.0	10.3	6.2
Cycle Queue Clearance Time (*gc*), s	0.0	33.9	33.9	9.9	15.2	14.4	6.0	14.5	16.5	16.0	10.3	6.2
Green Ratio (*g/C*)	0.30	0.38	0.38	0.41	0.43	0.43	0.24	0.19	0.29	0.36	0.28	0.31
Capacity (*c*), veh/h	296	639	607	238	736	701	307	618	430	355	935	465
Volume-to-Capacity Ratio (*X*)	0.472	0.906	0.907	0.876	0.565	0.566	0.420	0.783	0.625	0.999	0.426	0.254
Available Capacity (*ca*), veh/h	296	639	607	238	736	701	307	618	430	355	935	465
Back of Queue (*Q*), veh/ln (95th percentile)	6.2	23.0	22.2	7.4	8.3	7.5	5.4	10.8	10.7	17.2	7.5	3.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.82	0.60	0.58	1.29	0.08	0.07	0.46	0.28	1.09	2.20	0.19	0.29
Uniform Delay (*d1*), s/veh	32.6	31.0	31.0	20.0	14.4	13.1	32.9	40.7	32.3	31.2	30.8	6.8
Incremental Delay (*d2*), s/veh	5.3	18.8	19.7	28.6	2.5	2.7	4.2	9.6	6.7	47.4	1.4	1.3
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	37.9	49.8	50.7	48.6	17.0	15.8	37.1	50.3	39.0	78.6	32.2	8.1
Level of Service (LOS)	D	D	D	D	B	B	D	D	D	E	C	A
Approach Delay, s/veh / LOS	48.9		D	23.0		C	44.9		D	47.9		D
Intersection Delay, s/veh / LOS	41.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	3.0	C	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.5	A	1.3	A	1.2	A	1.2	A

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 11:46:57 AM

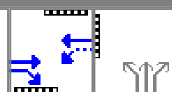
HCS 2010 Signalized Intersection Results Summary

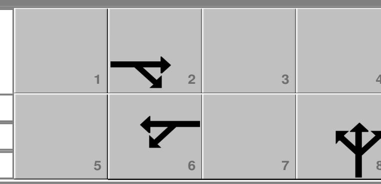
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 13, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	60th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_60th_St_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		460	70	50	1400		190	0	40			

Signal Information										
Cycle, s	75.0	Reference Phase	2							
Offset, s	42	Reference Point	Begin	Green	46.7	14.3	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.0	5.0	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	0.0	0.0	0.0	0.0





Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		8.0		12.0		
Phase Duration, s		53.7		53.7		21.3		
Change Period, ($Y+R_c$), s		7.0		7.0		7.0		
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		
Queue Clearance Time (g_s), s						13.7		
Green Extension Time (g_e), s		0.0		0.0		0.7		
Phase Call Probability						1.00		
Max Out Probability						0.02		

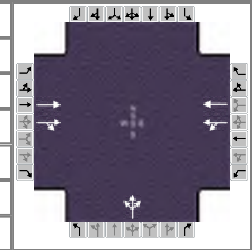
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8	18			
Adjusted Flow Rate (*v*), veh/h		318	305	885	821			271				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1765	1683	1675	1606			1678				
Queue Service Time (g_s), s		8.6	3.3	6.9	39.3			11.7				
Cycle Queue Clearance Time (g_c), s		8.6	3.3	21.7	39.3			11.7				
Green Ratio (*g/C*)		0.62	0.62	0.62	0.62			0.19				
Capacity (*c*), veh/h		1098	1047	1093	999			321				
Volume-to-Capacity Ratio (*X*)		0.290	0.292	0.809	0.822			0.843				
Available Capacity (c_a), veh/h		1098	1047	1093	999			559				
Back of Queue (*Q*), veh/ln (95th percentile)		1.8	1.7	8.2	7.8			8.6				
Queue Storage Ratio (*RQ*) (95th percentile)		0.01	0.01	0.21	0.20			0.00				
Uniform Delay (d_1), s/veh		2.9	2.9	4.5	4.2			29.2				
Incremental Delay (d_2), s/veh		0.6	0.7	6.5	7.6			6.0				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0			0.0				
Control Delay (*d*), s/veh		3.5	3.6	11.0	11.8			35.2				
Level of Service (LOS)		A	A	B	B			D				
Approach Delay, s/veh / LOS	3.6	A		11.4	B		35.2	D		0.0		
Intersection Delay, s/veh / LOS	12.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.3	A	1.9	A	2.7	B	2.7	B
Bicycle LOS Score / LOS	1.0	A	1.9	A	0.9	A		

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:26:35 AM

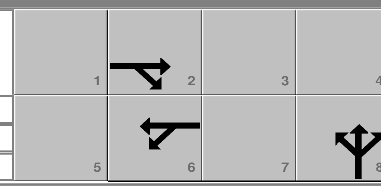
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 5, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	60th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_60th_St_PM_BestCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1970	60	20	530		190	0	50			

Signal Information										
Cycle, s	120.0	Reference Phase	2							
Offset, s	2	Reference Point	Begin	Green	84.6	21.4	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.0	5.0	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		8.0		12.0		
Phase Duration, s		91.6		91.6		28.4		
Change Period, ($Y+R_c$), s		7.0		7.0		7.0		
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		
Queue Clearance Time (g_s), s						20.4		
Green Extension Time (g_e), s		0.0		0.0		0.9		
Phase Call Probability						1.00		
Max Out Probability						0.00		

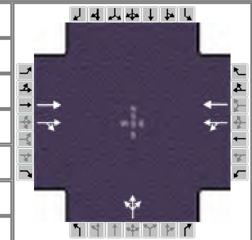
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8	18			
Adjusted Flow Rate (*v*), veh/h		1091	1091	22	570			258				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1765	1746	0	1606			1638				
Queue Service Time (g_s), s		100.2	50.8	0.0	15.9			18.4				
Cycle Queue Clearance Time (g_c), s		100.2	50.8	84.6	15.9			18.4				
Green Ratio (g/C)		0.71	0.71	0.71	0.71			0.18				
Capacity (*c*), veh/h		1244	1231	60	1132			292				
Volume-to-Capacity Ratio (*X*)		0.877	0.886	0.358	0.503			0.884				
Available Capacity (c_a), veh/h		1244	1231	60	1132			642				
Back of Queue (*Q*), veh/ln (95th percentile)		16.3	16.3	1.6	2.4			12.8				
Queue Storage Ratio (*RQ*) (95th percentile)		0.11	0.11	0.04	0.06			0.00				
Uniform Delay (d_1), s/veh		8.3	8.3	60.0	1.2			48.1				
Incremental Delay (d_2), s/veh		4.1	4.4	15.9	1.6			8.7				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0			0.0				
Control Delay (*d*), s/veh		12.4	12.8	75.9	2.8			56.8				
Level of Service (LOS)		B	B	E	A			E				
Approach Delay, s/veh / LOS	12.6		B	5.5		A	56.8		E	0.0		
Intersection Delay, s/veh / LOS	14.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.3	A	1.9	A	2.8	C	2.8	C
Bicycle LOS Score / LOS	2.3	B	1.0	A	0.9	A		

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:28:36 AM

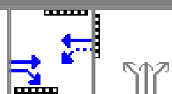
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency	HDR			Duration, h	0.25	
Analyst	GHM	Analysis Date	Feb 5, 2015	Area Type	Other	
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85	
Intersection	60th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 7:15	
File Name	2035_NB_60th_St_AM_WorstCase.xus					
Project Description	2035 NB AM					

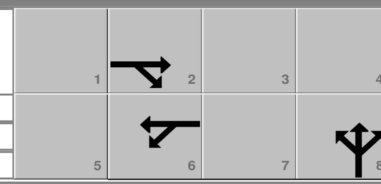


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		460	70	50	1400		190	0	40			

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	42	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	46.4	14.6	0.0	0.0	0.0	0.0
Yellow	5.0	5.0	0.0	0.0	0.0	0.0
Red	2.0	2.0	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		8.0		12.0		
Phase Duration, s		53.4		53.4		21.6		
Change Period, ($Y+R_c$), s		7.0		7.0		7.0		
Max Allow Headway (MAH), s		0.0		0.0		4.2		
Queue Clearance Time (g_s), s						13.9		
Green Extension Time (g_e), s		0.0		0.0		0.7		
Phase Call Probability						1.00		
Max Out Probability						0.02		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8	18			
Adjusted Flow Rate (v), veh/h		318	305	885	821			271				
Adjusted Saturation Flow Rate (s), veh/h/ln		1765	1683	1675	1606			1645				
Queue Service Time (g_s), s		8.6	3.5	7.6	39.3			11.9				
Cycle Queue Clearance Time (g_c), s		8.6	3.5	22.3	39.3			11.9				
Green Ratio (g/C)		0.62	0.62	0.62	0.62			0.19				
Capacity (c), veh/h		1092	1042	1088	994			320				
Volume-to-Capacity Ratio (X)		0.291	0.293	0.813	0.826			0.847				
Available Capacity (c_a), veh/h		1092	1042	1088	994			548				
Back of Queue (Q), veh/ln (95th percentile)		2.0	1.9	8.4	8.0			8.6				
Queue Storage Ratio (RQ) (95th percentile)		0.01	0.01	0.21	0.20			0.00				
Uniform Delay (d_1), s/veh		3.2	3.2	4.7	4.3			29.1				
Incremental Delay (d_2), s/veh		0.7	0.7	6.7	7.8			6.2				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0			0.0				
Control Delay (d), s/veh		3.8	3.9	11.3	12.2			35.3				
Level of Service (LOS)		A	A	B	B			D				

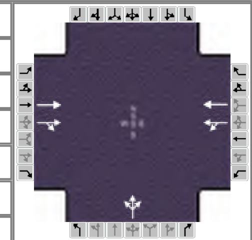
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	3.9	A	11.7	B	35.3	D	0.0	
Intersection Delay, s/veh / LOS	12.3				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.3	A	1.9	A	2.7	B	2.7	B
Bicycle LOS Score / LOS	1.0	A	1.9	A	0.9	A		

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:27:47 AM

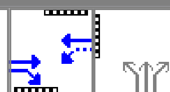
HCS 2010 Signalized Intersection Results Summary

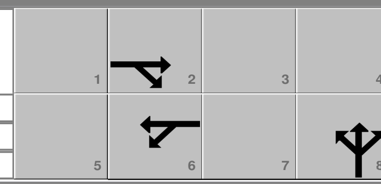
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 13, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	60th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_60th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1970	60	20	530		190	0	50			

Signal Information									
Cycle, s	120.0	Reference Phase	2						
Offset, s	2	Reference Point	Begin	Green	85.0	21.0	0.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.0	5.0	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	0.0	0.0	0.0	0.0





Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		
Case Number		8.0		8.0		12.0		
Phase Duration, s		92.0		92.0		28.0		
Change Period, ($Y+R_c$), s		7.0		7.0		7.0		
Max Allow Headway (*MAH*), s		0.0		0.0		4.2		
Queue Clearance Time (g_s), s						20.1		
Green Extension Time (g_e), s		0.0		0.0		0.9		
Phase Call Probability						1.00		
Max Out Probability						0.00		

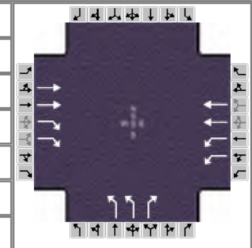
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8	18			
Adjusted Flow Rate (*v*), veh/h		1091	1091	22	570			258				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1765	1746	0	1606			1671				
Queue Service Time (g_s), s		100.2	51.2	0.0	15.9			18.1				
Cycle Queue Clearance Time (g_c), s		100.2	51.2	85.0	15.9			18.1				
Green Ratio (*g/C*)		0.71	0.71	0.71	0.71			0.18				
Capacity (*c*), veh/h		1250	1237	60	1137			293				
Volume-to-Capacity Ratio (*X*)		0.873	0.883	0.358	0.501			0.882				
Available Capacity (c_a), veh/h		1250	1237	60	1137			655				
Back of Queue (*Q*), veh/ln (95th percentile)		16.3	16.4	1.6	2.3			12.8				
Queue Storage Ratio (*RQ*) (95th percentile)		0.11	0.11	0.04	0.06			0.00				
Uniform Delay (d_1), s/veh		8.7	8.7	60.0	1.1			48.3				
Incremental Delay (d_2), s/veh		3.0	3.3	15.9	1.6			8.5				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0			0.0				
Control Delay (*d*), s/veh		11.7	12.0	75.9	2.7			56.8				
Level of Service (LOS)		B	B	E	A			E				

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	11.8	B	5.3	A	56.8	E	0.0	
Intersection Delay, s/veh / LOS	14.4				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.3	A	1.9	A	2.8	C	2.8	C
Bicycle LOS Score / LOS	2.3	B	1.0	A	0.9	A		

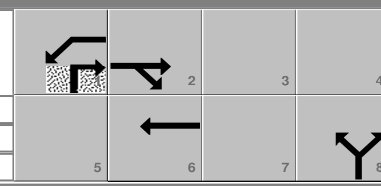
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 13, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	60th St & Lewis Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_60th_St_AM_BestCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		440	300	290	1300		260		90			

Signal Information										
Cycle, s	75.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	10.2	35.5	9.8	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.0	5.0	3.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.5	0.0	0.0	0.0



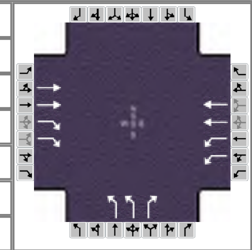
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	2.0	4.0		9.0		
Phase Duration, s		42.5	17.2	59.7		15.3		
Change Period, ($Y+R_c$), s		7.0	7.0	7.0		5.5		
Max Allow Headway (*MAH*), s		0.0	3.1	0.0		4.3		
Queue Clearance Time (g_s), s			9.4			8.7		
Green Extension Time (g_e), s		0.0	0.8	0.0		1.1		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			0.20		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		518	353	341	1529		306		106			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1680	1324	1632	1680		1632		1496			
Queue Service Time (g_s), s		7.2	6.1	7.4	13.3		6.7		4.2			
Cycle Queue Clearance Time (g_c), s		7.2	6.1	7.4	13.3		6.7		4.2			
Green Ratio (g/C)		0.47	0.47	0.14	0.70		0.13		0.27			
Capacity (*c*), veh/h		1589	1252	444	2359		428		400			
Volume-to-Capacity Ratio (*X*)		0.326	0.282	0.769	0.648		0.715		0.265			
Available Capacity (c_a), veh/h		1589	1252	1204	2359		718		532			
Back of Queue (*Q*), veh/ln (95th percentile)		4.6	3.1	4.5	3.9		4.9		2.6			
Queue Storage Ratio (*RQ*) (95th percentile)		0.12	0.31	0.46	0.03		0.49		0.26			
Uniform Delay (d_1), s/veh		12.3	12.0	29.4	3.3		31.2		21.7			
Incremental Delay (d_2), s/veh		0.5	0.6	0.5	0.6		2.2		0.4			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		12.9	12.6	29.9	3.9		33.5		22.0			
Level of Service (LOS)		B	B	C	A		C		C			
Approach Delay, s/veh / LOS	12.8	B		8.7	A		30.5	C		0.0		
Intersection Delay, s/veh / LOS	12.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	0.6	A	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.2	A	2.0	B		F		

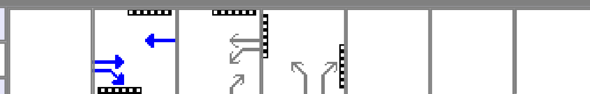
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 5, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	60th St & Lewis Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_60th_St_PM_BestCase.xus				
Project Description	2035 NB PM				

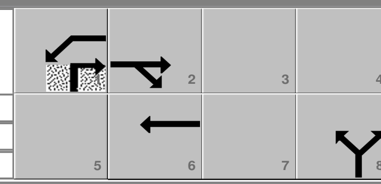


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1560	260	80	640		380		470			

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	59.4	5.4	35.7	0.0	0.0	0.0
Yellow	5.0	5.0	3.0	0.0	0.0	0.0
Red	2.0	2.0	2.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	2.0	4.0		9.0		
Phase Duration, s		66.4	12.4	78.8		41.2		
Change Period, (*Y+R*c), s		7.0	7.0	7.0		5.5		
Max Allow Headway (*MAH*), s		0.0	4.1	0.0		4.3		
Queue Clearance Time (g_s), s			5.1			34.4		
Green Extension Time (g_e), s		0.0	0.7	0.0		4.7		
Phase Call Probability			0.94			1.00		
Max Out Probability			0.00			0.00		

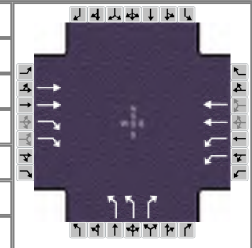
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		1677	280	86	688		409		505			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1680	1324	1632	1680		1632		1496			
Queue Service Time (g_s), s		57.2	6.8	3.1	11.6		12.5		32.4			
Cycle Queue Clearance Time (g_c), s		57.2	6.8	3.1	11.6		12.5		32.4			
Green Ratio (*g/C*)		0.49	0.49	0.05	0.60		0.30		0.34			
Capacity (*c*), veh/h		1754	1382	150	2104		880		472			
Volume-to-Capacity Ratio (*X*)		0.956	0.202	0.574	0.327		0.464		1.071			
Available Capacity (c_a), veh/h		1754	1382	2203	2104		2199		1076			
Back of Queue (*Q*), veh/ln (95th percentile)		32.9	3.7	2.4	7.1		8.7		24.6			
Queue Storage Ratio (*RQ*) (95th percentile)		0.84	0.38	0.25	0.05		0.89		2.50			
Uniform Delay (d_1), s/veh		27.4	15.3	57.3	10.6		36.6		41.1			
Incremental Delay (d_2), s/veh		13.4	0.3	2.6	0.3		0.4		41.5			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		40.8	15.7	60.0	10.9		37.0		82.6			
Level of Service (LOS)		D	B	E	B		D		F			
Approach Delay, s/veh / LOS	37.2	D		16.3	B		62.2	E		0.0		
Intersection Delay, s/veh / LOS	39.0						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	0.7	A	3.0	C	3.0	C
Bicycle LOS Score / LOS	2.1	B	1.1	A		F		

 HCS 2010™ Streets Version 6.50 Generated: 5/18/2016 7:28:36 AM

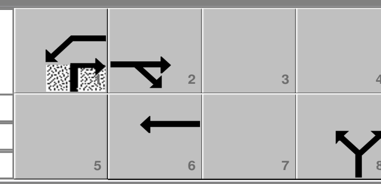
HCS 2010 Signalized Intersection Results Summary

General Information				**Intersection Information**	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Feb 5, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	60th St & Lewis Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_60th_St_AM_WorstCase.xus				
Project Description	2035 NB AM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		440	300	290	1300		260		90			

Signal Information										
Cycle, s	75.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	10.2	35.5	9.8	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.0	5.0	3.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.5	0.0	0.0	0.0



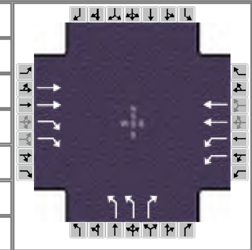
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	2.0	4.0		9.0		
Phase Duration, s		42.5	17.2	59.7		15.3		
Change Period, ($Y+R_c$), s		7.0	7.0	7.0		5.5		
Max Allow Headway (MAH), s		0.0	3.1	0.0		4.3		
Queue Clearance Time (g_s), s			9.5			8.7		
Green Extension Time (g_e), s		0.0	0.8	0.0		1.1		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			0.20		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		518	353	341	1529		306		106			
Adjusted Saturation Flow Rate (s), veh/h/ln		1680	1324	1632	1680		1632		1496			
Queue Service Time (g_s), s		7.2	6.1	7.5	12.8		6.7		4.2			
Cycle Queue Clearance Time (g_c), s		7.2	6.1	7.5	12.8		6.7		4.2			
Green Ratio (g/C)		0.47	0.47	0.14	0.70		0.13		0.27			
Capacity (c), veh/h		1589	1252	444	2359		428		400			
Volume-to-Capacity Ratio (X)		0.326	0.282	0.768	0.648		0.715		0.265			
Available Capacity (c_a), veh/h		1589	1252	1204	2359		718		532			
Back of Queue (Q), veh/ln (95th percentile)		4.6	3.1	4.5	3.7		4.9		2.6			
Queue Storage Ratio (RQ) (95th percentile)		0.12	0.31	0.46	0.03		0.49		0.26			
Uniform Delay (d_1), s/veh		12.3	12.0	29.5	3.1		31.2		21.7			
Incremental Delay (d_2), s/veh		0.5	0.6	0.5	0.6		2.2		0.4			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		12.9	12.6	30.0	3.7		33.5		22.0			
Level of Service (LOS)		B	B	C	A		C		C			
Approach Delay, s/veh / LOS	12.8	B		8.5	A		30.5	C		0.0		
Intersection Delay, s/veh / LOS	12.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	0.6	A	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.2	A	2.0	B		F		

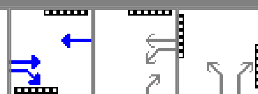
HCS 2010 Signalized Intersection Results Summary

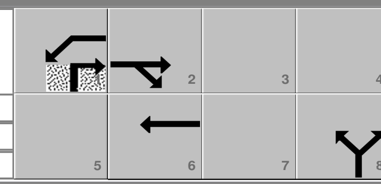
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 13, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	60th St & Lewis Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_NB_60th_St_PM_WorstCase.xus				
Project Description	2035 NB PM				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		1560	260	80	640		380		470			

Signal Information									
Cycle, s	120.0	Reference Phase	2						
Offset, s	0	Reference Point	End	Green	56.7	5.4	38.4	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	5.0	5.0	3.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.5	0.0	0.0	0.0





Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	2.0	4.0		9.0		
Phase Duration, s		63.7	12.4	76.1		43.9		
Change Period, (Y+R_c), s		7.0	7.0	7.0		5.5		
Max Allow Headway (MAH), s		0.0	4.1	0.0		4.3		
Queue Clearance Time (g_s), s			5.1			37.1		
Green Extension Time (g_e), s		0.0	0.7	0.0		4.6		
Phase Call Probability			0.94			1.00		
Max Out Probability			0.00			0.01		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		1677	280	86	688		409		505			
Adjusted Saturation Flow Rate (s), veh/h/ln		1680	1324	1632	1680		1632		1496			
Queue Service Time (g_s), s		59.9	7.1	3.1	12.7		12.2		35.1			
Cycle Queue Clearance Time (g_c), s		59.9	7.1	3.1	12.7		12.2		35.1			
Green Ratio (g/C)		0.47	0.47	0.05	0.58		0.32		0.37			
Capacity (c), veh/h		1678	1322	149	2028		954		506			
Volume-to-Capacity Ratio (X)		0.999	0.211	0.578	0.339		0.428		1.000			
Available Capacity (c_a), veh/h		1678	1322	1741	2028		1820		902			
Back of Queue (Q), veh/ln (95th percentile)		36.5	3.9	2.4	7.8		8.5		21.9			
Queue Storage Ratio (RQ) (95th percentile)		0.93	0.40	0.25	0.05		0.86		2.23			
Uniform Delay (d_1), s/veh		30.0	16.8	57.6	12.5		34.3		39.7			
Incremental Delay (d_2), s/veh		21.9	0.4	2.7	0.3		0.3		22.2			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		51.9	17.2	60.3	12.8		34.6		62.0			
Level of Service (LOS)		D	B	E	B		C		E			
Approach Delay, s/veh / LOS	46.9	D		18.1	B		49.7	D		0.0		
Intersection Delay, s/veh / LOS	41.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	0.7	A	3.0	C	3.0	C
Bicycle LOS Score / LOS	2.1	B	1.1	A		F		

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APPENDIX -

2035 NO-BUILD FREEWAY HCS 2010 REPORTS

6300 W. Old Village Place, Suite 100, Sioux Falls, SD, 57108
(605) 977-7740

FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	I-29 NB to Louise Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	Two-Sided
Weaving number of lanes, N	2
Weaving segment length, L_S	2900ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1086	0.85	14	0	1.5	1.2	0.935	1.00	1367
V_{RF}	604	0.85	10	0	1.5	1.2	0.952	1.00	746
V_{FR}	119	0.85	2	0	1.5	1.2	0.990	1.00	141
V_{RR}	301	0.85	2	0	1.5	1.2	0.990	1.00	358
V_{NW}	2254							V =	2442
V_W	358								
VR	0.137								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	0 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	0 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	1 lc/pc
Minimum weaving lane changes, LC_{MIN}	358 lc/h
Weaving lane changes, LC_W	496 lc/h
Non-weaving lane changes, LC_{NW}	1651 lc/h
Total lane changes, LC_{ALL}	2147 lc/h
Non-weaving vehicle index, I_{NW}	654

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2442 veh/h
Weaving segment capacity, c_w	3895 veh/h
Weaving segment v/c ratio	0.627
Weaving segment density, D	21.7 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.178
Weaving segment speed, S	60.2 mph
Average weaving speed, S_W	60.8 mph
Average non-weaving speed, S_{NW}	60.2 mph
Maximum weaving length, L_{MAX}	7035 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

 HCS 2010™ Version 6.50 Generated: 1/16/2017 10:44 AM

FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	I-29 NB to Louise Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	Two-Sided
Weaving number of lanes, N	2
Weaving segment length, L_S	2900ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	934	0.93	18	0	1.5	1.2	0.917	1.00	1095
V_{RF}	756	0.93	10	0	1.5	1.2	0.952	1.00	854
V_{FR}	231	0.93	2	0	1.5	1.2	0.990	1.00	251
V_{RR}	539	0.93	2	0	1.5	1.2	0.990	1.00	585
V_{NW}	2200							V =	2556
V_W	585								
VR	0.210								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	0 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	0 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	1 lc/pc

Minimum weaving lane changes, LC_{MIN}	585 lc/h
Weaving lane changes, LC_W	723 lc/h
Non-weaving lane changes, LC_{NW}	1640 lc/h
Total lane changes, LC_{ALL}	2363 lc/h
Non-weaving vehicle index, I_{NW}	638

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2556 veh/h
Weaving segment capacity, c_w	3719 veh/h
Weaving segment v/c ratio	0.687
Weaving segment density, D	23.8 pc/mi/ln
Level of Service, LOS	C

Weaving intensity factor, W	0.192
Weaving segment speed, S	58.6 mph
Average weaving speed, S_W	60.3 mph
Average non-weaving speed, S_{NW}	58.1 mph
Maximum weaving length, L_{MAX}	7771 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

 HCS 2010^{TM} Version 6.50 Generated: 1/16/2017 10:45 AM

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Louise Off-Ramp to SB On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1690*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*12*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.943*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1054*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*15.1*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

 HCS 2010™ Version 6.50 Generated: 1/16/2017 10:45 AM

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Louise Off-Ramp to SB On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*
Project Description	*I-229 MIS*		

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1690*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*14*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.935*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*972*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*13.9*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

 HCS 2010™ Version 6.50 Generated: 1/16/2017 10:45 AM

FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Louise SB to Western
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5030ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1255	0.85	12	0	1.5	1.2	0.943	1.00	1565
V_{RF}	575	0.85	2	0	1.5	1.2	0.990	1.00	683
V_{FR}	435	0.85	2	0	1.5	1.2	0.990	1.00	517
V_{RR}	25	0.85	2	0	1.5	1.2	0.990	1.00	30
V_{NW}	1595							V =	2637
V_W	1200								
VR	0.429								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1200 lc/h
Weaving lane changes, LC_W	1620 lc/h
Non-weaving lane changes, LC_{NW}	2477 lc/h
Total lane changes, LC_{ALL}	4097 lc/h
Non-weaving vehicle index, I_{NW}	802

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2637 veh/h
Weaving segment capacity, c_w	5274 veh/h
Weaving segment v/c ratio	0.500
Weaving segment density, D	16.1 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.192
Weaving segment speed, S	57.7 mph
Average weaving speed, S_W	60.3 mph
Average non-weaving speed, S_{NW}	55.9 mph
Maximum weaving length, L_{MAX}	7012 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Louise SB to Western
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5030ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1232	0.93	14	0	1.5	1.2	0.935	1.00	1417
V_{RF}	958	0.93	2	0	1.5	1.2	0.990	1.00	1040
V_{FR}	458	0.93	2	0	1.5	1.2	0.990	1.00	497
V_{RR}	22	0.93	2	0	1.5	1.2	0.990	1.00	24
V_{NW}	1441							V =	2784
V_W	1537								
VR	0.516								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1537 lc/h
Weaving lane changes, LC_W	1957 lc/h
Non-weaving lane changes, LC_{NW}	2445 lc/h
Total lane changes, LC_{ALL}	4402 lc/h
Non-weaving vehicle index, I_{NW}	725

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2784 veh/h
Weaving segment capacity, c_w	4346 veh/h
Weaving segment v/c ratio	0.640
Weaving segment density, D	17.6 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.203
Weaving segment speed, S	56.4 mph
Average weaving speed, S_W	59.9 mph
Average non-weaving speed, S_{NW}	53.2 mph
Maximum weaving length, L_{MAX}	8015 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Louise NB to Western
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3510ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1914	0.85	8	0	1.5	1.2	0.962	1.00	2342
V_{RF}	486	0.85	2	0	1.5	1.2	0.990	1.00	577
V_{FR}	376	0.85	2	0	1.5	1.2	0.990	1.00	447
V_{RR}	84	0.85	2	0	1.5	1.2	0.990	1.00	100
V_{NW}	2442							V =	3333
V_W	1024								
VR	0.295								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	577 lc/h
Weaving lane changes, LC_W	923 lc/h
Non-weaving lane changes, LC_{NW}	1828 lc/h
Total lane changes, LC_{ALL}	2751 lc/h
Non-weaving vehicle index, I_{NW}	857

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3333 veh/h
Weaving segment capacity, c_w	6476 veh/h
Weaving segment v/c ratio	0.515
Weaving segment density, D	19.4 pc/mi/ln
Level of Service, LOS	B

Weaving intensity factor, W	0.186
Weaving segment speed, S	59.7 mph
Average weaving speed, S_W	60.5 mph
Average non-weaving speed, S_{NW}	59.3 mph
Maximum weaving length, L_{MAX}	5535 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Louise NB to Western
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3510ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2244	0.93	7	0	1.5	1.2	0.966	1.00	2497
V_{RF}	396	0.93	2	0	1.5	1.2	0.990	1.00	430
V_{FR}	426	0.93	2	0	1.5	1.2	0.990	1.00	463
V_{RR}	54	0.93	2	0	1.5	1.2	0.990	1.00	59
V_{NW}	2556							V =	3333
V_W	893								
VR	0.259								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	430 lc/h
Weaving lane changes, LC_W	776 lc/h
Non-weaving lane changes, LC_{NW}	1851 lc/h
Total lane changes, LC_{ALL}	2627 lc/h
Non-weaving vehicle index, I_{NW}	897

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3333 veh/h
Weaving segment capacity, c_w	6594 veh/h
Weaving segment v/c ratio	0.505
Weaving segment density, D	19.0 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.180
Weaving segment speed, S	60.5 mph
Average weaving speed, S_W	60.8 mph
Average non-weaving speed, S_{NW}	60.4 mph
Maximum weaving length, L_{MAX}	5147 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Western Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2400*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1461*	pc/h/ln
S	*69.2*	mph
D = v_p / S	*21.1*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Western Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2640*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1469*	pc/h/ln
S	*69.2*	mph
D = v_p / S	*21.2*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Western Ave to Minnesota Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2870ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1963	0.85	7	0	1.5	1.2	0.966	1.00	2390
V_{RF}	517	0.85	2	0	1.5	1.2	0.990	1.00	614
V_{FR}	437	0.85	3	0	1.5	1.2	0.985	1.00	522
V_{RR}	83	0.85	2	0	1.5	1.2	0.990	1.00	99
V_{NW}	2489							V =	3503
V_W	1136								
VR	0.313								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1136 lc/h
Weaving lane changes, LC_W	1446 lc/h
Non-weaving lane changes, LC_{NW}	1490 lc/h
Total lane changes, LC_{ALL}	2936 lc/h
Non-weaving vehicle index, I_{NW}	714

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3503 veh/h
Weaving segment capacity, c_w	6322 veh/h
Weaving segment v/c ratio	0.554
Weaving segment density, D	21.2 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.230
Weaving segment speed, S	57.1 mph
Average weaving speed, S_W	59.7 mph
Average non-weaving speed, S_{NW}	56.0 mph
Maximum weaving length, L_{MAX}	5728 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Western Ave to Minnesota Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2870ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2262	0.93	7	0	1.5	1.2	0.966	1.00	2517
V_{RF}	768	0.93	2	0	1.5	1.2	0.990	1.00	834
V_{FR}	378	0.93	3	0	1.5	1.2	0.985	1.00	413
V_{RR}	42	0.93	2	0	1.5	1.2	0.990	1.00	46
V_{NW}	2563							V =	3682
V_W	1247								
VR	0.327								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1247 lc/h
Weaving lane changes, LC_W	1557 lc/h
Non-weaving lane changes, LC_{NW}	1506 lc/h
Total lane changes, LC_{ALL}	3063 lc/h
Non-weaving vehicle index, I_{NW}	736

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3682 veh/h
Weaving segment capacity, c_w	6290 veh/h
Weaving segment v/c ratio	0.585
Weaving segment density, D	22.5 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.238
Weaving segment speed, S	56.3 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	54.9 mph
Maximum weaving length, L_{MAX}	5879 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Minnesota Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2480*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*70.0*	mph	FFS	*70.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1503*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*68.9*	mph	S	mph
D = v_p / S	*21.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Minnesota Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3030*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1670*	pc/h/ln
S	*67.4*	mph
D = v_p / S	*24.8*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Minnesota Ave to Cliff Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3130ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1989	0.85	6	0	1.5	1.2	0.971	1.00	2410
V_{RF}	411	0.85	3	0	1.5	1.2	0.985	1.00	491
V_{FR}	491	0.85	3	0	1.5	1.2	0.985	1.00	586
V_{RR}	79	0.85	3	0	1.5	1.2	0.985	1.00	94
V_{NW}	2504							V =	3477
V_W	1077								
VR	0.301								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1077 lc/h
Weaving lane changes, LC_W	1402 lc/h
Non-weaving lane changes, LC_{NW}	1634 lc/h
Total lane changes, LC_{ALL}	3036 lc/h
Non-weaving vehicle index, I_{NW}	784

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3477 veh/h
Weaving segment capacity, c_w	6443 veh/h
Weaving segment v/c ratio	0.540
Weaving segment density, D	20.7 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.221
Weaving segment speed, S	57.5 mph
Average weaving speed, S_W	60.1 mph
Average non-weaving speed, S_{NW}	56.5 mph
Maximum weaving length, L_{MAX}	5592 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Minnesota Ave to Cliff Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3130ft
Freeway free-flow speed, FFS	70 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2504	0.93	6	0	1.5	1.2	0.971	1.00	2773
V_{RF}	486	0.93	3	0	1.5	1.2	0.985	1.00	530
V_{FR}	526	0.93	3	0	1.5	1.2	0.985	1.00	574
V_{RR}	24	0.93	3	0	1.5	1.2	0.985	1.00	26
V_{NW}	2799							V =	3790
V_W	1104								
VR	0.283								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1104 lc/h
Weaving lane changes, LC_W	1429 lc/h
Non-weaving lane changes, LC_{NW}	1695 lc/h
Total lane changes, LC_{ALL}	3124 lc/h
Non-weaving vehicle index, I_{NW}	876

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3790 veh/h
Weaving segment capacity, c_w	6483 veh/h
Weaving segment v/c ratio	0.585
Weaving segment density, D	22.9 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.226
Weaving segment speed, S	56.9 mph
Average weaving speed, S_W	59.9 mph
Average non-weaving speed, S_{NW}	55.8 mph
Maximum weaving length, L_{MAX}	5401 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Cliff Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2400*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1447*	pc/h/ln
S	*69.3*	mph
D = v_p / S	*20.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Cliff Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2990*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1648*	pc/h/ln
S	*67.7*	mph
D = v_p / S	*24.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Cliff Ave to 26th St
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1870	0.85	8	0	1.5	1.2	0.962	1.00	2288
V_{RF}	510	0.85	3	0	1.5	1.2	0.985	1.00	609
V_{FR}	530	0.85	3	0	1.5	1.2	0.985	1.00	633
V_{RR}	10	0.85	3	0	1.5	1.2	0.985	1.00	12
V_{NW}	2300							V =	3406
V_W	1242								
VR	0.351								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1544 lc/h
Non-weaving lane changes, LC_{NW}	1387 lc/h
Total lane changes, LC_{ALL}	2931 lc/h
Non-weaving vehicle index, I_{NW}	633

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3406 veh/h
Weaving segment capacity, c_w	6176 veh/h
Weaving segment v/c ratio	0.551
Weaving segment density, D	21.2 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.238
Weaving segment speed, S	55.8 mph
Average weaving speed, S_W	58.6 mph
Average non-weaving speed, S_{NW}	54.4 mph
Maximum weaving length, L_{MAX}	6134 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Cliff Ave to 26th St
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2200	0.93	8	0	1.5	1.2	0.962	1.00	2460
V_{RF}	410	0.93	3	0	1.5	1.2	0.985	1.00	447
V_{FR}	790	0.93	3	0	1.5	1.2	0.985	1.00	862
V_{RR}	10	0.93	3	0	1.5	1.2	0.985	1.00	11
V_{NW}	2471							V =	3635
V_W	1309								
VR	0.346								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1309 lc/h
Weaving lane changes, LC_W	1611 lc/h
Non-weaving lane changes, LC_{NW}	1422 lc/h
Total lane changes, LC_{ALL}	3033 lc/h
Non-weaving vehicle index, I_{NW}	680

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3635 veh/h
Weaving segment capacity, c_w	6188 veh/h
Weaving segment v/c ratio	0.587
Weaving segment density, D	22.9 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.244
Weaving segment speed, S	55.1 mph
Average weaving speed, S_W	58.4 mph
Average non-weaving speed, S_{NW}	53.5 mph
Maximum weaving length, L_{MAX}	6086 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*26th St Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2380*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1449*	pc/h/ln
S	*69.3*	mph
D = v_p / S	*20.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*26th St Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2610*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1452*	pc/h/ln
S	*69.3*	mph
D = v_p / S	*21.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	26th St On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	2380
Ramp Volume, V_R	570
Freeway Free-Flow Speed, S_{FF}	68.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2380	0.85	Level	7	0	0.966	1.00	2898
Ramp	570	0.85	Level	3	0	0.985	1.00	681
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2898 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3579	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3579	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 27.4 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.398 (Exibit 13-11)

S_R= 57.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 57.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	26th St On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	900
Deceleration Lane Length L_D	
Freeway Volume, V_F	2610
Ramp Volume, V_R	160
Freeway Free-Flow Speed, S_{FF}	68.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2610	0.93	Level	7	0	0.966	1.00	2905
Ramp	160	0.93	Level	3	0	0.985	1.00	175
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = 1.000 using Equation (Exhibit 13-6)
V_{12} = 2905 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3080	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3080	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 23.8 (pc/mi/ln)
LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.343 (Exibit 13-11)
S_R= 59.1 mph (Exhibit 13-11)
S_0= N/A mph (Exhibit 13-11)
S = 59.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = using Equation (Exhibit 13-7)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)
S_R= mph (Exhibit 13-12)
S_0= mph (Exhibit 13-12)
S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*26th St to 10th St*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2950*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1813*	pc/h/ln
S	*65.6*	mph
D = v_p / S	*27.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*26th St to 10th St*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2770*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1556*	pc/h/ln
S	*68.5*	mph
D = v_p / S	*22.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	10th St Off-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	700
Freeway Volume, V_F	2950
Ramp Volume, V_R	770
Freeway Free-Flow Speed, S_{FF}	68.0
Ramp Free-Flow Speed, S_{FR}	58.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2950	0.85	Level	9	0	0.957	1.00	3627
Ramp	770	0.85	Level	6	0	0.971	1.00	933
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3627 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3627	Exhibit 13-8	4760	No
$V_{FO} = V_F - V_R$	2694	Exhibit 13-8	4760	No
V_R	933	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3627	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 29.1 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.213 (Exhibit 13-12)

S_R= 62.5 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 62.5 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	10th St Off-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp			Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N	2	☐ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N	1	☑ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A		L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D	700	V_D = veh/h
	Freeway Volume, V_F	2770	
	Ramp Volume, V_R	850	
	Freeway Free-Flow Speed, S_{FF}	68.0	
	Ramp Free-Flow Speed, S_{FR}	58.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2770	0.93	Level	9	0	0.957	1.00	3113
Ramp	850	0.93	Level	6	0	0.971	1.00	941
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 3113 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3113	Exhibit 13-8	4760	No
$V_{FO} = V_F - V_R$	2172	Exhibit 13-8	4760	No
V_R	941	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3113	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = 24.7 (pc/mi/ln)
LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.214 (Exhibit 13-12)
S_R= 62.4 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 62.4 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*10th St Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2180*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1346*	pc/h/ln
S	*69.8*	mph
D = v_p / S	*19.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*10th St Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1920*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1084*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*15.5*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	10th to Rice
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5110ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1812	0.85	10	0	1.5	1.2	0.952	1.00	2238
V_{RF}	578	0.85	6	0	1.5	1.2	0.971	1.00	700
V_{FR}	368	0.85	6	0	1.5	1.2	0.971	1.00	446
V_{RR}	32	0.85	6	0	1.5	1.2	0.971	1.00	39
V_{NW}	2277							V =	3260
V_W	1146								
VR	0.335								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1146 lc/h
Weaving lane changes, LC_W	1570 lc/h
Non-weaving lane changes, LC_{NW}	2661 lc/h
Total lane changes, LC_{ALL}	4231 lc/h
Non-weaving vehicle index, I_{NW}	1164

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3260 veh/h
Weaving segment capacity, c_w	6529 veh/h
Weaving segment v/c ratio	0.499
Weaving segment density, D	20.8 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.195
Weaving segment speed, S	54.9 mph
Average weaving speed, S_W	58.5 mph
Average non-weaving speed, S_{NW}	53.3 mph
Maximum weaving length, L_{MAX}	5960 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	10th to Rice
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5110ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1424	0.93	10	0	1.5	1.2	0.952	1.00	1608
V_{RF}	586	0.93	6	0	1.5	1.2	0.971	1.00	649
V_{FR}	496	0.93	6	0	1.5	1.2	0.971	1.00	549
V_{RR}	14	0.93	6	0	1.5	1.2	0.971	1.00	16
V_{NW}	1624							V =	2688
V_W	1198								
VR	0.425								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1198 lc/h
Weaving lane changes, LC_W	1622 lc/h
Non-weaving lane changes, LC_{NW}	2526 lc/h
Total lane changes, LC_{ALL}	4148 lc/h
Non-weaving vehicle index, I_{NW}	830

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2688 veh/h
Weaving segment capacity, c_w	5384 veh/h
Weaving segment v/c ratio	0.499
Weaving segment density, D	16.9 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.192
Weaving segment speed, S	55.8 mph
Average weaving speed, S_W	58.6 mph
Average non-weaving speed, S_{NW}	53.9 mph
Maximum weaving length, L_{MAX}	6958 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		**Site Information**	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Rice Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2390*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1469*	pc/h/ln
S	*64.9*	mph
D = v_p / S	*22.6*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Rice Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2010*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1129*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*17.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Rice to Benson
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	4510ft
Freeway free-flow speed, FFS	72 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	825	0.85	9	0	1.5	1.2	0.957	1.00	1014
V_{RF}	475	0.85	6	0	1.5	1.2	0.971	1.00	576
V_{FR}	1490	0.85	6	0	1.5	1.2	0.971	1.00	1806
V_{RR}	170	0.85	6	0	1.5	1.2	0.971	1.00	206
V_{NW}	1220							V =	3447
V_W	2382								
VR	0.661								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	576 lc/h
Weaving lane changes, LC_W	973 lc/h
Non-weaving lane changes, LC_{NW}	2118 lc/h
Total lane changes, LC_{ALL}	3091 lc/h
Non-weaving vehicle index, I_{NW}	550

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3447 veh/h
Weaving segment capacity, c_w	3473 veh/h
Weaving segment v/c ratio	0.992
Weaving segment density, D	19.0 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.168
Weaving segment speed, S	63.2 mph
Average weaving speed, S_W	63.8 mph
Average non-weaving speed, S_{NW}	62.1 mph
Maximum weaving length, L_{MAX}	9772 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Northbound
Weaving Segment Location	Rice to Benson
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	4510ft
Freeway free-flow speed, FFS	72 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1348	0.93	7	0	1.5	1.2	0.966	1.00	1500
V_{RF}	232	0.93	6	0	1.5	1.2	0.971	1.00	257
V_{FR}	662	0.93	6	0	1.5	1.2	0.971	1.00	733
V_{RR}	48	0.93	6	0	1.5	1.2	0.971	1.00	53
V_{NW}	1553							V =	2458
V_W	990								
VR	0.389								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	257 lc/h
Weaving lane changes, LC_W	654 lc/h
Non-weaving lane changes, LC_{NW}	2187 lc/h
Total lane changes, LC_{ALL}	2841 lc/h
Non-weaving vehicle index, I_{NW}	700

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2458 veh/h
Weaving segment capacity, c_w	5956 veh/h
Weaving segment v/c ratio	0.413
Weaving segment density, D	13.0 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.157
Weaving segment speed, S	65.4 mph
Average weaving speed, S_W	64.3 mph
Average non-weaving speed, S_{NW}	66.1 mph
Maximum weaving length, L_{MAX}	6561 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Benson On-Ramp to Off-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1300*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*72.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*72.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*795*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*11.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Benson On-Ramp to Off-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1580*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*72.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*72.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*879*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*12.6*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	Benson Rd On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1300
Deceleration Lane Length L_D	
Freeway Volume, V_F	1300
Ramp Volume, V_R	110
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1300	0.85	Level	8	0	0.962	1.00	1591
Ramp	110	0.85	Level	6	0	0.971	1.00	133
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1591 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1724	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1724	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 10.7 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.187 (Exibit 13-11)

S_R= 64.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 64.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	Benson Rd On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1300
Deceleration Lane Length L_D	
Freeway Volume, V_F	1580
Ramp Volume, V_R	220
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1580	0.93	Level	7	0	0.966	1.00	1758
Ramp	220	0.93	Level	6	0	0.971	1.00	244
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1758 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2002	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2002	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 12.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.194 (Exibit 13-11)

S_R= 64.6 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 64.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Benson On-Ramp to I-90*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1410*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*863*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*12.3*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Northbound*
From/To	*Benson On-Ramp to I-90*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1800*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*70.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*70.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1006*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*14.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	I-90 Off-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	600
Freeway Volume, V_F	1410
Ramp Volume, V_R	480
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1410	0.85	Level	9	0	0.957	1.00	1733
Ramp	480	0.85	Level	9	0	0.957	1.00	590
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 1733 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1733	Exhibit 13-8	4800	No
$V_{FO} = V_F - V_R$	1143	Exhibit 13-8	4800	No
V_R	590	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1733	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 13.8 (pc/mi/ln)
LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.156 (Exhibit 13-12)
S_R= 65.6 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 65.6 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Northbound
Agency or Company	HDR	Junction	I-90 Off-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	600
Freeway Volume, V_F	1800
Ramp Volume, V_R	590
Freeway Free-Flow Speed, S_{FF}	70.0
Ramp Free-Flow Speed, S_{FR}	60.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1800	0.93	Level	9	0	0.957	1.00	2023
Ramp	590	0.93	Level	9	0	0.957	1.00	663
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)
P_{FM} = using Equation (Exhibit 13-6)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = (pc/mi/ln)
LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)
S_R= mph (Exhibit 13-11)
S_0= mph (Exhibit 13-11)
S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)
P_{FD} = 1.000 using Equation (Exhibit 13-7)
V_{12} = 2023 pc/h
V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2023	Exhibit 13-8	4800	No
$V_{FO} = V_F - V_R$	1360	Exhibit 13-8	4800	No
V_R	663	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2023	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = 16.2 (pc/mi/ln)
LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.163 (Exhibit 13-12)
S_R= 65.4 mph (Exhibit 13-12)
S_0= N/A mph (Exhibit 13-12)
S = 65.4 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	I-90 On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	950
Deceleration Lane Length L_D	
Freeway Volume, V_F	1420
Ramp Volume, V_R	390
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	59.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1420	0.85	Level	8	0	0.962	1.00	1737
Ramp	390	0.85	Level	8	0	0.962	1.00	477
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1737 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2214	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2214	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 16.6 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.245 (Exibit 13-11)

S_R= 62.4 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 62.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	I-90 On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	950
Deceleration Lane Length L_D	
Freeway Volume, V_F	1040
Ramp Volume, V_R	640
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	59.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1040	0.93	Level	8	0	0.962	1.00	1163
Ramp	640	0.93	Level	8	0	0.962	1.00	716
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1163 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1879	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1879	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 13.8 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.234 (Exibit 13-11)

S_R= 62.7 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 62.7 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*I-90 to Benson Off-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1810*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1107*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*15.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*I-90 to Benson Off-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1680*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*939*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*13.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	Benson Rd Off-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	275
Freeway Volume, V_F	1810
Ramp Volume, V_R	220
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	59.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1810	0.85	Level	8	0	0.962	1.00	2215
Ramp	220	0.85	Level	6	0	0.971	1.00	267
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 2215 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2215	Exhibit 13-8	4780	No
$V_{FO} = V_F - V_R$	1948	Exhibit 13-8	4780	No
V_R	267	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	2215	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 20.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

D_s = 0.140 (Exhibit 13-12)

S_R= 65.2 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 65.2 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	Benson Rd Off-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	275
Freeway Volume, V_F	1680
Ramp Volume, V_R	110
Freeway Free-Flow Speed, S_{FF}	69.0
Ramp Free-Flow Speed, S_{FR}	59.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1680	0.93	Level	8	0	0.962	1.00	1879
Ramp	110	0.93	Level	6	0	0.971	1.00	122
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 1879 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1879	Exhibit 13-8	4780	No
$V_{FO} = V_F - V_R$	1757	Exhibit 13-8	4780	No
V_R	122	Exhibit 13-10	2200	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1879	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$$

D_R = 17.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

D_s = 0.127 (Exhibit 13-12)

S_R= 65.6 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 65.6 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*Benson Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1590*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*977*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*14.0*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Benson Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1570*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*68.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*68.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*882*	pc/h/ln
S	*70.0*	mph
D = v_p / S	*12.6*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Benson to Rice
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5670ft
Freeway free-flow speed, FFS	68 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1390	0.85	7	0	1.5	1.2	0.966	1.00	1693
V_{RF}	640	0.85	6	0	1.5	1.2	0.971	1.00	776
V_{FR}	200	0.85	6	0	1.5	1.2	0.971	1.00	242
V_{RR}	10	0.85	6	0	1.5	1.2	0.971	1.00	12
V_{NW}	1705							V =	2631
V_W	1018								
VR	0.374								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1018 lc/h
Weaving lane changes, LC_W	1466 lc/h
Non-weaving lane changes, LC_{NW}	2847 lc/h
Total lane changes, LC_{ALL}	4313 lc/h
Non-weaving vehicle index, I_{NW}	967

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2631 veh/h
Weaving segment capacity, c_w	6203 veh/h
Weaving segment v/c ratio	0.424
Weaving segment density, D	15.8 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.182
Weaving segment speed, S	57.6 mph
Average weaving speed, S_W	59.8 mph
Average non-weaving speed, S_{NW}	56.3 mph
Maximum weaving length, L_{MAX}	6390 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Benson to Rice
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	5670ft
Freeway free-flow speed, FFS	68 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1300	0.93	8	0	1.5	1.2	0.962	1.00	1454
V_{RF}	1320	0.93	6	0	1.5	1.2	0.971	1.00	1462
V_{FR}	270	0.93	6	0	1.5	1.2	0.971	1.00	299
V_{RR}	10	0.93	6	0	1.5	1.2	0.971	1.00	11
V_{NW}	1465							V =	3102
V_W	1761								
VR	0.546								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1761 lc/h
Weaving lane changes, LC_W	2209 lc/h
Non-weaving lane changes, LC_{NW}	2797 lc/h
Total lane changes, LC_{ALL}	5006 lc/h
Non-weaving vehicle index, I_{NW}	831

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3102 veh/h
Weaving segment capacity, c_w	4227 veh/h
Weaving segment v/c ratio	0.734
Weaving segment density, D	19.7 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.205
Weaving segment speed, S	54.6 mph
Average weaving speed, S_W	59.0 mph
Average non-weaving speed, S_{NW}	50.2 mph
Maximum weaving length, L_{MAX}	8368 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Rice Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2030*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*69.0*	mph	FFS	*69.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1236*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*70.0*	mph	S	mph
D = v_p / S	*17.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst		Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Rice Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2620*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1458*	pc/h/ln
S	*69.2*	mph
D = v_p / S	*21.1*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Rice to 10th St
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	4840ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1520	0.85	10	0	1.5	1.2	0.952	1.00	1878
V_{RF}	570	0.85	6	0	1.5	1.2	0.971	1.00	691
V_{FR}	510	0.85	6	0	1.5	1.2	0.971	1.00	618
V_{RR}	10	0.85	6	0	1.5	1.2	0.971	1.00	12
V_{NW}	1890							V =	3047
V_W	1309								
VR	0.409								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1309 lc/h
Weaving lane changes, LC_W	1721 lc/h
Non-weaving lane changes, LC_{NW}	2435 lc/h
Total lane changes, LC_{ALL}	4156 lc/h
Non-weaving vehicle index, I_{NW}	915

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3047 veh/h
Weaving segment capacity, c_w	5586 veh/h
Weaving segment v/c ratio	0.545
Weaving segment density, D	18.8 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.200
Weaving segment speed, S	56.6 mph
Average weaving speed, S_W	60.0 mph
Average non-weaving speed, S_{NW}	54.5 mph
Maximum weaving length, L_{MAX}	6784 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Rice to 10th St
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	4840ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2000	0.93	10	0	1.5	1.2	0.952	1.00	2258
V_{RF}	660	0.93	6	0	1.5	1.2	0.971	1.00	731
V_{FR}	620	0.93	6	0	1.5	1.2	0.971	1.00	687
V_{RR}	10	0.93	6	0	1.5	1.2	0.971	1.00	11
V_{NW}	2269							V =	3512
V_W	1418								
VR	0.385								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1418 lc/h
Weaving lane changes, LC_W	1830 lc/h
Non-weaving lane changes, LC_{NW}	2513 lc/h
Total lane changes, LC_{ALL}	4343 lc/h
Non-weaving vehicle index, I_{NW}	1098

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3512 veh/h
Weaving segment capacity, c_w	5943 veh/h
Weaving segment v/c ratio	0.591
Weaving segment density, D	22.2 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.207
Weaving segment speed, S	55.3 mph
Average weaving speed, S_W	59.7 mph
Average non-weaving speed, S_{NW}	52.9 mph
Maximum weaving length, L_{MAX}	6509 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*10th St Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2090*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*67.0*	mph	FFS	*67.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1291*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*65.0*	mph	S	mph
D = v_p / S	*19.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*C*		Required Number of Lanes, N	

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*10th St Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2660*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1494*	pc/h/ln
S	*64.9*	mph
D = v_p / S	*23.0*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	10th St On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	575
Deceleration Lane Length L_D	
Freeway Volume, V_F	2090
Ramp Volume, V_R	760
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	57.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2090	0.85	Level	10	0	0.952	1.00	2582
Ramp	760	0.85	Level	6	0	0.971	1.00	921
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F\,(P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2582 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3503	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3503	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\,v_R + 0.0078\,V_{12} - 0.00627\,L_A$$

D_R = 28.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.385 (Exibit 13-11)

S_R= 57.4 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 57.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\,V_{12} - 0.009\,L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	10th St On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	575
Deceleration Lane Length L_D	
Freeway Volume, V_F	2660
Ramp Volume, V_R	780
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	57.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2660	0.93	Level	9	0	0.957	1.00	2989
Ramp	780	0.93	Level	6	0	0.971	1.00	864
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2989 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3853	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3853	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 31.5 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.439 (Exibit 13-11)

S_R= 56.0 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 56.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*10th St to 26th St*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2850*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	f_{HV} = $1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1752*	pc/h/ln
S	*63.2*	mph
D = v_p / S	*27.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*PM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*10th St to 26th St*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3440*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1933*	pc/h/ln
S	*61.0*	mph
D = v_p / S	*31.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	26th St Off-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	400
Freeway Volume, V_F	2850
Ramp Volume, V_R	530
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2850	0.85	Level	9	0	0.957	1.00	3504
Ramp	530	0.85	Level	3	0	0.985	1.00	633
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F\,(P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3504 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3504	Exhibit 13-8	4740	No
$V_{FO} = V_F - V_R$	2871	Exhibit 13-8	4740	No
V_R	633	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3504	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = 30.8 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.485 (Exhibit 13-12)

S_R= 54.9 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.9 mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	26th St Off-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	
Deceleration Lane Length L_D	400
Freeway Volume, V_F	3440
Ramp Volume, V_R	780
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3440	0.93	Level	9	0	0.957	1.00	3865
Ramp	780	0.93	Level	3	0	0.985	1.00	851
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F\ (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = using Equation (Exhibit 13-6)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 13-8		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = (Exibit 13-11)

S_R= mph (Exhibit 13-11)

S_0= mph (Exhibit 13-11)

S = mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 using Equation (Exhibit 13-7)

V_{12} = 3865 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	3865	Exhibit 13-8	4740	No
$V_{FO} = V_F - V_R$	3014	Exhibit 13-8	4740	No
V_R	851	Exhibit 13-10	2000	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3865	Exhibit 13-8	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 33.9 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

D_s = 0.505 (Exhibit 13-12)

S_R= 54.4 mph (Exhibit 13-12)

S_0= N/A mph (Exhibit 13-12)

S = 54.4 mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*26th St Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2320*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1433*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*22.1*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*26th St Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2660*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*11*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.948*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1509*	pc/h/ln
S	*64.8*	mph
D = v_p / S	*23.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	26th St to Cliff Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2670ft
Freeway free-flow speed, FFS	69 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1900	0.85	8	0	1.5	1.2	0.962	1.00	2325
V_{RF}	780	0.85	3	0	1.5	1.2	0.985	1.00	931
V_{FR}	420	0.85	3	0	1.5	1.2	0.985	1.00	502
V_{RR}	10	0.85	3	0	1.5	1.2	0.985	1.00	12
V_{NW}	2337							V =	3625
V_W	1433								
VR	0.380								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1433 lc/h
Weaving lane changes, LC_W	1731 lc/h
Non-weaving lane changes, LC_{NW}	1351 lc/h
Total lane changes, LC_{ALL}	3082 lc/h
Non-weaving vehicle index, I_{NW}	624

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3625 veh/h
Weaving segment capacity, c_w	6071 veh/h
Weaving segment v/c ratio	0.597
Weaving segment density, D	23.0 pc/mi/ln
Level of Service, LOS	C

Weaving intensity factor, W	0.253
Weaving segment speed, S	54.6 mph
Average weaving speed, S_W	58.1 mph
Average non-weaving speed, S_{NW}	52.7 mph
Maximum weaving length, L_{MAX}	6459 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	26th St to Cliff Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2670ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2250	0.93	8	0	1.5	1.2	0.962	1.00	2516
V_{RF}	610	0.93	3	0	1.5	1.2	0.985	1.00	666
V_{FR}	410	0.93	3	0	1.5	1.2	0.985	1.00	447
V_{RR}	10	0.93	3	0	1.5	1.2	0.985	1.00	11
V_{NW}	2527							V =	3500
V_W	1113								
VR	0.306								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1113 lc/h
Weaving lane changes, LC_W	1411 lc/h
Non-weaving lane changes, LC_{NW}	1390 lc/h
Total lane changes, LC_{ALL}	2801 lc/h
Non-weaving vehicle index, I_{NW}	675

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3500 veh/h
Weaving segment capacity, c_w	6265 veh/h
Weaving segment v/c ratio	0.559
Weaving segment density, D	21.6 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.235
Weaving segment speed, S	56.2 mph
Average weaving speed, S_W	58.7 mph
Average non-weaving speed, S_{NW}	55.2 mph
Maximum weaving length, L_{MAX}	5646 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*GHM*
Agency or Company	*HDR*
Date Performed	*11/3/2014*
Analysis Time Period	*AM Peak*

Site Information

Highway/Direction of Travel	*I-229 Southbound*
From/To	*Cliff Off-Ramp to On-Ramp*
Jurisdiction	*Sioux Falls*
Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2680*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1632*	pc/h/ln
S	*67.8*	mph
D = v_p / S	*24.1*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	mph
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		**Site Information**	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Cliff Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2860*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*7*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.966*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1591*	pc/h/ln
S	*68.2*	mph
D = v_p / S	*23.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Cliff Ave to Minnesota Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3120ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2325	0.85	6	0	1.5	1.2	0.971	1.00	2817
V_{RF}	455	0.85	3	0	1.5	1.2	0.985	1.00	543
V_{FR}	355	0.85	3	0	1.5	1.2	0.985	1.00	424
V_{RR}	115	0.85	3	0	1.5	1.2	0.985	1.00	137
V_{NW}	2954							V =	3807
V_W	967								
VR	0.247								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	967 lc/h
Weaving lane changes, LC_W	1292 lc/h
Non-weaving lane changes, LC_{NW}	1722 lc/h
Total lane changes, LC_{ALL}	3014 lc/h
Non-weaving vehicle index, I_{NW}	922

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3807 veh/h
Weaving segment capacity, c_w	6422 veh/h
Weaving segment v/c ratio	0.593
Weaving segment density, D	23.9 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.220
Weaving segment speed, S	54.7 mph
Average weaving speed, S_W	57.6 mph
Average non-weaving speed, S_{NW}	53.8 mph
Maximum weaving length, L_{MAX}	5018 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Cliff Ave to Minnesota Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3120ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2414	0.93	6	0	1.5	1.2	0.971	1.00	2674
V_{RF}	676	0.93	3	0	1.5	1.2	0.985	1.00	738
V_{FR}	446	0.93	3	0	1.5	1.2	0.985	1.00	487
V_{RR}	34	0.93	3	0	1.5	1.2	0.985	1.00	37
V_{NW}	2711							V =	3822
V_W	1225								
VR	0.311								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1225 lc/h
Weaving lane changes, LC_W	1550 lc/h
Non-weaving lane changes, LC_{NW}	1672 lc/h
Total lane changes, LC_{ALL}	3222 lc/h
Non-weaving vehicle index, I_{NW}	846

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3822 veh/h
Weaving segment capacity, c_w	6268 veh/h
Weaving segment v/c ratio	0.610
Weaving segment density, D	24.6 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.232
Weaving segment speed, S	53.4 mph
Average weaving speed, S_W	57.2 mph
Average non-weaving speed, S_{NW}	51.9 mph
Maximum weaving length, L_{MAX}	5705 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Minnesota Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2780*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1676*	pc/h/ln
S	*67.4*	mph
D = v_p / S	*24.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		**Site Information**	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Minnesota Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3090*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*5*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.976*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*69.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*69.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1703*	pc/h/ln
S	*67.1*	mph
D = v_p / S	*25.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Minnesota Ave to Western Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3220ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1961	0.85	7	0	1.5	1.2	0.966	1.00	2388
V_{RF}	369	0.85	3	0	1.5	1.2	0.985	1.00	441
V_{FR}	819	0.85	2	0	1.5	1.2	0.990	1.00	973
V_{RR}	51	0.85	2	0	1.5	1.2	0.990	1.00	61
V_{NW}	2449							V =	3733
V_W	1414								
VR	0.366								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1414 lc/h
Weaving lane changes, LC_W	1744 lc/h
Non-weaving lane changes, LC_{NW}	1672 lc/h
Total lane changes, LC_{ALL}	3416 lc/h
Non-weaving vehicle index, I_{NW}	789

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3733 veh/h
Weaving segment capacity, c_w	6272 veh/h
Weaving segment v/c ratio	0.595
Weaving segment density, D	23.5 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.237
Weaving segment speed, S	54.7 mph
Average weaving speed, S_W	58.7 mph
Average non-weaving speed, S_{NW}	52.6 mph
Maximum weaving length, L_{MAX}	6303 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Minnesota Ave to Western Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3220ft
Freeway free-flow speed, FFS	69 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2400
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2316	0.93	7	0	1.5	1.2	0.966	1.00	2577
V_{RF}	604	0.93	3	0	1.5	1.2	0.985	1.00	659
V_{FR}	774	0.93	2	0	1.5	1.2	0.990	1.00	841
V_{RR}	36	0.93	2	0	1.5	1.2	0.990	1.00	39
V_{NW}	2616							V =	3977
V_W	1500								
VR	0.364								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1500 lc/h
Weaving lane changes, LC_W	1830 lc/h
Non-weaving lane changes, LC_{NW}	1706 lc/h
Total lane changes, LC_{ALL}	3536 lc/h
Non-weaving vehicle index, I_{NW}	842

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3977 veh/h
Weaving segment capacity, c_w	6275 veh/h
Weaving segment v/c ratio	0.634
Weaving segment density, D	25.5 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.243
Weaving segment speed, S	53.9 mph
Average weaving speed, S_W	58.4 mph
Average non-weaving speed, S_{NW}	51.6 mph
Maximum weaving length, L_{MAX}	6285 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Western Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2330*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1412*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*21.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Western Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2920*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1617*	pc/h/ln
S	*64.3*	mph
D = v_p / S	*25.1*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	AM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Western Ave to Louise Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3500ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1264	0.85	10	0	1.5	1.2	0.952	1.00	1561
V_{RF}	156	0.85	2	0	1.5	1.2	0.990	1.00	185
V_{FR}	1066	0.85	2	0	1.5	1.2	0.990	1.00	1267
V_{RR}	74	0.85	2	0	1.5	1.2	0.990	1.00	88
V_{NW}	1649							V =	2954
V_W	1452								
VR	0.468								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	185 lc/h
Weaving lane changes, LC_W	531 lc/h
Non-weaving lane changes, LC_{NW}	1659 lc/h
Total lane changes, LC_{ALL}	2190 lc/h
Non-weaving vehicle index, I_{NW}	577

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2954 veh/h
Weaving segment capacity, c_w	4882 veh/h
Weaving segment v/c ratio	0.605
Weaving segment density, D	17.1 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.156
Weaving segment speed, S	60.4 mph
Average weaving speed, S_W	60.0 mph
Average non-weaving speed, S_{NW}	60.7 mph
Maximum weaving length, L_{MAX}	7458 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	GHM
Agency/Company	HDR
Date Performed	11/3/2014
Analysis Time Period	PM Peak

Site Information

Freeway/Dir of Travel	I-229 Southbound
Weaving Segment Location	Western Ave to Louise Ave
Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	3500ft
Freeway free-flow speed, FFS	67 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1805	0.93	9	0	1.5	1.2	0.957	1.00	2028
V_{RF}	345	0.93	2	0	1.5	1.2	0.990	1.00	375
V_{FR}	1115	0.93	2	0	1.5	1.2	0.990	1.00	1211
V_{RR}	75	0.93	2	0	1.5	1.2	0.990	1.00	81
V_{NW}	2109							V =	3536
V_W	1586								
VR	0.429								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	1.0 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	375 lc/h
Weaving lane changes, LC_W	721 lc/h
Non-weaving lane changes, LC_{NW}	1754 lc/h
Total lane changes, LC_{ALL}	2475 lc/h
Non-weaving vehicle index, I_{NW}	738

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3536 veh/h
Weaving segment capacity, c_w	5351 veh/h
Weaving segment v/c ratio	0.661
Weaving segment density, D	20.9 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.172
Weaving segment speed, S	58.8 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	58.4 mph
Maximum weaving length, L_{MAX}	7011 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Northbound*
Agency or Company	*HDR*	From/To	*Louise Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1420*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*9*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.957*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*67.0*	mph	FFS	*67.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
			Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*873*	pc/h/ln	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*65.0*	mph	S	mph
D = v_p / S	*13.4*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Louise Off-Ramp to On-Ramp*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2150*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1202*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*18.5*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	Louise On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	AM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On; ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1200
Deceleration Lane Length L_D	
Freeway Volume, V_F	1420
Ramp Volume, V_R	430
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	57.0

Downstream Adj Ramp: ☐ Yes ☐ On; ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1420	0.85	Level	10	0	0.952	1.00	1754
Ramp	430	0.85	Level	2	0	0.990	1.00	511
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1754 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2265	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2265	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 15.4 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.222 (Exibit 13-11)

S_R= 61.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 61.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	GHM	Freeway/Dir of Travel	I-229 Southbound
Agency or Company	HDR	Junction	Louise On-Ramp
Date Performed	11/3/2014	Jurisdiction	Sioux Falls
Analysis Time Period	PM Peak	Analysis Year	2035 No Build

Project Description I-229 MIS

Inputs

Upstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{up} = ft; V_u = veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	1200
Deceleration Lane Length L_D	
Freeway Volume, V_F	2150
Ramp Volume, V_R	540
Freeway Free-Flow Speed, S_{FF}	67.0
Ramp Free-Flow Speed, S_{FR}	57.0

Downstream Adj Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ft; V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2150	0.93	Level	8	0	0.962	1.00	2404
Ramp	540	0.93	Level	2	0	0.990	1.00	586
UpStream								
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 2404 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2990	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2990	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 21.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.262 (Exibit 13-11)

S_R= 60.5 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 60.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes,V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information / Site Information

Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Louise On-Ramp to I-29 NB*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*AM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1850*	veh/h	Peak-Hour Factor, PHF	*0.85*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs / Calc Speed Adj and FFS

Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*67.0*	mph	FFS	*67.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1143*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*17.6*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		**Site Information**	
Analyst	*GHM*	Highway/Direction of Travel	*I-229 Southbound*
Agency or Company	*HDR*	From/To	*Louise On-Ramp to I-29 NB*
Date Performed	*11/3/2014*	Jurisdiction	*Sioux Falls*
Analysis Time Period	*PM Peak*	Analysis Year	*2035 No Build*

Project Description *I-229 MIS*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2690*	veh/h	Peak-Hour Factor, PHF	*0.93*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*67.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*67.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1519*	pc/h/ln
S	*64.8*	mph
D = v_p / S	*23.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
f_{LW} - Exhibit 11-8
E_T - Exhibits 11-10, 11-11, 11-13
f_{LC} - Exhibit 11-9
f_p - Page 11-18
TRD - Page 11-11
LOS, S, FFS, v_p - Exhibits 11-2, 11-3

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APPENDIX F1. EXISTING CONDITIONS CRASH RATES

Crash data was reviewed for the study area based on the Crash Geodatabase which includes crashes between January 2009 and December 2012.

SEGMENT AND INTERSECTION CRASH RATES:

Mainline and ramp sections were each analyzed separately to allow calculation of representative crash rates and critical rates for each type of interstate feature. The I-229 corridor was divided into segments representing mainline interchange areas, mainline areas between interchanges, and interchange ramps.

Crash rates for interstate mainline segments are shown in ***TABLE 1***. Crash rates for interstate ramps and arterial street intersections are shown in ***TABLE 2*** and ***TABLE 3***, respectively.

Table 1. I-229 Interstate Segment Crash Rates (2009-2012)

Travel Direction	Segment	Number Crashes	Segment Length	Daily Volume	MVMT[1]	Crash Rate	TEV*R[2]	Critical Rate	Difference
SB	I-90 to Benson	2	0.66	10,	9.9	0.	2056	1.	-1.59
SB	Benson Interchange	1	0.70	8,4	8.7	0.	967.	1.	-1.72
SB	Benson to Rice	21	1.06	16,	25.	0.	1351	1.	-0.72
SB	Rice Interchange Area	5	0.20	14,	4.2	1.	1670	2.	-0.99
SB	Rice to 10th	36	0.96	17,	24.	1.	2568	1.	-0.11
SB	10th Interchange Area	16	0.40	12,	7.3	2.	2712	1.	0.26
SB	10th to 26th	54	1.20	18,	32.	1.	3071	1.	0.17
SB	26th Interchange Area	2	0.19	15,	4.2	0.	7209	2.	-1.69
SB	26th to Cliff	11	0.55	21,	17.	0.	1367	1.	-1.00
SB	Cliff Interchange Area	23	0.55	18,	14.	1.	2818	1.	-0.14
SB	Cliff to Minnesota	10	0.65	22,	20.	0.	1052	1.	-1.11
SB	Minnesota Interchange	22	0.41	17,	10.	2.	3666	1.	0.28
SB	Minnesota to Western	12	0.63	20,	18.	0.	1298	1.	-0.97
SB	Western Interchange	7	0.32	12,	5.8	1.	1470	2.	-0.80
SB	Western to Louise	29	0.65	15,	14.	2.	3023	1.	0.32
SB	Louise Interchange	7	0.79	6,2	7.1	0.	6046	1.	-0.94
SB	Louise to I-29	14	0.50	14,	10.	1.	1887	1.	-0.49
NB	I-29 to Louise	19	0.51	13,	10.	1.	2531	1.	0.06
NB	Louise Interchange	8	0.69	10,	10.	0.	7884	1.	-1.01
NB	Louise to Western	27	0.67	14,	14.	1.	2723	1.	0.21
NB	Western Interchange	5	0.37	11,	6.2	0.	9255	1.	-1.17
NB	Western to Minnesota	22	0.60	17,	15.	1.	2498	1.	-0.25
NB	Minnesota Interchange	14	0.43	13,	8.7	1.	2184	1.	-0.23
NB	Minnesota to Cliff	28	0.60	24,	21.	1.	3164	1.	-0.28
NB	Cliff Interchange Area	19	0.45	19,	13.	1.	2835	1.	-0.26
NB	Cliff to 26th	11	0.55	22,	18.	0.	1350	1.	-1.02
NB	26th Interchange Area	4	0.24	15,	5.7	0.	1104	2.	-1.31
NB	26th to 10th	56	1.29	18,	35.	1.	2952	1.	0.10
NB	10th Interchange Area	10	0.39	11,	6.7	1.	1738	1.	-0.46
NB	10th to Rice	29	1.03	17,	26.	1.	1915	1.	-0.46
NB	Rice Interchange Area	6	0.18	14,	3.8	1.	2197	2.	-0.66
NB	Rice to Benson	28	0.97	15,	22.	1.	1969	1.	-0.34
NB	Benson Interchange	4	0.66	8,5	8.2	0.	4132	1.	-1.37
NB	Benson to I-90	4	0.76	9,5	10.	0.	3567	1.	-1.40

1 MVMT = Million Vehicle Miles Traveled
*2 TEV*R = Total Entering Vehicles per Day, Times Observed Crash Rate*
Source: Highway Safety Manual, First Edition, 2010, AASHTO

Table 2. I-229 Interstate Ramp Crash Rates (2009-2012)

Trav el Direction	Segment	Nu mber Crashes	Seg ment Length	Dai ly Volume	MV MT[1]	Cr ash Rate	*TEV* R*[2]	Cr itical Rate	Differ ence
SB	Benson Off Ramp	1	0.40	1,0	0.6	1.	1699	5.	-3.94
SB	Benson On Ramp	0	0.33	7,8	3.8	0.	0.00	3.	-3.19
SB	Rice Off Ramp	0	0.29	2,0	0.8	0.	0.00	4.	-4.88
SB	Rice On Ramp	4	0.19	3,5	1.0	3.	1412	4.	-0.67
SB	10th Off Ramp	3	0.26	5,2	2.0	1.	7783	3.	-2.25
SB	10th On Ramp	7	0.16	7,0	1.6	4.	2905	3.	0.22
SB	26th Off Ramp	2	0.13	3,1	0.6	3.	9926	5.	-2.36
SB	26th On Ramp	1	0.09	6,4	0.9	1.	7134	4.	-3.73
SB	Cliff Off Ramp	2	0.31	2,9	1.3	1.	4418	4.	-2.73
SB	Cliff On Ramp	1	0.21	5,3	1.6	0.	3261	3.	-3.36
SB	Minnesota Off Ramp	4	0.19	4,0	1.1	3.	1419	4.	-0.96
SB	Minnesota On Ramp	2	0.23	5,3	1.8	1.	5879	3.	-2.75
SB	Western Off Ramp	0	0.18	7,7	2.0	0.	0.00	3.	-3.71
SB	Western On Ramp	3	0.16	2,7	0.6	4.	1284	5.	-0.78
SB	Louise Off Ramp	4	0.35	8,9	4.6	0.	7717	3.	-2.19
SB	Louise On Ramp	5	0.43	4,6	2.9	1.	7801	3.	-1.69
NB	Louise Off Ramp	8	0.46	3,6	2.4	3.	1175	3.	-0.28
NB	Louise Loop Ramp	0	0.35	4,8	2.4	0.	0.00	3.	-3.54
NB	Louise On Ramp	3	0.41	3,4	2.1	1.	4915	3.	-2.27
NB	Western Off Ramp	1	0.20	2,9	0.8	1.	3357	4.	-3.75
NB	Western On Ramp	2	0.24	7,5	2.7	0.	5501	3.	-2.72
NB	Minnesota Off Ramp	6	0.18	4,1	1.0	5.	2270	4.	1.01
NB	Minnesota On Ramp	1	0.21	4,6	1.4	0.	3246	4.	-3.44
NB	Cliff Off Ramp	6	0.20	4,8	1.4	4.	1994	4.	0.03
NB	Cliff On Ramp	0	0.27	3,3	1.3	0.	0.00	4.	-4.23
NB	26th Off Ramp	10	0.44	6,3	4.0	2.	1542	3.	-0.69
NB	26th On Ramp	5	0.35	2,6	1.3	3.	9701	4.	-0.56
NB	10th Off Ramp	9	0.18	6,7	1.8	4.	3261	3.	1.01
NB	10th On Ramp	4	0.23	5,6	1.9	2.	1151	3.	-1.73
NB	Rice Off Ramp	1	0.17	3,5	0.9	1.	3869	4.	-3.71
NB	Rice On Ramp	2	0.25	2,1	0.7	2.	5435	5.	-2.54
NB	Benson Off Ramp	8	0.40	7,4	4.3	1.	1369	3.	-1.26
NB	Benson On Ramp	0	0.29	1,3	0.5	0.	0.00	5.	-5.81

[1] MVMT = Million Vehicle Miles Traveled
*[2] TEV*R = Total Entering Vehicles per Day, Times Observed Crash Rate*
Source: Highway Safety Manual, First Edition, 2010, AASHTO

Table 3. Arterial Intersection Crash Rates (2009- 2012)

Intersection	Nu mber Crashes	Dai ly Volume	ME V^1	Cr ash Rate	*TEV* R^2*	Cri tical Rate	Differ ence
57th/ Solberg	20	36,	53.	0.	1369	0.	-0.52
69th/ Solberg	0	50	0.7	0.	0.00	2.	-2.98
57th/Louise	76	59,	87.	0.	5205	0.	0.03
59th/Louise	43	35,	51.	0.	2945	0.	-0.06
I-229 SB/Louise	70	39,	58.	1.	4794	0.	0.32
I-229 NB/Louise	13	28,	41.	0.	8904.	0.	-0.60
69TH/Louise	32	27,	39.	0.	2191	0.	-0.11
49th/ Western	31	34,	50.	0.	2123	0.	-0.28
I-229 SB/Western	21	37,	54.	0.	1438	0.	-0.50
I-229 NB/Western	17	32,	47.	0.	1164	0.	-0.54
57th/Western	45	44,	64.	0.	3082	0.	-0.17
41st /Minnesota	57	50,	74.	0.	3904	0.	-0.09
49th /Minnesota	18	28,	41.	0.	1232	0.	-0.48
I-229	28	30,	44.	0.	1917	0.	-0.28
I-229	15	29,	43.	0.	1027	0.	-0.57
57TH/Minnesota	43	36,	52.	0.	2945	0.	-0.08
33RD/Cliff	23	21,	31.	0.	1575	0.	-0.23
I-229 SB/Cliff	33	24,	36.	0.	2260	0.	-0.03
I-229 NB/Cliff	20	24,	35.	0.	1369	0.	-0.37
49th/ Cliff	14	27,	40.	0.	9589.	0.	-0.57
26th /Cliff	33	26,	38.	0.	2260	0.	-0.06
26th /Van Eps	5	13,	19.	0.	3424.	1.	-0.77
26th /Yeager	27	22,	33.	0.	1849	0.	-0.13
I-229 SB/ Yeager	9	5,8	8.5	1.	6164.	1.	-0.16
I-229 NB/26th	56	32,	47.	1.	3835	0.	0.28
26th /Southeastern	40	35,	51.	0.	2739	0.	-0.12
18th /	10	16,	23.	0.	6849.	1.	-0.57
18th /Cleveland	18	12,	18.	0.	1232	1.	-0.07
12th /Lowell	4	2,5	3.6	1.	2739.	1.	-0.45
12th /Cleveland	17	12,	18.	0.	1164	1.	-0.13
10th /Lowell	20	24,	35.	0.	1369	0.	-0.37
I-229/10th	59	43,	63.	0.	4041	0.	0.05
10th /Cleveland	70	42,	62.	1.	4794	0.	0.25
6th /Lowell	7	12,	18.	0.	4794.	1.	-0.66
6th /Cleveland	34	23,	34.	0.	2328	0.	0.05
Rice/Wayland	10	12,	18.	0.	6849.	1.	-0.50
I-229 SB/Rice	5	15,	22.	0.	3424.	1.	-0.78
I-229 NB/Rice	13	19,	29.	0.	8904.	0.	-0.52
Rice /Bahnson	12	10,	15.	0.	8219.	1.	-0.29
Benson /Cliff	40	29,	42.	0.	2739	0.	0.03
Benson /Lewis	10	19,	28.	0.	6849.	0.	-0.61

Intersection	Number	Daily	MEV[1]	Crash	*TEV*R*[2]	Critical	Difference
I-229 SB/Benson	4	14,	21.	0.	2739.	1.	-0.83
I-229 NB/Benson	10	14,	21.	0.	6849.	1.	-0.54
Benson /Hall	0	1,2	1.7	0.	0.00	2.	-2.01
60th N/Lewis	3	9,4	13.	0.	2054.	1.	-0.88

1 MVMT = Million Vehicle Miles Traveled
*2 TEV*R = Total Entering Vehicles per Day, Times Observed Crash Rate*
Source: Highway Safety Manual, First Edition, 2010, AASHTO

SEGMENT AND INTERSECTION CRITICAL CRASH RATES:

Critical crash rates were calculated based on the statistical populations shown in ***TABLE 1***, ***TABLE 2***, and ***TABLE 3***, using the methods shown in the Highway Safety Manual (*American Association of State Highway and Transportation Officials, 2010*). Roadway segments and intersections that are outside the critical rates are highlighted. The segments and intersections that were identified as having crash rates outside of the critical rates are reviewed in more detail later in the Sub-Study 1 report.

CRASH TRENDS:

Review of the crash summaries for each Interstate segment and arterial street intersection revealed a few crash trends:

- Many of the crashes on I-229 are associated with drivers losing control in slippery road conditions. Drivers in this group were cited for either driving too fast for conditions or following too closely.
- Driver distraction or use of electronic devices were cited in a growing number of crashes throughout the corridor. The ubiquitous use of cell phones, particularly in adverse weather conditions, appears to be elevating crash levels.
- A large percentage of the crashes on ramps and at intersections are related to drivers being unprepared for congestion. It has grown common for drivers in the PM peak travel period to encounter long queues on off ramps and at intersections. Unprepared drivers then risk either colliding with the rear of another vehicle or leaving the roadway to avoid a rear-end crash.

APPENDIX F2 -

EXISTING CONDITIONS SAFETY ASSESSMENT

HDR ONE COMPANY *Many Solutions*

Technical Memo

To:	Steve Gramm, Study Advisory Team		
From:	HDR	Project:	I-229 MIS
CC:	file		
Date:	7/25/13	Job No:	207030

RE: Safety Analysis

This memorandum documents the safety analysis conducted for the I-229 corridor in Substudy 1 of the I-229 Major Investment Study (MIS). The safety analysis was conducted to help determine if any safety-related improvements could be incorporated into future construction.

Methodogy:

The Methods and Assumptions (M&A) document for this study addresses safety issues in the following excerpt:

> *"Crash data will be reviewed for the study area based on the Crash Geodatabase which includes crashes between January 2009 and December 2012. SDDOT's database will be the only database used in the calculation of crash rates and critical crash rates. The following information will be provided as a result of the crash analysis:*
>
> - *Segment and Intersection Crash Rates*
> - *Segment and Intersection Critical Crash Rates (per Highway Safety Manual)*
> - *Crash Trends*
> - *Potential Mitigation Measures to Improve Locations Above Critical Crash Rates."*

This direction from the M&A document will provide the structure for documenting the safety analysis.

Segment and Intersection Crash Rates:

The I-229 corridor was divided into segments representing

- mainline interchange areas (Table 1),
- mainline areas between interchanges (Table 2), and
- interchange ramps (Table 3).

Mainline and ramp sections were each analyzed separately to allow calculation of representative crash rates and critical rates for each type of Interstate feature.

The arterial street intersections named in the M&A document were grouped for calculation of crash rates and critical rates.

Crash rates for Interstate mainline segments, Interstate ramps and arterial street intersections are shown in the following tables.

TABLE 1 - INTERSTATE SEGMENT CRASH RATES (2009-2012)

I-229 MIS

TRAVEL DIRECTION	SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R* [2]	CRITICAL RATE	DIFFERENCE
SB	I-90 TO BENSON	2	0.666	10220	9.94	0.20	2056.85	1.79	-1.59
SB	BENSON INTERCHANGE AREA	1	0.708	8440	8.72	0.11	967.42	1.84	-1.72
SB	BENSON TO RICE	21	1.064	16280	25.29	0.83	13518.39	1.55	-0.72
SB	RICE INTERCHANGE AREA	5	0.205	14220	4.26	1.17	16705.65	2.16	-0.99
SB	RICE TO 10TH	36	0.960	17730	24.85	1.45	25684.93	1.56	-0.11
SB	10TH INTERCHANGE AREA	16	0.404	12520	7.38	2.17	27126.00	1.90	**0.26**
SB	10TH TO 26TH	54	1.204	18270	32.12	1.68	30719.52	1.51	**0.17**
SB	26TH INTERCHANGE AREA	2	0.190	15150	4.20	0.48	7209.81	2.17	-1.69
SB	26TH TO CLIFF	11	0.551	21260	17.10	0.64	13673.77	1.64	-1.00
SB	CLIFF INTERCHANGE AREA	23	0.559	18360	14.98	1.53	28181.44	1.67	-0.14
SB	CLIFF TO MINNESOTA	10	0.651	22010	20.92	0.48	10521.22	1.59	-1.11
SB	MINNESOTA INTERCHANGE AREA	22	0.411	17930	10.76	2.04	36663.00	1.77	**0.28**
SB	MINNESOTA TO WESTERN	12	0.633	20000	18.48	0.65	12984.48	1.62	-0.97
SB	WESTERN INTERCHANGE AREA	7	0.326	12300	5.85	1.20	14707.12	2.00	-0.80
SB	WESTERN TO LOUISE	29	0.657	15100	14.48	2.00	30232.90	1.68	**0.32**
SB	LOUISE INTERCHANGE AREA	7	0.793	6200	7.18	0.98	6046.05	1.91	-0.94
SB	LOUISE TO I-29	14	0.508	14800	10.98	1.28	18876.07	1.76	-0.49
NB	I-29 TO LOUISE	19	0.514	13750	10.32	1.84	25318.48	1.78	**0.06**
NB	LOUISE INTERCHANGE AREA	8	0.695	10150	10.30	0.78	7884.10	1.78	-1.01
NB	LOUISE TO WESTERN	27	0.679	14400	14.28	1.89	27235.86	1.68	**0.21**
NB	WESTERN INTERCHANGE AREA	5	0.370	11500	6.21	0.80	9255.83	1.97	-1.17
NB	WESTERN TO MINNESOTA	22	0.603	17700	15.58	1.41	24989.21	1.66	-0.25
NB	MINNESOTA INTERCHANGE AREA	14	0.439	13600	8.72	1.61	21842.92	1.84	-0.23
NB	MINNESOTA TO CLIFF	28	0.606	24300	21.50	1.30	31647.00	1.59	-0.28
NB	CLIFF INTERCHANGE AREA	19	0.459	19500	13.07	1.45	28352.28	1.71	-0.26
NB	CLIFF TO 26TH	11	0.558	22230	18.11	0.61	13502.23	1.62	-1.02
NB	26TH INTERCHANGE AREA	4	0.248	15930	5.77	0.69	11047.28	2.01	-1.31
NB	26TH TO 10TH	56	1.299	18550	35.18	1.59	29527.46	1.49	**0.10**
NB	10TH INTERCHANGE AREA	10	0.394	11800	6.79	1.47	17384.05	1.94	-0.46
NB	10TH TO RICE	29	1.037	17720	26.83	1.08	19154.30	1.54	-0.46
NB	RICE INTERCHANGE AREA	6	0.187	14130	3.86	1.56	21976.41	2.22	-0.66
NB	RICE TO BENSON	28	0.974	15990	22.74	1.23	19690.02	1.57	-0.34
NB	BENSON INTERCHANGE AREA	4	0.663	8550	8.28	0.48	4132.32	1.86	-1.37
NB	BENSON TO I-90	4	0.768	9510	10.66	0.38	3567.35	1.77	-1.40

[1]MVMT = MILLION VEHICLE MILES TRAVELED

[2]TEV*R = TOTAL ENTERING VEHICLES PER DAY, TIMES OBSERVED CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO

TABLE 2 - INTERSTATE RAMP CRASH RATES (2009-2012)

I-229 MIS

TRAVEL DIRECTION	SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R* [2]	CRITICAL RATE	DIFFERENCE
SB	BENSON OFF RAMP	1	0.403	1090	0.64	1.56	1699.58	5.50	-3.94
SB	BENSON ON RAMP	0	0.332	7840	3.80	0.00	0.00	3.19	-3.19
SB	RICE OFF RAMP	0	0.292	2060	0.88	0.00	0.00	4.88	-4.88
SB	RICE ON RAMP	4	0.194	3540	1.00	3.99	14122.30	4.66	-0.67
SB	10TH OFF RAMP	3	0.264	5210	2.01	1.49	7783.31	3.74	-2.25
SB	10TH ON RAMP	7	0.165	7000	1.69	4.15	29057.70	3.94	**0.22**
SB	26TH OFF RAMP	2	0.138	3120	0.63	3.18	9926.54	5.55	-2.36
SB	26TH ON RAMP	1	0.096	6400	0.90	1.11	7134.70	4.84	-3.73
SB	CLIFF OFF RAMP	2	0.310	2900	1.31	1.52	4418.91	4.25	-2.73
SB	CLIFF ON RAMP	1	0.210	5300	1.62	0.62	3261.58	3.98	-3.36
SB	MINNESOTA OFF RAMP	4	0.193	4080	1.15	3.48	14195.47	4.44	-0.96
SB	MINNESOTA ON RAMP	2	0.233	5300	1.80	1.11	5879.24	3.86	-2.75
SB	WESTERN OFF RAMP	0	0.184	7700	2.07	0.00	0.00	3.71	-3.71
SB	WESTERN ON RAMP	3	0.160	2700	0.63	4.76	12842.47	5.54	-0.78
SB	LOUISE OFF RAMP	4	0.355	8900	4.61	0.87	7717.54	3.06	-2.19
SB	LOUISE ON RAMP	5	0.439	4610	2.95	1.69	7801.04	3.38	-1.69
NB	LOUISE OFF RAMP	8	0.466	3600	2.45	3.27	11758.48	3.55	-0.28
NB	LOUISE LOOP RAMP	0	0.351	4800	2.46	0.00	0.00	3.54	-3.54
NB	LOUISE ON RAMP	3	0.418	3460	2.11	1.42	4915.78	3.69	-2.27
NB	WESTERN OFF RAMP	1	0.204	2900	0.86	1.16	3357.51	4.91	-3.75
NB	WESTERN ON RAMP	2	0.249	7500	2.73	0.73	5501.46	3.45	-2.72
NB	MINNESOTA OFF RAMP	6	0.181	4100	1.08	5.54	22704.91	4.53	**1.01**
NB	MINNESOTA ON RAMP	1	0.211	4670	1.44	0.70	3246.12	4.13	-3.44
NB	CLIFF OFF RAMP	6	0.206	4800	1.44	4.16	19949.46	4.13	**0.03**
NB	CLIFF ON RAMP	0	0.272	3370	1.34	0.00	0.00	4.23	-4.23
NB	26TH OFF RAMP	10	0.444	6300	4.08	2.45	15426.39	3.14	-0.69
NB	26TH ON RAMP	5	0.353	2670	1.38	3.63	9701.58	4.19	-0.56
NB	10TH OFF RAMP	9	0.189	6750	1.86	4.83	32615.79	3.82	**1.01**
NB	10TH ON RAMP	4	0.238	5640	1.96	2.04	11511.45	3.77	-1.73
NB	RICE OFF RAMP	1	0.177	3590	0.93	1.08	3869.67	4.78	-3.71
NB	RICE ON RAMP	2	0.252	2130	0.78	2.55	5435.96	5.09	-2.54
NB	BENSON OFF RAMP	8	0.400	7440	4.34	1.84	13698.63	3.10	-1.26
NB	BENSON ON RAMP	0	0.291	1320	0.56	0.00	0.00	5.81	-5.81

[1]MVMT = MILLION VEHICLE MILES TRAVELED

[2]TEV*R = TOTAL ENTERING VEHICLES TIMES CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO

TABLE 3 - INTERSECTION CRASH RATES (2009-2012)

I-229 MIS

INTERSECTION	NUMBER CRASHES	DAILY VOLUME	MEV[1]	CRASH RATE	*TEV*R* [2]	CRITICAL RATE	DIFFERENCE
57TH/SOLBERG	20	36900	53.87	0.37	13698.63	0.89	-0.52
69TH/SOLBERG	0	500	0.73	0.00	0.00	2.98	-2.98
57TH/LOUISE	76	59600	87.02	0.87	52054.79	0.85	**0.03**
59TH/LOUISE	43	35400	51.68	0.83	29452.05	0.89	-0.06
I-229 SB/LOUISE	70	39800	58.11	1.20	47945.21	0.88	**0.32**
I-229 NB/LOUISE	13	28500	41.61	0.31	8904.11	0.92	-0.60
69TH/LOUISE	32	27000	39.42	0.81	21917.81	0.92	-0.11
49TH/WESTERN	31	34400	50.22	0.62	21232.88	0.90	-0.28
I-229 SB/WESTERN	21	37100	54.17	0.39	14383.56	0.89	-0.50
I-229 NB/WESTERN	17	32300	47.16	0.36	11643.84	0.90	-0.54
57TH/WESTERN	45	44200	64.53	0.70	30821.92	0.87	-0.17
41ST/MINNESOTA	57	50900	74.31	0.77	39041.10	0.86	-0.09
49TH/MINNESOTA	18	28200	41.17	0.44	12328.77	0.92	-0.48
I-229 SB/MINNESOTA	28	30480	44.50	0.63	19178.08	0.91	-0.28
I-229 NB/MINNESOTA	15	29600	43.22	0.35	10273.97	0.91	-0.57
57TH/MINNESOTA	43	36200	52.85	0.81	29452.05	0.89	-0.08
33RD/CLIFF	23	21700	31.68	0.73	15753.42	0.95	-0.23
I-229 SB/CLIFF	33	24900	36.35	0.91	22602.74	0.93	-0.03
I-229 NB/CLIFF	20	24000	35.04	0.57	13698.63	0.94	-0.37
49TH/CLIFF	14	27500	40.15	0.35	9589.04	0.92	-0.57
26TH/CLIFF	33	26200	38.25	0.86	22602.74	0.93	-0.06
26TH/VAN EPS	5	13100	19.13	0.26	3424.66	1.03	-0.77
26TH/YEAGER	27	22800	33.29	0.81	18493.15	0.94	-0.13
I-229 SB/YEAGER	9	5820	8.50	1.06	6164.38	1.22	-0.16
I-229 NB/26TH	56	32300	47.16	1.19	38356.16	0.90	**0.28**
26TH/SOUTHEASTERN	40	35500	51.83	0.77	27397.26	0.89	-0.12
18TH/SOUTHEASTERN	10	16100	23.51	0.43	6849.32	1.00	-0.57
18TH/CLEVELAND	18	12800	18.69	0.96	12328.77	1.04	-0.07
12TH/LOWELL	4	2500	3.65	1.10	2739.73	1.55	-0.45
12TH/CLEVELAND	17	12800	18.69	0.91	11643.84	1.04	-0.13
10TH/LOWELL	20	24300	35.48	0.56	13698.63	0.94	-0.37
I-229/10TH	59	43660	63.74	0.93	40410.96	0.87	**0.05**
10TH/CLEVELAND	70	42500	62.05	1.13	47945.21	0.87	**0.25**
6TH/LOWELL	7	12500	18.25	0.38	4794.52	1.04	-0.66
6TH/CLEVELAND	34	23500	34.31	0.99	23287.67	0.94	**0.05**
RICE/WAYLAND	10	12700	18.54	0.54	6849.32	1.04	-0.50
I-229 SB/RICE	5	15260	22.28	0.22	3424.66	1.01	-0.78
I-229 NB/RICE	13	19990	29.19	0.45	8904.11	0.96	-0.52
RICE/BAHNSON	12	10530	15.37	0.78	8219.18	1.07	-0.29
BENSON/CLIFF	40	29000	42.34	0.94	27397.26	0.91	**0.03**
BENSON/LEWIS	10	19400	28.32	0.35	6849.32	0.97	-0.61
I-229 SB/BENSON	4	14990	21.89	0.18	2739.73	1.01	-0.83
I-229 NB/BENSON	10	14390	21.01	0.48	6849.32	1.02	-0.54
BENSON/HALL	0	1200	1.75	0.00	0.00	2.01	-2.01
60TH N/LEWIS	3	9400	13.72	0.22	2054.79	1.10	-0.88

[1]MEV = MILLION ENTERING VEHICLES

[2]TEV*R = TOTAL ENTERING VEHICLES TIMES CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO

Segment and Intersection Critical Crash Rates:

Critical crash rates were calculated based on the statistical populations shown in each spreadsheet, using the methods shown in the Highway Safety Manual (American Association of State Highway and Transportation Officials, 2010). Those segments and intersections that lay outside the critical rates are shown with red coloration in the last column of each spreadsheet. All the segments and intersections that lay within the critical rate are shown in green. The segments and intersections that were identified as having crash rates outside of the critical rates were reviewed in more detail later in this report.

Crash Trends:

Review of the crash summaries for each Interstate segment and arterial street intersection revealed a few crash trends:

- Many of the crashes on I-229 are associated with drivers losing control in slippery road conditions. Drivers in this group were cited for either driving too fast for conditions or following too closely.
- Driver distraction or use of electronic devices were cited in a growing number of crashes throughout the corridor. The ubiquitous use of cell phones, particularly in adverse weather conditions, appears to be elevating crash levels.
- A large percentage of the crashes on ramps and at intersections are related to drivers being unprepared for congestion. It has grown common for drivers in the PM peak travel period to encounter long queues on off ramps and at intersections. Unprepared drivers then risk either colliding with the rear of another vehicle or leaving the roadway to avoid a rear-end crash.

Potential Mitigation Measures:

The general crash trends identified above suggest several potential strategies for reducing crash rates along the I-229 corridor:

- Provide enhanced driver information during inclement weather. Such information could include suggested travel speeds or temporary speed limits, notice of winter maintenance activities, notice of roadway conditions, and other information to help drivers respond to changing weather.
- Continued education about the effects of using cell phones and other electronic devices while driving.
- Congestion relief on corridor crossroads.

Each of the Interstate segments and arterial intersections that were identified as having crash rates outside of the critical rates are discussed in the following points.

Interstate segments:

- 10th Street interchange area, southbound – crashes appeared to be concentrated near the 10th Street overpass and were primarily single vehicle crashes under slippery conditions. Provide driver information during inclement weather.
- 10th Street to 26th Street, southbound – crashes appeared to be evenly distributed and were primarily single vehicle, sideswipe or rear-end crashes under slippery conditions. Provide driver information during inclement weather.
- Minnesota Avenue interchange area, southbound – crashes appeared to be concentrated near the Minnesota Avenue overpass and were primarily single vehicle crashes under slippery conditions. Provide driver information during inclement weather.
- Western Avenue to Louise Avenue, southbound – crashes appeared to be evenly distributed and were primarily single vehicle crashes under slippery conditions. Provide driver information during inclement weather.
- I-29 to Louise Avenue, northbound – crashes appeared to be concentrated near a drainage area and were either animal hits or single vehicle crashes under slippery conditions. Provide driver information during inclement weather, check for deer crossing warning signs.
- Louise Avenue to Western Avenue, northbound - crashes appeared to be concentrated near a drainage area and were either animal hits or single vehicle crashes under slippery conditions. Provide driver information during inclement weather, check for deer crossing warning signs.

- 26th Street to 10th Street, northbound – crashes appeared to be evenly distributed and were primarily single vehicle, sideswipe or rear-end crashes under slippery conditions. Provide driver information during inclement weather.

Interstate ramps:

- 10th Street on ramp, southbound – crashes were primarily rear-end type near the gore area. Merge area was extended in 2012 and auxiliary lane may be considered.
- Minnesota Avenue off ramp, northbound – crashes were primarily rear-end type near the gore area and terminal area. Reduce congestion and queues on ramp. Consider advance driver information.
- Cliff Avenue off ramp, northbound – crashes were primarily rear-end type near ramp terminal. Reduce congestion and queues on ramp. Consider advance driver information.
- 10th Street off ramp, northbound – crashes were primarily rear-end type near the gore area and terminal area. Reduce congestion and queues on ramp. Consider advance driver information.

Arterial intersections:

- 57th Street/Louise Avenue – crashes were evenly split between rear-end and angle types and occurred mostly in the intersection. Many drivers were cited for being distracted and following too closely. Intersection experiences long queues during peak demand periods. Reduce congestion.
- I-229 southbound/Louise Avenue – crashes were primarily on Louise Avenue and were 57% rear-end and 34% angle types. Many drivers were cited for being distracted and following too closely. Intersection experiences long queues during peak demand periods. Reduce congestion.
- I-229 northbound/26th Street – crashes were almost all rear-end type on 26th Street. I-229/26th St. (Exit 5) Corridor Study has identified the need for interchange improvements.
- I-229/10th Street – crashes were primarily rear-end type and occurred most frequently on the westbound-to-southbound left turn and the northbound-to-eastbound right turn. Reduce congestion.
- 10th Street/Cleveland Avenue – crashes were primarily on Cleveland Avenue and included a mix of crash types. Previous studies have recommended intersection improvements. Reduce congestion.
- 6th Street/Cleveland Avenue – crashes were primarily on 6th Street and were 53% angle and 38% rear-end types. Review sight distance and intersection clearance times.
- Benson Road/Cliff Avenue – crashes were primarily in the intersection and were 48% angle and 33% rear-end types. Intersection has been within a construction work zone during the monitoring period. Review crash statistics at later date.

APPENDIX

Interstate Segment Maps and Summaries

Interstate Ramp Maps and Summaries

Intersection Maps and Summaries

6300 So Old Village Place
Suite 100
Sioux Falls, South Dakota 57108
Phone (605) 977-7740
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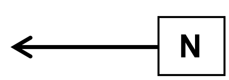
Interstate Segment – I-90 to Benson Road SB



Crash Summary - I-90 to Benson, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
4829	7/21/2011 10:15:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4840	11/5/2009 3:00:00 PM	Daylight	No collision between 2 MV in transport	Animal - domestic	No injury	Dry	Non-junction	Straight ahead	None	Animal in roadway	None	Clear

Interstate Segment – Benson Road Interchange Area SB ← N

Crash Summary - Benson Rd. interchange area, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
4673	2/2/2011 10:23:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow

Interstate Segment – Benson Road to Rice Street SB

Crash Summary - Benson to Rice SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4590	1/19/2011 8:00:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Non-junction	Overtaking /passing	None	None	Driving too fast for conditions	Clear
4595	12/8/2012 10:45:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
4598	8/1/2010 4:36:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Non-junction	Straight ahead	Tires	None	Running off road	Clear
4599	5/13/2010 10:45:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4600	12/3/2009 7:40:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
4603	12/10/2012 7:02:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4607	5/22/2012 5:02:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Non-junction	Straight ahead	None	None	Running off road	Clear
4608	3/19/2012 8:22:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Clear
4615	12/15/2010 11:15:00	Dark - roadway	No collision between 2	Highway traffic sign	No injury	Ice	Non-junction	Slowing in traffic lane	None	Road surface	None	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	PM	not lighted	MV in transport	post/sign						condition wet, icy, snow, slush, etc.		
4619	12/27/2012 1:20:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
4621	5/21/2012 1:50:00 AM	Dark - roadway not lighted	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
4623	10/28/2010 6:53:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4630	9/24/2011 3:45:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4631	10/10/2009 1:35:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Wet	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
4632	9/17/2012 4:30:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	None	Clear
4641	4/14/2009 8:05:00 PM	Dusk	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4644	4/11/2012 5:04:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Possible	Dry	Non-junction	Changing lanes	None	None	Failed to yield to vehicle	Clear
4645	4/11/2012 8:35:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	None	Clear
4646	5/9/2009	Dark -	Rear-end	Motor	Possible	Wet	Non-	Straight	None	None	Failed to	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	12:40:00 AM	roadway not lighted	front to rear	vehicle in transport			junction	ahead			yield to vehicle	
4649	9/4/2012 7:22:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
4656	12/19/2010 5:55:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Ditch	No injury	Dry	Non-junction	Straight ahead	Steering	None	None	Clear

Interstate Segment – Rice Street Interchange Area SB

Crash Summary - Rice St. interchange area, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4529	1/19/2011 8:21:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Frost	Interchange area	Straight ahead	None	None	None	Clear
4575	5/13/2011 9:17:00 AM	Daylight	No collision between 2 MV in transport	Delineator post	Possible	Dry	Interchange area	Straight ahead	None	None	Failure to keep in proper lane	Cloudy
4576	11/25/2011 6:53:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4577	2/5/2012 12:10:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchange area	Changing lanes	None	None	Fatigued/asleep	Clear
4578	5/9/2012 5:17:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear

Interstate Segment – Rice Street to 10th Street SB

Crash Summary - Rice to 10th SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4005	2/1/2011 6:25:00 AM	Dawn	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Snow	Non-junction	Straight ahead	None	Pedestrian, bicyclist, other non-occupants in road	Driving too fast for conditions	Cloudy
4051	3/6/2011 12:30:00 PM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Wet	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
4107	12/27/2012 1:45:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
4226	10/20/2010 7:35:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4269	5/29/2009 5:50:00 AM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4288	8/10/2012 9:50:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4289	4/20/2012 9:22:00 PM	Dark - lighted roadway	Wild animal hit - damage	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage	Wild animal hit	Wild animal hit - damage	Wild animal hit - damage	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			only					only		only	only	
4290	11/16/2010 6:34:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4293	6/1/2010 8:00:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4302	10/15/2010 6:45:00 PM	Dusk	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4305	10/14/2011 11:50:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
4325	11/5/2009 5:35:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4327	1/31/2012 11:00:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4335	11/28/2010 5:40:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4342	11/5/2010 7:10:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4349	12/10/2009 9:00:00 AM	Daylight	No collision between 2 MV in transport	Tree/shrubbery	No injury	Frost	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Clear
4354	10/12/2010 6:06:00 PM	Daylight	Wild animal hit - damage	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage	Wild animal hit	Wild animal hit - damage	Wild animal hit - damage	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			only					only		only	only	
4374	11/6/2012 8:41:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4395	12/28/2012 6:45:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
4460	8/19/2012 9:50:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4474	6/1/2012 5:45:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Unknown	Cloudy
4475	1/6/2010 4:00:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Failure to keep in proper lane	Snow
4478	1/10/2011 12:47:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
4503	2/26/2011 11:23:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
4504	11/21/2010 1:35:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Other	Sleet, hail freezing rain or drizzle

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE'	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON'	DRIVERCO	WEATHER
4505	12/31/2011 6:13:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Delineator post	No injury	Frost	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
4507	1/31/2011 11:00:00 AM	Daylight	No collision between 2 MV in transport	Guardrail end	No injury	Snow	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Snow
4508	12/27/2010 3:34:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
4509	4/27/2012 3:15:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Cloudy
4512	9/2/2011 9:45:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Bridge rail	No injury	Dry	Non-junction	Straight ahead	None	None	Fatigued/as leep	Cloudy
4514	1/18/2010 10:00:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Wet	Interchang e area	Straight ahead	None	None	None	Fog, smog, smoke
4515	12/27/2012 1:20:00 PM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
4518	8/4/2010 5:45:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchang e area	Straight ahead	None	None	Running off road	Clear
4519	1/25/2011 10:26:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Other	Fog, smog, smoke
4522	8/9/2010 2:57:00 PM	Daylight	Sideswipe, same	Motor vehicle in	No injury	Dry	Interchang e area	Changing lanes	None	None	Improper lane	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
			direction	transport							change	
4525	8/13/2009 9:00:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Bridge rail	No injury	Dry	Interchange area	Straight ahead	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Cloudy

Interstate Segment – 10th Street Interchange Area SB

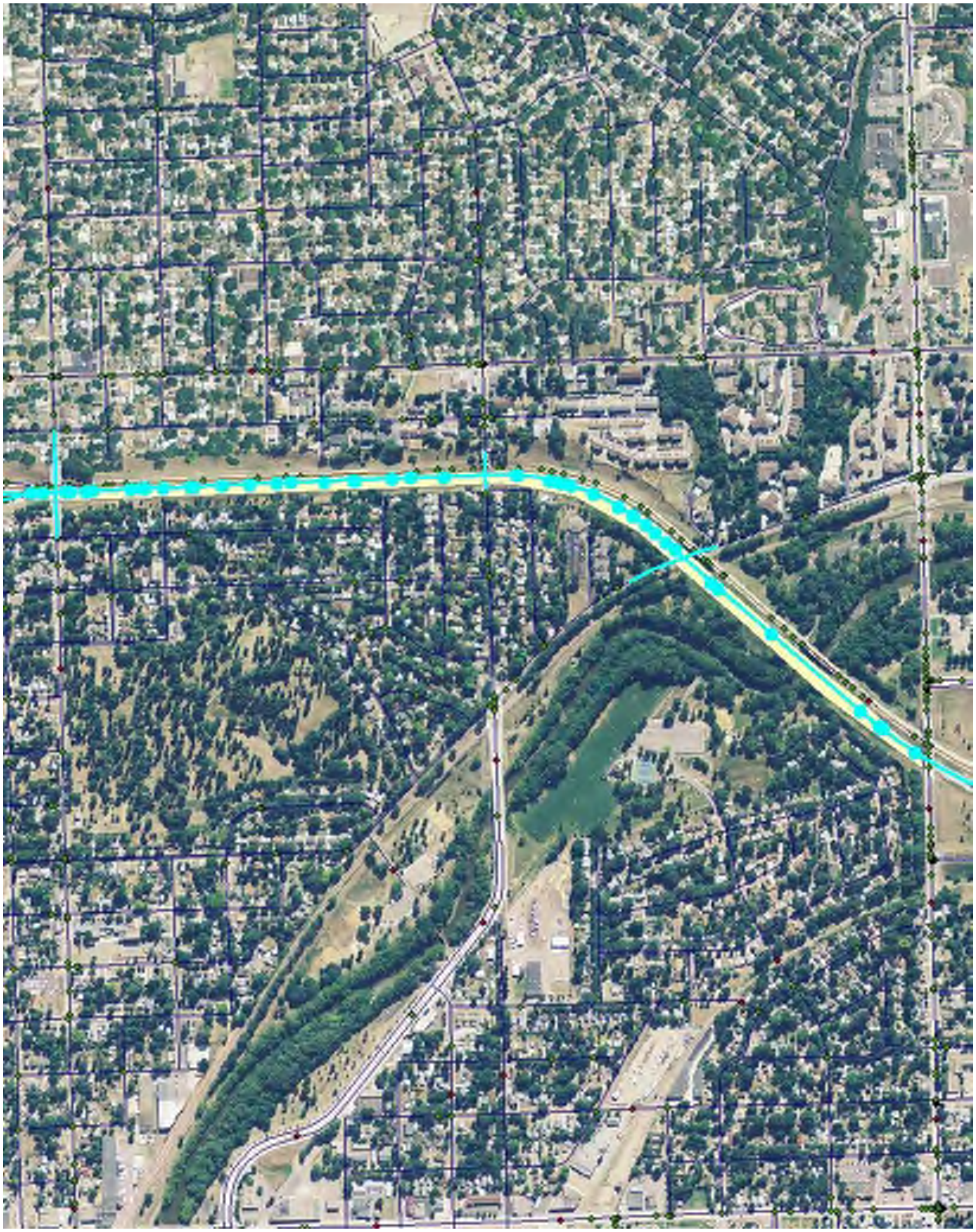
N

Crash Summary - 10th St. interchange area, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
3630	7/21/2010 5:36:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3288	2/6/2010 6:06:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
3350	12/28/2010 10:00:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	Non-incapacitating	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
3412	2/7/2010 7:10:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Ice	Interchange area	Straight ahead	None	None	None	Cloudy
3542	3/14/2011 7:40:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	Possible	Dry	Interchange area	Straight ahead	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Cloudy
3595	1/8/2010 12:20:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3778	2/1/2010 3:03:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Incapacitating	Ice	Interchange area	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
3819	2/6/2010 6:06:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
3830	2/26/2011 1:25:00 PM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Slush	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
3869	6/1/2010 11:56:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	Possible	Water standing, moving	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Rain
3870	2/6/2010 6:06:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
3889	2/1/2010 2:43:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
3947	1/24/2010 2:30:00 PM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
3972	3/7/2011 10:35:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	Possible	Wet	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
3990	12/29/2009 5:25:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Snow bank	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
3996	9/11/2012 1:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Stopped in traffic lane	None	None	Improper parking	Clear



Interstate Segment – 10th Street to 26th Street SB

Crash Summary - 10th to 26th, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2605	1/7/2010 9:36:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2627	1/7/2010 8:00:00 AM	Daylight	No collision between 2 MV in transport	Snow bank	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Clear
2628	11/29/2010 1:55:00 PM	Daylight	No collision between 2 MV in transport	Other post, pole, or support	No injury	Slush	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
2667	1/1/2011 1:15:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2674	1/10/2011 11:40:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2675	1/31/2011 10:45:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2692	12/7/2009 7:36:00 AM	Daylight	Angle	Motor vehicle in	No injury	Snow	Non-junction	Changing lanes	None	Non-contact	Driving too fast for	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
				transport						vehicle caused evasive action	conditions	
2698	3/9/2009 8:35:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Exceeded posted speed limit	Sleet, hail freezing rain or drizzle
2699	8/11/2010 10:45:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Non-junction	Straight ahead	None	None	Running off road	Clear
2701	12/30/2011 6:54:00 AM	Dark - roadway not lighted	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Slowing in traffic lane	None	Obstruction in roadway	None	Rain
2702	3/25/2011 10:51:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Non-junction	Straight ahead	None	None	Exceeded posted speed limit	Clear
2705	1/6/2010 9:35:00 PM	Dark - roadway not lighted	Angle	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
2706	7/5/2011 7:35:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Overtaking /passing	None	None	Improper passing	Clear
2708	1/9/2011 10:40:00 AM	Daylight	No collision between 2 MV in transport	Guardrail end	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2710	1/6/2010 4:20:00 PM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2711	1/10/2011 11:35:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2716	7/6/2010 12:40:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
2717	3/9/2011 6:54:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
2738	12/8/2009 7:43:00 AM	Daylight	No collision between 2 MV in transport	Rock	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2739	1/25/2010 11:45:00 AM	Daylight	No collision between 2 MV in transport	Other movable object	No injury	Wet	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Snow
2742	1/6/2010 9:10:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2743	1/31/2011 10:45:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2745	8/13/2012 4:57:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Water standing, moving	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow,	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
										slush, etc.		
2746	1/6/2010 2:25:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2747	2/1/2010 11:25:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2748	2/14/2011 7:56:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2752	12/7/2009 7:47:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2760	2/6/2010 5:29:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
2761	8/13/2012 4:43:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Possible	Wet	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
2834	1/13/2010 8:20:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow,	Driving too fast for conditions	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										slush, etc.		
2850	3/20/2012 2:15:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear
2854	12/2/2009 8:00:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2866	1/31/2011 10:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2869	7/17/2009 4:14:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	Cargo	None	Failure to keep in proper lane	Clear
2876	12/20/2012 7:54:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	Non-contact vehicle caused evasive action	Unknown	Clear
2889	7/17/2009 4:14:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2895	2/1/2011 9:40:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2915	1/9/2010 11:00:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2993	1/9/2010 11:10:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Frost	Non-junction	Slowing in traffic lane	None	None	None	Clear
3007	2/6/2010 5:15:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Snow
3008	11/21/2010 4:25:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Sleet, hail freezing rain or drizzle
3029	12/30/2009 8:25:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
3036	1/6/2010 3:30:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
3037	11/3/2010 4:45:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Failed to yield to vehicle	Clear
3039	12/28/2010 8:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
3066	4/15/2012	Daylight	Sideswipe,	Motor	No injury	Dry	Non-	Straight	None	None	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	2:40:00 PM		same direction	vehicle in transport			junction	ahead				
3070	12/7/2009 8:49:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Stopped in traffic lane	None	Other	None	Cloudy
3105	1/13/2011 9:50:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Ice	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Cloudy
3116	1/12/2011 11:30:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Ice	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
3236	8/10/2010 4:15:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
3240	11/17/2010 5:00:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
3274	4/8/2009 7:58:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Entering traffic lane	None	None	Failed to yield to vehicle	Clear
3275	1/13/2011 2:54:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Possible	Wet	Interchange area	Entering traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	Failure to keep in proper lane	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3276	11/13/2012 4:59:00 PM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchang e area	Changing lanes	None	None	Improper lane change	Clear

Interstate Segment – 26th Street Interchange Area SB ← N

Crash Summary - 26th St. interchange area, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2321	11/19/2011 10:15:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Interchange area	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
2335	11/19/2011 10:10:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Interchange area	Unknown	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle

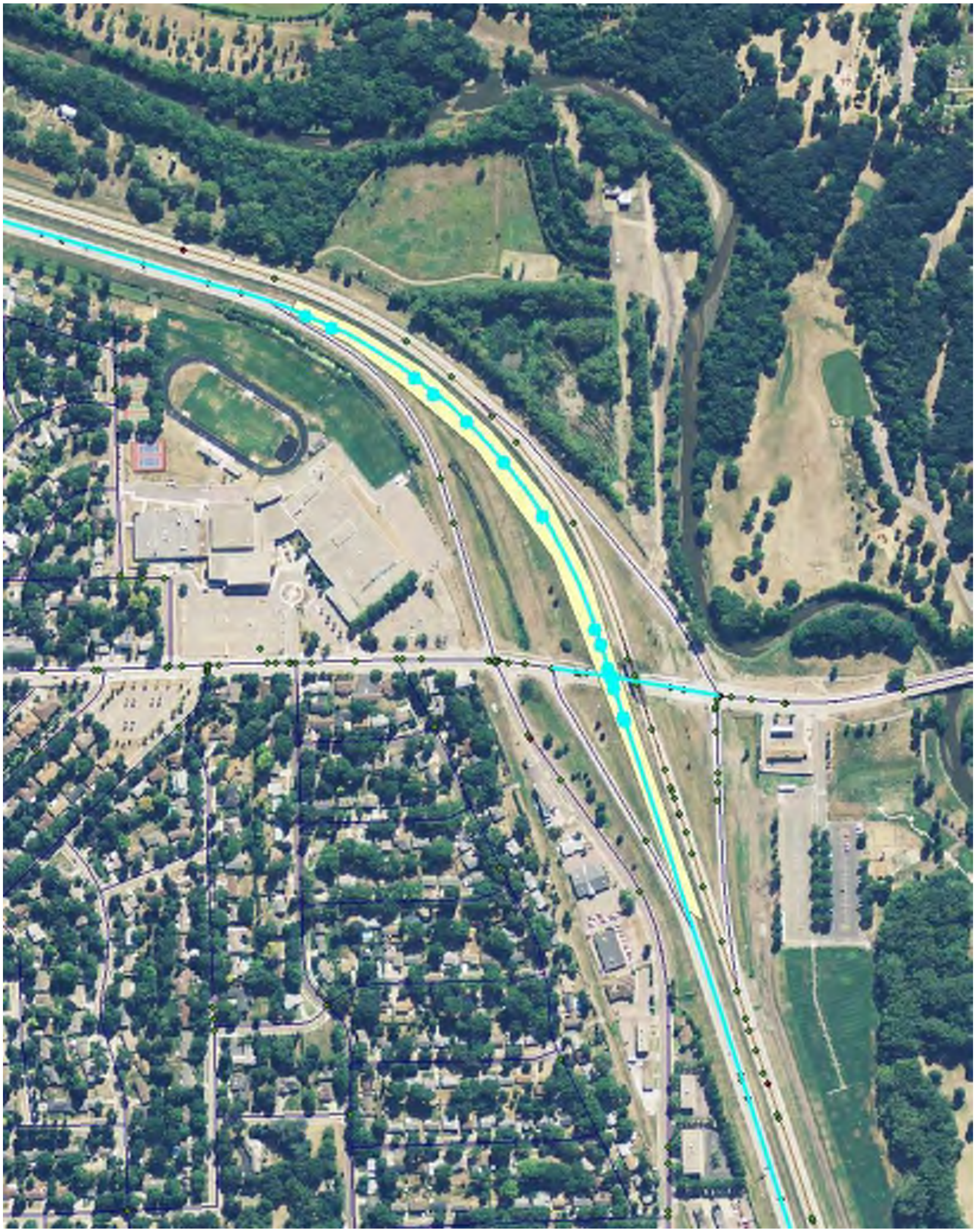
Interstate Segment – 26th Street to Cliff Avenue SB

N

Crash Summary - 26th to Cliff, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2106	1/20/2012 7:25:00 AM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Failure to keep in proper lane	Snow
2115	12/9/2012 5:01:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	Non-incapacitating	Snow	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Cloudy
2167	2/1/2011 11:35:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2210	5/13/2011 10:45:00 AM	Daylight	No collision between 2 MV in transport	Other non-collision	No injury	Dry	Non-junction	Straight ahead	Body, doors, hood	None	None	Clear
2253	11/15/2012 8:15:00 AM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
2260	12/27/2010 8:39:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2261	10/12/2009 6:22:00 PM	Dusk	No collision between 2 MV in transport	Fence	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Running off road	Cloudy
2276	5/5/2011 3:45:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
2281	11/29/2010	Daylight	Angle	Motor	No injury	Snow	Non-	Straight	None	Road	Driving too	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	4:00:00 PM			vehicle in transport			junction	ahead		surface condition wet, icy, snow, slush, etc.	fast for conditions	
2290	4/10/2012 9:59:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
2291	12/20/2012 7:25:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Straight ahead	None	None	None	Cloudy



Interstate Segment – Cliff Avenue Interchange Area SB

N

Crash Summary - Cliff Ave. interchange area, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1973	1/9/2011 10:45:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	Possible	Snow	Interchange area	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
1892	1/7/2010 2:40:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
1893	4/9/2010 6:01:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
1896	2/15/2010 10:02:00 AM	Daylight	No collision between 2 MV in transport	Snow bank	No injury	Frost	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
1897	11/29/2010 2:03:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	Non-incapacitating	Ice	Interchange area	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Improper lane change	Sleet, hail freezing rain or drizzle
1898	10/22/2009 3:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Other electronic device list in narrative	Cloudy
1899	2/26/2011 11:50:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Cloudy
1901	1/20/2010 4:50:00 AM	Dark - lighted	No collision between 2	Guardrail face	Non-incapacitati	Ice	Interchange area	Straight ahead	None	Road surface	Driving too fast for	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
		roadway	MV in transport		ng					condition wet, icy, snow, slush, etc.	conditions	
1902	7/26/2012 10:50:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchang e area	Straight ahead	None	None	Running off road	Clear
1905	2/9/2010 7:03:00 AM	Dawn	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchang e area	Straight ahead	None	Other	None	Clear
1908	12/24/2009 8:50:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
1909	4/2/2010 6:53:00 AM	Dawn	No collision between 2 MV in transport	Bridge rail	Possible	Dry	Interchang e area	Straight ahead	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
1910	1/9/2011 3:35:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Snow
1911	1/11/2011 12:34:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1913	7/29/2009	Daylight	Wild	Animal -	Wild	Wet	Non-	Wild	Wild	Wild	Wild	Rain

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	6:15:00 PM		animal hit - damage only	wild	animal hit		junction	animal hit - damage only	animal hit	animal hit - damage only	animal hit - damage only	
1914	11/18/2011 3:10:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1915	2/23/2012 2:50:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Slush	Interchange area	Straight ahead	None	None	Running off road	Snow
1937	12/24/2009 9:50:00 AM	Daylight	No collision between 2 MV in transport	Guardrail end	Possible	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2000	1/24/2010 4:07:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Snow
2008	12/14/2012 3:20:00 PM	Daylight	No collision between 2 MV in transport	Other non-collision	No injury	Dry	Non-junction	Straight ahead	Tires	None	None	Cloudy
2011	9/12/2010 4:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Exceeded posted speed limit	Clear
2067	11/29/2010 1:45:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2086	2/13/2012 8:22:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow

Interstate Segment – Cliff Avenue to Minnesota Avenue SB

N

Crash Summary - Cliff to Minnesota, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1325	1/11/2011 11:15:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Over-correcting/over-steering	Clear
1326	1/11/2011 12:50:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1390	7/1/2012 3:25:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1392	6/20/2011 5:00:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Failure to keep in proper lane	Cloudy
1394	11/28/2012 7:05:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	None	Clear
1397	5/18/2012 7:26:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1400	12/26/2010 1:29:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
1412	5/16/2009 5:15:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1476	1/10/2011 2:00:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy,	Running off road	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
										snow, slush, etc.		
1507	1/7/2010 1:39:00 PM	Daylight	No collision between 2 MV in transport	Snow bank	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Blowing snow

Interstate Segment – Minnesota Avenue Interchange Area SB

N

Crash Summary - Minnesota Ave. interchange area, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1152	2/20/2011 1:17:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
1153	11/27/2012 9:30:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchang e area	Changing lanes	None	None	Failed to yield to vehicle	Cloudy
1171	10/25/2009 5:11:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Highway traffic sign post/sign	Non-incapacitati ng	Dry	Interchang e area	Straight ahead	None	None	Drinking	Clear
1177	12/28/2012 7:39:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1178	11/8/2011 2:00:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchang e area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1179	6/18/2011 6:55:00 PM	Daylight	No collision between 2 MV in transport	Other non-collision	No injury	Dry	Interchang e area	Straight ahead	Body, doors, hood	None	None	Clear
1183	12/7/2009 7:30:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
1184	5/5/2009 4:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitati ng	Dry	Interchang e area	Straight ahead	None	None	None	Clear
1192	1/9/2011 12:29:00	Daylight	Rear-end front to	Motor vehicle in	No injury	Snow	Interchang e area	Straight ahead	None	Road surface	Other	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	PM		rear	transport						condition wet, icy, snow, slush, etc.		
1197	2/26/2011 9:28:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Over-correcting/o ver-steering	Snow
1209	1/1/2011 10:15:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1210	1/9/2011 1:39:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Snow	Interchang e area	Slowing in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1211	7/19/2010 12:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
1212	10/8/2010 10:54:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Dry	Interchang e area	Straight ahead	None	Unknown	Running off road	Clear
1216	1/1/2011 12:40:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1217	1/24/2010 3:30:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1218	6/12/2012	Daylight	Rear-end	Motor	No injury	Dry	Interchang	Slowing in	None	None	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	8:45:00 AM		front to rear	vehicle in transport			e area	traffic lane				
1220	1/9/2011 1:19:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
1267	1/31/2011 7:37:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/r ollover	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1285	8/3/2011 8:30:00 PM	Dusk	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchang e area	Changing lanes	None	None	Improper lane change	Clear
1288	2/9/2011 1:40:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Delineator post	No injury	Dry	Interchang e area	Straight ahead	None	None	Drinking	Clear
1304	6/12/2012 8:11:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear

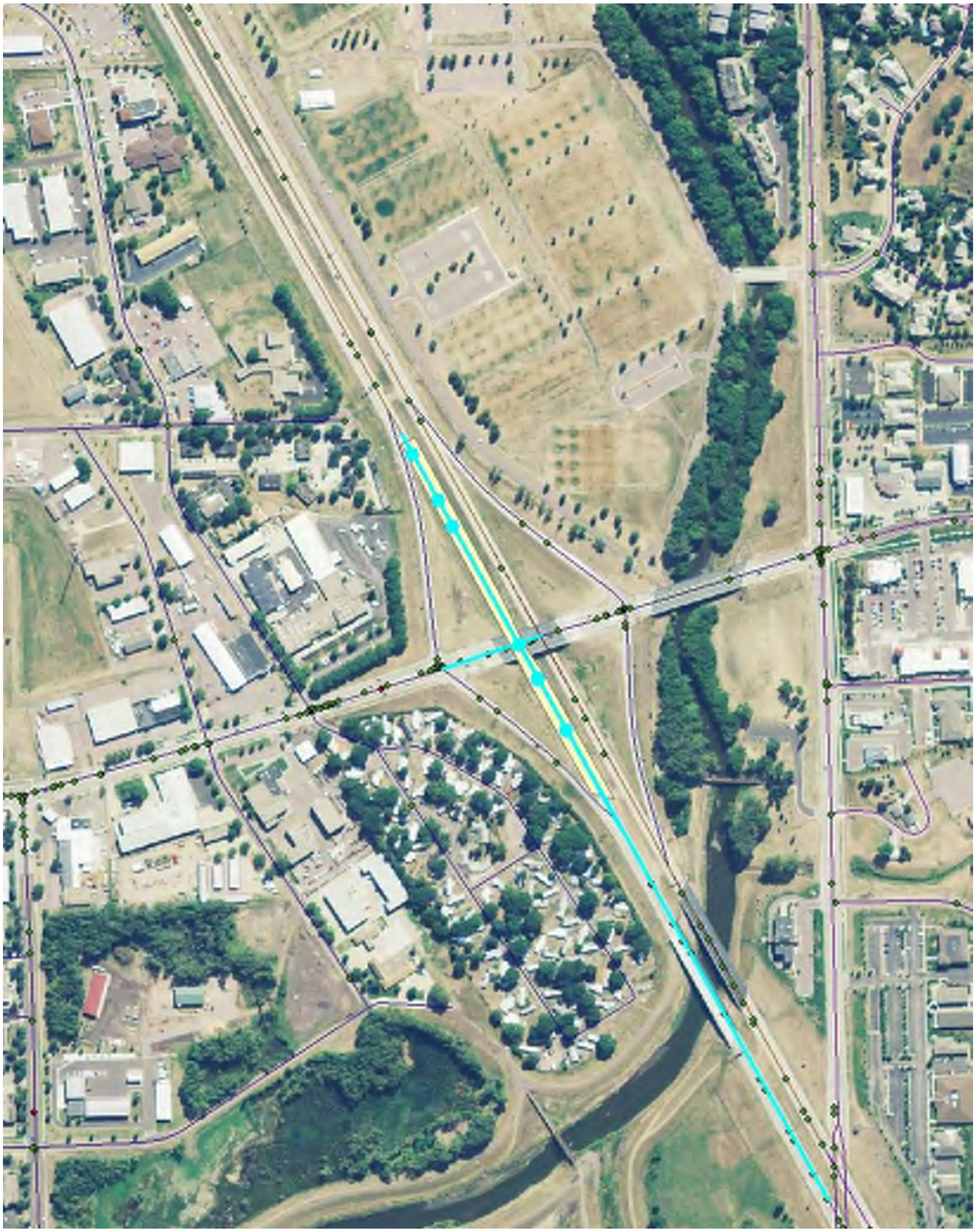
Interstate Segment – Minnesota Avenue to Western Avenue SB

N

Crash Summary - Minnesota to Western SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
888	12/8/2009 4:15:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
896	9/29/2009 9:31:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	Other	None	Clear
900	10/31/2011 4:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
1040	2/2/2012 6:25:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
1051	12/7/2012 7:24:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	None	Sleet, hail freezing rain or drizzle
1062	12/7/2009 7:30:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
1106	11/4/2009 3:18:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Other	Clear
1113	1/1/2011 12:45:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1114	2/17/2010 4:10:00 PM	Daylight	Angle	Motor vehicle in	Incapacitat ing	Dry	Non-junction	Changing lanes	None	None	Improper lane	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
				transport							change	
1127	1/21/2012 9:30:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Blowing snow
1128	2/18/2011 7:30:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear
1130	10/31/2010 3:56:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Non-junction	Straight ahead	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear

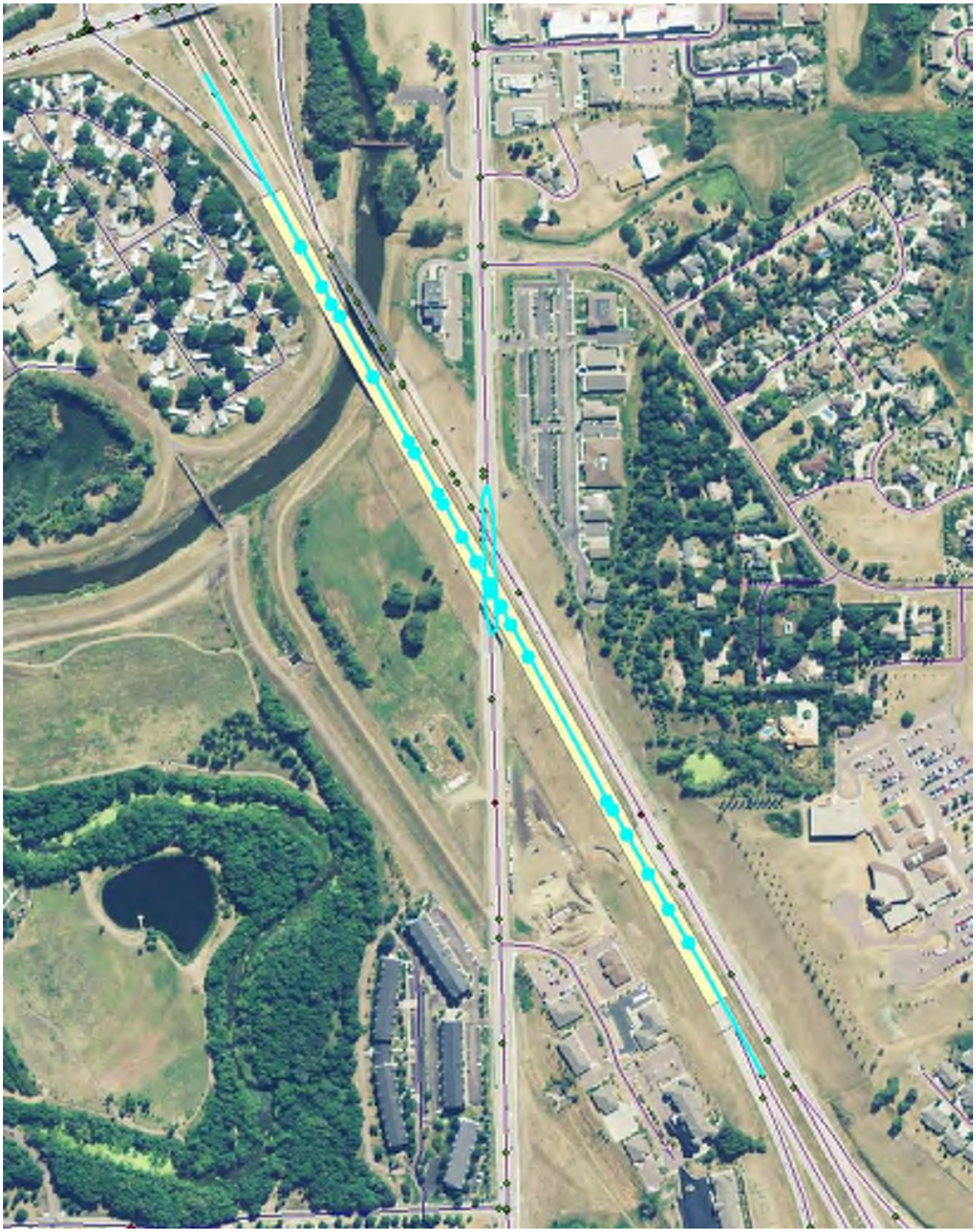


Interstate Segment – Western Avenue Interchange Area SB ← N

Crash Summary - Western Ave. interchange area, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
867	1/9/2011 12:13:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Possible	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Unknown	Cloudy
812	11/1/2011 5:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Slowing in traffic lane	None	Work zone construction/maintenance/utility	None	Clear
821	2/6/2010 5:12:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
822	2/26/2011 11:30:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Snow	Interchange area	Stopped in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
832	2/1/2010 10:19:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
853	1/31/2011 10:52:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Interchange area	Straight ahead	None	Other	Driving too fast for conditions	Snow
882	2/25/2010 12:55:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Dry	Interchange area	Straight ahead	None	Non-contact vehicle caused evasive action	Swerving or avoiding due to wind, slippery surface,	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
											vehicle, object, non-motorist, etc.	



Interstate Segment – Western Avenue to Louise Avenue SB

N

Crash Summary - Western to Louise SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
373	11/11/2010 6:42:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
378	8/7/2010 11:00:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Jackknife	No injury	Dry	Non-junction	Straight ahead	Truck coupling / trailer hitch / safety chains	None	Other	Clear
379	8/7/2010 11:00:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
381	2/5/2010 1:54:00 AM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	No injury	Slush	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Sleet, hail freezing rain or drizzle
382	12/6/2012 1:22:00 PM	Daylight	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	Debris	None	Cloudy
323	10/11/2012 4:49:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
361	10/4/2010 5:20:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Slowing in traffic lane	None	None	None	Clear
362	12/4/2010 12:30:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
481	2/1/2010 11:07:00	Daylight	No collision between 2	Delineator post	No injury	Snow	Non-junction	Straight ahead	None	Non-contact	None	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	AM		MV in transport							vehicle caused evasive action		
572	12/31/2011 5:40:00 AM	Dark - roadway not lighted	Angle	Motor vehicle in transport	No injury	Frost	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
592	12/31/2011 5:40:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Overturn/rollover	Possible	Frost	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
593	1/9/2011 5:00:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
605	1/31/2011 2:40:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
606	1/9/2011 1:19:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	Non-incapacitating	Snow	Non-junction	Straight ahead	None	None	None	Cloudy
607	12/3/2011 2:57:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Wet	Non-junction	Straight ahead	None	None	None	Cloudy
608	6/7/2012 5:38:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
613	12/27/2012 1:33:00 PM	Daylight	No collision between 2 MV in	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition	None	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
			transport							wet, icy, snow, slush, etc.		
627	1/10/2011 1:28:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Snow	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Cloudy
683	8/30/2011 9:11:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	None	None	Cloudy
698	1/7/2010 12:48:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
727	9/23/2009 4:55:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
754	11/9/2010 2:11:00 PM	Daylight	No collision between 2 MV in transport	Fence	No injury	Dry	Non-junction	Straight ahead	Truck coupling / trailer hitch / safety chains	None	Other	Clear
755	12/9/2009 10:00:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
768	12/8/2009 11:06:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
776	2/20/2011	Daylight	No collision	Guardrail	No injury	Slush	Non-	Straight	None	Road	Over-	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	11:45:00 AM		between 2 MV in transport	face			junction	ahead		surface condition wet, icy, snow, slush, etc.	correcting/over-steering	
778	6/28/2010 4:00:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
784	2/26/2011 11:20:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
785	10/24/2011 2:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
786	5/4/2010 5:14:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Non-junction	Straight ahead	None	None	Unknown	Clear

Interstate Segment – Louise Avenue Interchange Area SB

N

Crash Summary - Louise Ave. interchange area, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
159	5/11/2012 2:14:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Culvert	No injury	Dry	Interchange area	Straight ahead	None	None	Wrong side or wrong way	Clear
165	9/29/2009 9:24:00 AM	Daylight	No collision between 2 MV in transport	Fire/explosion	No injury	Dry	Interchange area	Straight ahead	Unknown	None	None	Clear
192	11/29/2010 1:45:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
194	10/11/2012 5:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Cloudy
200	6/14/2011 7:10:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Cloudy
212	8/14/2009 12:58:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
302	9/18/2012 8:25:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear

Interstate Segment – Louise Avenue to I-29 SB

N

Crash Summary - Louise Ave. to I-29, SB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
100	10/8/2012 7:01:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Fence	No injury	Dry	Non-junction	Straight ahead	None	None	Running off road	Clear
101	1/6/2011 6:35:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
102	11/24/2010 11:14:00 AM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Wet	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
103	11/22/2012 10:00:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
104	2/17/2010 8:09:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Slowing in traffic lane	None	None	None	Clear
114	10/19/2010 7:18:00 AM	Dawn	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Stopped in traffic lane	None	None	None	Clear
116	9/11/2012 7:46:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
119	11/9/2009 6:35:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
130	10/4/2010 11:55:00 AM	Daylight	No collision between 2 MV in transport	Construction - pavement cutout/road materials	Possible	Dry	Non-junction	Straight ahead	None	Work zone construction/maintenance/utility	Illegally in roadway	Clear
131	11/3/2011 9:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
136	11/12/2010 9:10:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	Obstruction in roadway	None	Clear
137	12/29/2010 5:15:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
145	10/15/2010 8:12:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
152	6/9/2011 5:33:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	None	Cloudy

Interstate Segment – I-29 to Louise Avenue NB

N

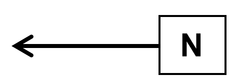
Crash Summary - I-29 to Louise Ave., NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
83	9/22/2012 3:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
86	6/21/2010 7:30:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
87	10/22/2010 6:15:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
94	2/3/2011 8:30:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
96	6/23/2009 12:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Cloudy
97	1/22/2010 10:50:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
108	8/16/2012 2:30:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
110	11/4/2009 6:20:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
111	1/19/2010 5:43:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Delineator post	Possible	Wet	Non-junction	Changing lanes	None	None	Running off road	Cloudy
112	6/6/2009 8:50:00 AM	Daylight	No collision between 2	Highway traffic sign	No injury	Wet	Non-junction	Straight ahead	None	Road surface	Other	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			MV in transport	post/sign						condition wet, icy, snow, slush, etc.		
113	7/13/2009 3:45:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
115	10/7/2012 8:04:00 AM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
117	7/27/2010 9:35:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Overturn/rollover	No injury	Wet	Non-junction	Straight ahead	Tires	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
121	3/22/2009 2:20:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
122	6/21/2010 7:59:00 AM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Wet	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Rain
123	10/22/2010 6:40:00 AM	Dark - roadway not lighted	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Failed to yield to vehicle	Clear
124	1/17/2012 8:45:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
134	11/27/2011 12:30:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
147	11/29/2010 2:00:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Snow	Non-junction	Overtaking /passing	None	Road surface condition wet, icy,	Driving too fast for conditions	Blowing snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										snow, slush, etc.		

Interstate Segment – Louise Avenue Interchange Area NB



Crash Summary - Louise Ave. interchange area, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
149	10/7/2011 8:15:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
155	11/10/2009 8:54:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
157	7/2/2011 3:05:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
160	10/20/2009 7:20:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
191	10/4/2010 5:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	Work zone construction/maintenance/utility	None	Clear
199	1/16/2010 5:06:00 PM	Dusk	Sideswipe, same direction	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
201	2/7/2010 6:15:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Snow bank	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle,	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
											object, non-motorist, etc.	
202	6/28/2012 7:35:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear

Interstate Segment – Louise Avenue to Western Avenue NB ← N

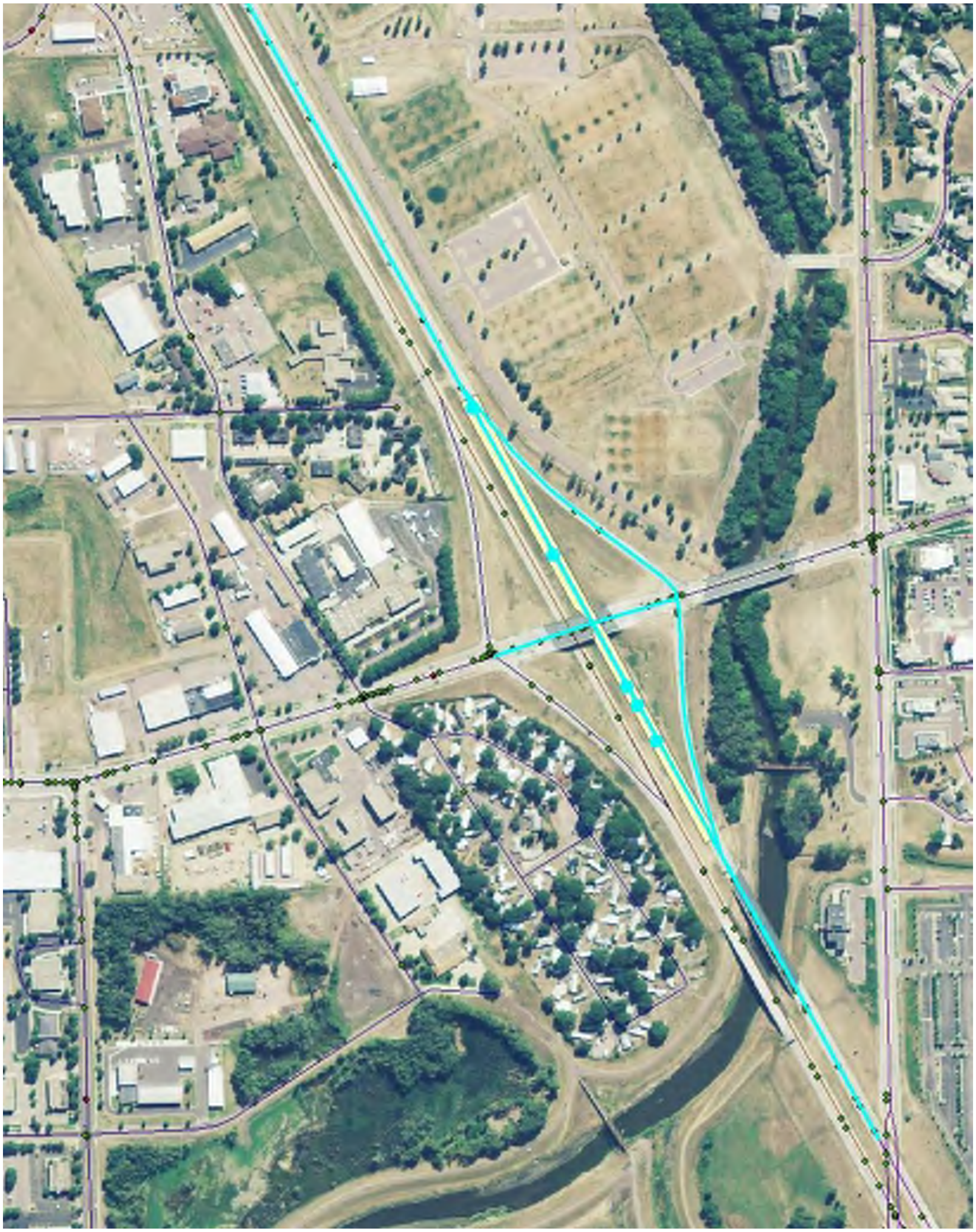
Crash Summary - Louise to Western, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
292	7/4/2011 12:00:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Changing lanes	None	None	Improper lane change	Clear
295	3/30/2010 8:54:00 AM	Daylight	No collision between 2 MV in transport	Other fixed object wall, building, tunnel, etc.	Incapacitating	Dry	Non-junction	Straight ahead	None	None	Illness heart attack, stroke, etc.	Clear
300	6/28/2012 5:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
306	11/24/2012 3:20:00 PM	Daylight	No collision between 2 MV in transport	Fire/explosion	No injury	Dry	Non-junction	Straight ahead	Other	None	None	Clear
307	11/17/2012 5:40:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Animal in roadway	Wild animal hit - damage only	Clear
326	7/24/2009 6:45:00 AM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
332	6/21/2010 8:59:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	None	Cloudy
369	5/29/2011 10:15:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Animal - wild	Possible	Wet	Non-junction	Straight ahead	None	Animal in roadway	None	Rain
507	8/10/2009 5:20:00 PM	Daylight	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
616	1/31/2011 3:08:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy,	Driving too fast for conditions	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										snow, slush, etc.		
641	12/8/2009 3:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
642	12/7/2009 8:50:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
688	1/19/2011 7:10:00 AM	Dawn	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
691	1/11/2011 7:49:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
731	8/10/2009 5:20:00 PM	Daylight	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
758	12/9/2009 6:50:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
759	6/15/2011 5:03:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
762	12/8/2009 10:15:00 AM	Daylight	No collision between 2 MV in	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition	Driving too fast for conditions	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			transport							wet, icy, snow, slush, etc.		
766	12/9/2009 6:45:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
769	12/7/2009 9:18:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
771	2/17/2010 4:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Slowing in traffic lane	None	None	None	Clear
774	1/8/2010 8:40:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
779	9/16/2009 6:32:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
780	10/11/2009 10:09:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Snow
781	10/11/2009 10:03:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Fence	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy,	Running off road	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										snow, slush, etc.		
782	11/7/2010 11:50:00 AM	Daylight	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
783	1/19/2011 6:30:00 AM	Daylight	No collision between 2 MV in transport	Snow bank	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear



Interchange Segment – Western Avenue Interchange Area NB

N

Crash Summary - Western Ave. interchange area, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
804	12/7/2009 8:56:00 AM	Daylight	No collision between 2 MV in transport	Parked motor vehicle	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
808	1/1/2010 12:54:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Pedestrian	Possible	Dry	Interchange area	Straight ahead	None	Pedestrian, bicyclist, other non-occupants in road	Drinking	Clear
810	12/16/2010 4:58:00 AM	Dark - unknown roadway lighting	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Changing lanes	None	None	Driving too fast for conditions	Cloudy
840	4/29/2009 2:15:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	None	Cloudy
879	7/27/2010 11:25:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Fence	No injury	Wet	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Rain

Interstate Segment – Western Avenue to Minnesota Avenue NB

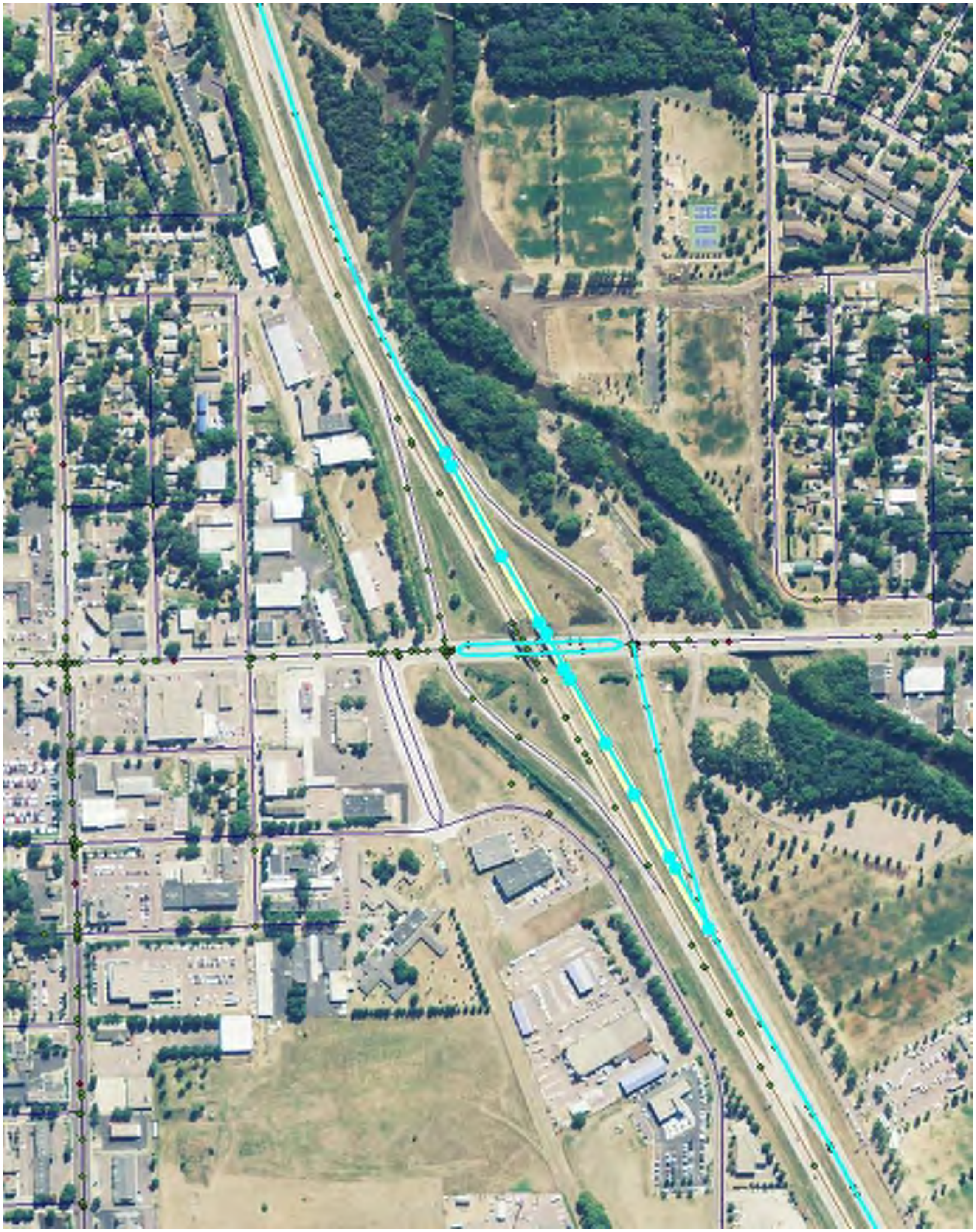
N

Crash Summary - Western to Minnesota, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
884	11/29/2012 3:16:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	None	Clear
890	1/4/2010 8:30:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Cloudy
891	7/23/2010 10:29:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	Possible	Dry	Non-junction	Changing lanes	None	Non-contact vehicle caused evasive action	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
960	1/6/2010 3:20:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Snow	Non-junction	Slowing in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
964	6/30/2010 9:13:00 AM	Daylight	No collision between 2 MV in transport	Fence	No injury	Dry	Non-junction	Straight ahead	None	None	Running off road	Clear
976	10/19/2011 7:55:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Failed to yield to vehicle	Clear
994	9/17/2012 4:05:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
997	1/6/2010 3:10:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow,	Driving too fast for conditions	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
										slush, etc.		
1000	6/15/2012 2:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Failed to yield to vehicle	Clear
1027	12/8/2009 3:45:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1028	11/15/2009 12:25:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1033	1/13/2010 7:15:00 AM	Dawn	No collision between 2 MV in transport	Snow bank	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
1034	7/10/2010 1:59:00 AM	Dark - lighted roadway	Head-on front to front	Motor vehicle in transport	Fatal injury	Dry	Non-junction	Changing lanes	None	None	Wrong side or wrong way	Clear
1035	9/26/2011 3:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Slowing in traffic lane	None	None	None	Clear
1041	6/15/2012 3:24:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
1042	7/10/2010 1:59:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	Debris	None	Clear
1049	2/17/2010 4:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	None	Clear
1050	1/31/2011 9:38:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow,	Running off road	Snow

OBJE(	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE'	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON'	DRIVERCO	WEATHER
										slush, etc.		
1061	1/21/2011 7:55:00 AM	Dawn	No collision between 2 MV in transport	Snow bank	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Failure to keep in proper lane	Cloudy
1121	10/11/2011 7:28:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	Brakes	None	None	Clear
1122	4/6/2012 9:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
1123	6/15/2012 3:11:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Failed to yield to vehicle	Clear



Interstate Segment – Minnesota Avenue Interchange Area NB ⟵ **N**

Crash Summary - Minnesota Ave. interchange area, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1126	10/19/2012 1:17:00 PM	Daylight	No collision between 2 MV in transport	Impact attenuator/ crash cushion	Incapacitating	Dry	Interchange area	Straight ahead	None	None	Running off road	Cloudy
1144	1/17/2011 4:11:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Slush	Interchange area	Straight ahead	None	None	None	Sleet, hail freezing rain or drizzle
1147	1/3/2011 6:20:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Other movable object	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
1163	12/7/2011 5:12:00 PM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	Incapacitating	Dry	Interchange area	Changing lanes	None	None	Improper lane change	Clear
1173	4/14/2012 6:30:00 AM	Dawn	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1181	2/28/2012 9:00:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Interchange area	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
1185	1/21/2012 1:10:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
1186	2/23/2012 10:46:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1191	1/10/2011	Daylight	Rear-end	Motor	No injury	Ice	Interchang	Straight	None	Other	Driving too	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	1:10:00 PM		front to rear	vehicle in transport			e area	ahead			fast for conditions	
1196	3/4/2012 11:02:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Wet	Interchang e area	Straight ahead	Tires	Road surface condition wet, icy, snow, slush, etc.	None	Snow
1223	4/15/2009 11:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	Work zone constructio n/maintena nce/utility	None	Clear
1239	5/16/2010 6:24:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	None	Clear
1240	2/18/2012 1:20:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Other movable object	No injury	Dry	Interchang e area	Straight ahead	None	Debris	None	Clear
1259	7/7/2009 4:19:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear

Interstate Segment – Minnesota Avenue to Cliff Avenue NB

N

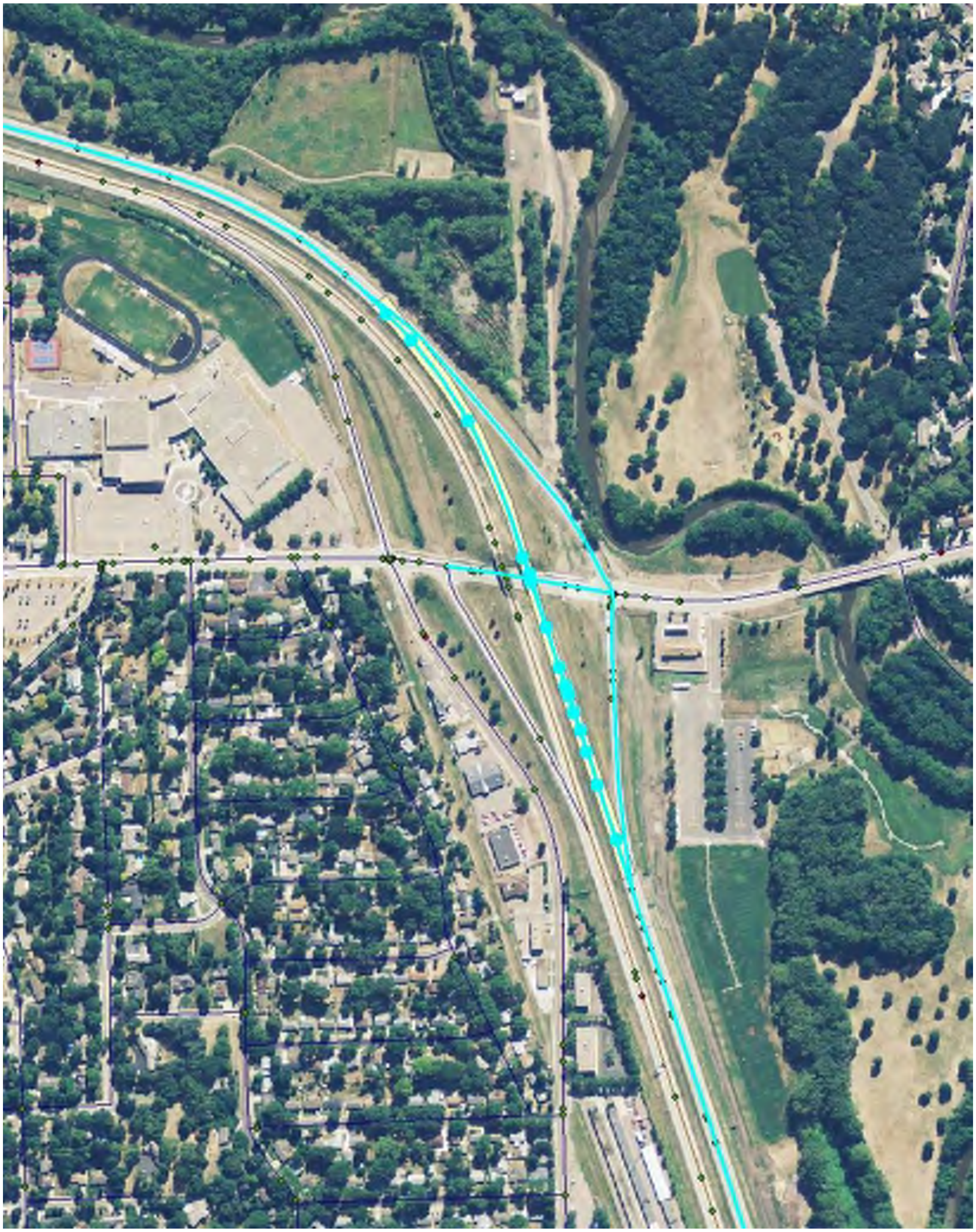
Crash Summary - Minnesota to Cliff NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1313	6/27/2009 1:20:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Wet	Non-junction	Straight ahead	Tires	Road surface condition wet, icy, snow, slush, etc.	Unknown	Rain
1315	2/18/2012 1:25:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	Debris	None	Clear
1323	2/9/2010 8:14:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
1327	8/12/2009 2:30:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Failed to yield to vehicle	Clear
1328	1/20/2012 6:55:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
1331	7/13/2011 10:45:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	Debris	None	Clear
1332	12/28/2011 9:17:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Other non-collision	No injury	Dry	Non-junction	Straight ahead	Power train	None	None	Clear
1307	2/18/2012 1:25:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	Debris	None	Clear
1335	6/15/2012	Daylight	Rear-end	Motor	No injury	Dry	Non-	Straight	None	None	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	5:50:00 PM		front to rear	vehicle in transport			junction	ahead				
1342	7/7/2009 4:56:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Slowing in traffic lane	None	None	None	Clear
1343	1/6/2010 3:30:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1344	10/1/2010 6:45:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1345	8/17/2011 9:15:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Dry	Non-junction	Straight ahead	Truck coupling / trailer hitch / safety chains	None	None	Clear
1348	5/10/2010 6:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	None	Cloudy
1359	7/19/2010 4:55:00 PM	Daylight	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	Debris	None	Clear
1363	1/6/2010 2:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Ice	Non-junction	Slowing in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Cloudy
1395	6/21/2012 4:52:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Slowing in traffic lane	None	None	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1396	7/23/2011 9:45:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1398	5/16/2009 12:27:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Over-correcting/over-steering	Clear
1399	11/29/2010 1:58:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Sleet, hail freezing rain or drizzle
1415	11/22/2010 8:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
1416	5/5/2009 5:20:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	None	Clear
1423	7/31/2009 3:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Incapacitating	Dry	Non-junction	Straight ahead	None	None	Failed to yield to vehicle	Clear
1426	11/29/2010 2:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Snow	Non-junction	Straight ahead	None	None	None	Snow
1431	11/15/2012 5:39:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
1433	8/9/2012 5:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Stopped in traffic lane	None	None	None	Clear
1550	7/8/2010 5:31:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
1551	11/22/2010 8:18:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Slush	Interchange area	Straight ahead	None	Road surface condition	Followed too closely	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										wet, icy, snow, slush, etc.		



Interstate Segment – Cliff Avenue Interchange Area NB

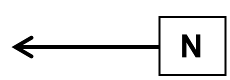
Crash Summary - Cliff Ave. interchange area, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1671	6/16/2012 3:01:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1744	12/24/2009 10:00:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
1949	9/23/2010 11:05:00 AM	Daylight	No collision between 2 MV in transport	Fence	No injury	Wet	Interchange area	Straight ahead	None	Other	Over-correcting/over-steering	Rain
1840	12/27/2012 11:54:00 AM	Daylight	No collision between 2 MV in transport	Tree/shrubbery	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1851	2/3/2010 4:15:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Delineator post	No injury	Wet	Interchange area	Straight ahead	None	None	Fatigued/asleep	Cloudy
1861	4/10/2010 4:01:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	Debris	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
1862	3/15/2012 10:51:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchange area	Straight ahead	None	None	Drinking	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1866	1/31/2011 12:45:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
1869	6/16/2012 3:01:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Slowing in traffic lane	None	None	None	Clear
1872	1/6/2010 9:05:00 AM	Daylight	No collision between 2 MV in transport	Snow bank	No injury	Snow	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Snow
1878	5/4/2010 5:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Cloudy
1881	1/21/2012 9:40:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Interchange area	Straight ahead	None	None	None	Snow
1887	9/17/2010 4:06:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
1888	1/11/2011 5:28:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1889	11/29/2010 1:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchange area	Stopped in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
1890	4/15/2009 11:35:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	Work zone construction/maintenance/utility	None	Clear
1891	3/7/2011 10:35:00	Daylight	No collision between 2	Guardrail face	No injury	Snow	Interchange area	Straight ahead	None	None	Driving too fast for	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	AM		MV in transport								conditions	
1925	1/17/2010 2:43:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Overturn/rollover	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1995	3/11/2010 10:07:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Slush	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow

Interstate Segment – Cliff Avenue to 26th Street NB

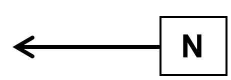


Crash Summary - Cliff Ave. to 26th St., NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2004	12/27/2012 11:40:00 AM	Daylight	No collision between 2 MV in transport	Fence	No injury	Snow	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2014	3/31/2010 12:16:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
2015	6/10/2010 1:01:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Running off road	Clear
2098	5/30/2012 8:31:00 PM	Dusk	Wild animal hit - damage only	Animal - wild	No injury	Wet	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
2208	12/20/2009 10:20:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	None	Cloudy
2216	6/9/2010 1:30:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
2262	7/1/2010 5:15:00 AM	Dawn	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
2267	5/17/2010 5:52:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
2268	12/2/2009 7:34:00 PM	Dark - roadway not lighted	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	None	None	Snow
2269	5/17/2010 5:17:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2270	6/15/2010	Daylight	Rear-end	Motor	Possible	Dry	Interchang	Straight	None	None	Followed	Clear

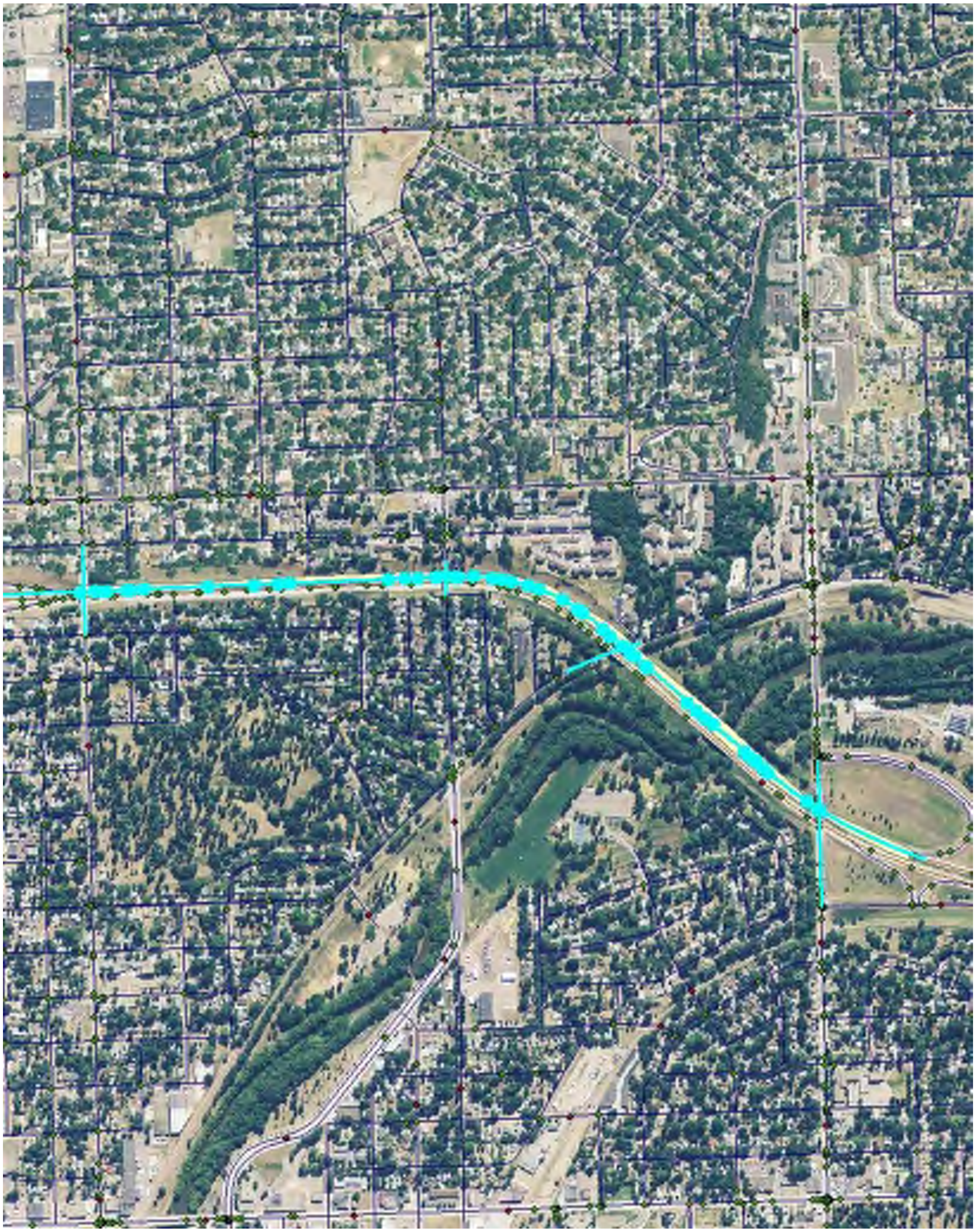
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	5:16:00 PM		front to rear	vehicle in transport			e area	ahead			too closely	

Interstate Segment – 26th Street Interchange Area NB



Crash Report - 26th St. interchange area, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2271	6/15/2010 5:17:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
2273	10/12/2012 9:40:00 AM	Daylight	No collision between 2 MV in transport	Parked motor vehicle	No injury	Dry	Non-junction	Backing	None	None	Improper backing	Clear
2285	1/7/2010 9:35:00 AM	Daylight	No collision between 2 MV in transport	Light/luminaire support	No injury	Snow	Interchange area	Straight ahead	Steering	Road surface condition wet, icy, snow, slush, etc.	Running off road	Blowing snow
2292	2/9/2010 5:26:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle



Interstate Segment – 26th Street to 10th Street NB

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Crash Summary - 26th St. to 10th St., NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2469	12/2/2009 7:45:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Snow
2517	12/7/2009 8:00:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Cloudy
2606	10/30/2009 10:55:00 PM	Dark - roadway not lighted	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
2607	4/28/2011 2:14:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	Non-incapacitating	Wet	Non-junction	Straight ahead	None	None	Drinking	Cloudy
2631	12/27/2010 8:53:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	Non-incapacitating	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2634	12/8/2009 3:46:00 PM	Daylight	No collision between 2 MV in transport	Tree/shrubbery	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
2635	12/31/2011 4:35:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Guardrail face	No injury	Frost	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Clear
2637	1/19/2011 6:44:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy,	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										snow, slush, etc.		
2640	1/29/2011 11:05:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Cloudy
2653	12/31/2011 6:35:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Ice	Non-junction	Straight ahead	None	Other	None	Cloudy
2657	6/18/2011 4:41:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
2659	12/7/2009 6:45:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2666	1/6/2010 2:54:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Snow
2670	1/10/2011 8:36:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Incapacitating	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2671	1/19/2011 8:30:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Non-junction	Stopped in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
2676	7/6/2012 10:00:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Failure to keep in proper lane	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2677	1/7/2010 11:55:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Blowing snow
2678	2/15/2010 7:25:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Frost	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2685	12/8/2009 3:43:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2686	1/10/2011 12:20:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	Possible	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Snow
2688	3/10/2009 3:53:00 PM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2689	12/9/2009 6:51:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2690	7/28/2011	Daylight	No collision	Other	No injury	Dry	Non-	Straight	None	None	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	2:00:00 PM		between 2 MV in transport	movable object			junction	ahead				
2694	12/8/2009 12:10:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
2704	1/10/2011 7:36:00 AM	Dawn	Angle	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2707	1/19/2011 8:08:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2712	1/18/2011 4:00:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2734	12/8/2009 2:54:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2735	12/20/2010 10:19:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	Incapacitating	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2736	12/16/2010 4:58:00 AM	Dark - lighted roadway	No collision between 2 MV in	Bridge rail	Possible	Slush	Non-junction	Straight ahead	None	Road surface condition	None	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
			transport							wet, icy, snow, slush, etc.		
2741	1/6/2010 8:28:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
2744	9/27/2012 6:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
2749	8/18/2012 8:46:00 AM	Daylight	No collision between 2 MV in transport	Light/luminaire support	Incapacitating	Wet	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Rain
2756	10/29/2010 8:58:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Over-correcting/over-steering	Clear
2758	9/26/2010 6:12:00 PM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Dry	Non-junction	Straight ahead	Wheels	None	Running off road	Clear
2759	2/13/2012 7:53:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
2764	3/31/2011 2:39:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Wet	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Rain
2765	12/2/2009 7:07:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy,	Driving too fast for conditions	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
										snow, slush, etc.		
2781	9/29/2009 4:12:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
2810	12/17/2010 5:12:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2828	1/31/2011 9:15:00 AM	Daylight	No collision between 2 MV in transport	Parked motor vehicle	Non-incapacitating	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2839	1/31/2011 8:40:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2840	12/2/2009 7:00:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Snow
2845	1/9/2011 3:30:00 PM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2886	2/15/2012 9:30:00 AM	Daylight	No collision between 2	Concrete traffic	No injury	Wet	Non-junction	Straight ahead	None	None	Driving too fast for	Sleet, hail freezing

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			MV in transport	barrier							conditions	rain or drizzle
2892	1/9/2012 3:40:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Culvert	Non-incapacitating	Dry	Non-junction	Changing lanes	None	None	Running off road	Clear
2893	12/27/2012 11:20:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2911	7/22/2010 2:03:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Tree/shrubbery	Possible	Wet	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Rain
3001	1/26/2012 8:05:00 AM	Daylight	No collision between 2 MV in transport	Other movable object	Non-incapacitating	Frost	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
3041	2/1/2011 11:15:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
3052	11/5/2011 12:50:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
3057	7/24/2009 2:45:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
3071	6/26/2012 5:49:00 AM	Dawn	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
3106	12/6/2011 5:30:00 PM	Dark - lighted	Rear-end front to	Motor vehicle in	Incapacitating	Dry	Non-junction	Straight ahead	None	None	Failed to yield to	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
		roadway	rear	transport							vehicle	
3112	3/10/2009 1:25:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
3152	3/14/2011 8:03:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Non-junction	Stopped in traffic lane	None	None	None	Cloudy

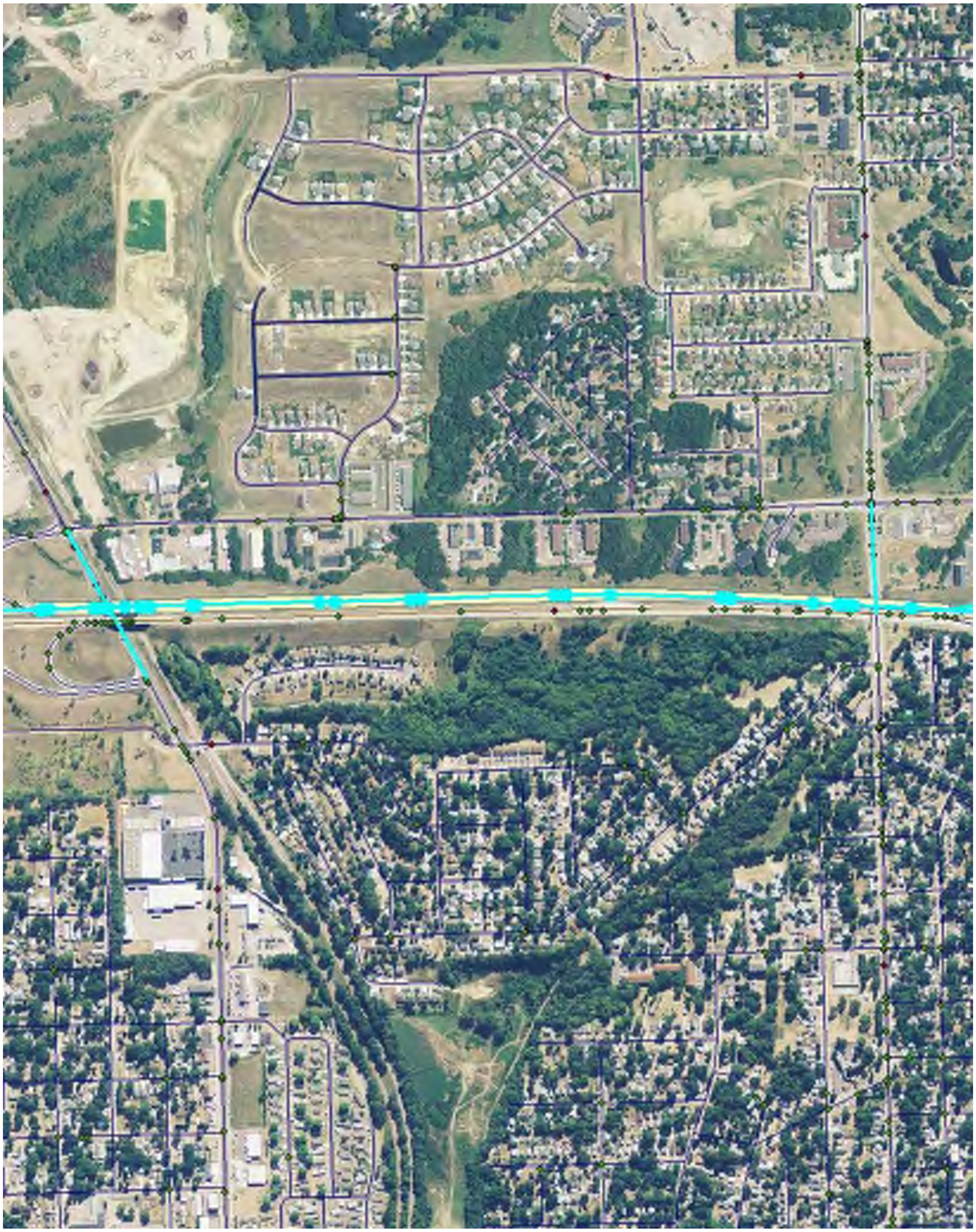
Interstate Segment – 10th Street Interchange Area NB

N

Crash Summary - 10th Street interchange area, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3329	3/26/2012 6:05:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	Incapacitating	Dry	Interchange area	Leaving traffic lane	None	None	Running off road	Clear
3737	5/21/2009 5:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Slowing in traffic lane	None	None	None	Cloudy
3816	3/1/2010 3:43:00 PM	Daylight	No collision between 2 MV in transport	Snow bank	Non-incapacitating	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Clear
3820	2/1/2010 11:45:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Snow
3865	11/5/2010 4:21:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
3872	1/11/2011 11:26:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Wet	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
3951	3/1/2010 3:38:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
3985	12/24/2009 8:53:00 AM	Daylight	No collision between 2	Overturn/rollover	No injury	Ice	Interchange area	Straight ahead	None	None	Driving too fast for	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			MV in transport								conditions	
3986	1/14/2011 4:47:00 PM	Daylight	No collision between 2 MV in transport	Snow bank	No injury	Slush	Driveway access	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
3987	10/2/2009 7:45:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Wet	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Rain



Interstate Segment – 10th Street to Rice Street NB

N

Crash Summary - 10th St. to Rice St., NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4012	3/28/2009 2:21:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	No injury	Dry	Non-junction	Straight ahead	None	None	Physical impairment	Clear
4217	12/18/2012 7:50:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Slush	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Sleet, hail freezing rain or drizzle
4229	1/6/2010 1:12:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Snow
4262	6/9/2011 1:13:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Cloudy
4263	4/13/2012 3:13:00 PM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Wet	Non-junction	Changing lanes	None	None	Improper lane change	Cloudy
4282	10/29/2012 9:00:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4323	8/18/2011 4:05:00 AM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4324	9/7/2012 11:20:00 AM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Possible	Dry	Non-junction	Straight ahead	None	None	Exceeded posted speed limit	Clear
4326	12/3/2011 12:48:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear
4339	9/20/2011 4:47:00 PM	Daylight	Wild animal hit - damage	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage	Wild animal hit	Wild animal hit - damage	Wild animal hit - damage	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			only					only		only	only	
4357	1/6/2010 4:37:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	None	None	Snow
4375	3/10/2009 3:20:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
4377	9/15/2010 10:00:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Wet	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Rain
4397	11/11/2009 12:55:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4399	5/1/2009 10:45:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4471	11/2/2012 8:22:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
4472	4/30/2011 9:08:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4493	1/8/2010 1:36:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
4499	11/14/2009 10:00:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4500	4/5/2010 5:35:00 AM	Dark - lighted	Wild animal hit -	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit -	Wild animal hit	Wild animal hit -	Wild animal hit -	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
		roadway	damage only					damage only		damage only	damage only	
4501	11/18/2012 12:29:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4506	9/4/2011 12:38:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Non-junction	Straight ahead	Tires	None	Drinking	Clear
4510	1/6/2010 2:30:00 PM	Daylight	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Snow
4511	1/6/2010 10:48:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Interchang e area	Straight ahead	None	None	Driving too fast for conditions	Snow
4520	3/10/2009 3:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Slush	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
4521	3/10/2009 12:00:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Slush	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
4549	7/17/2010 6:45:00 PM	Daylight	No collision between 2 MV in transport	Cargo/equi pment loss or shift	No injury	Dry	Interchang e area	Straight ahead	Truck coupling / trailer hitch / safety chains	None	None	Clear
4551	4/17/2010 11:45:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchang e area	Straight ahead	Truck coupling / trailer hitch / safety	None	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
									chains			
4552	10/27/2012 8:00:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchang e area	Straight ahead	None	None	Unknown	Clear

Interstate Segment – Rice Street Interchange Area NB

N

Crash Summary - Rice St. interchange area, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4562	2/1/2010 12:08:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Frost	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
4566	12/9/2009 6:45:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Bridge rail	Possible	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
4567	8/29/2012 9:25:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4587	8/17/2011 11:44:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4589	12/18/2012 8:40:00 AM	Daylight	No collision between 2 MV in transport	Tree/shrubbery	Possible	Slush	Interchange area	Changing lanes	Tires	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
4591	10/14/2012 7:15:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear

Interstate Segment – Rice Street to Benson Road NB

N

Crash Summary - Rice St. to Benson Rd., NB

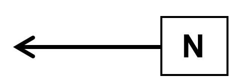
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4597	8/28/2012 7:53:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Wet	Non-junction	Changing lanes	None	Non-contact vehicle caused evasive action	Driving too fast for conditions	Cloudy
4601	3/10/2009 1:50:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
4604	6/28/2010 3:15:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4610	12/7/2009 8:50:00 AM	Daylight	No collision between 2 MV in transport	Guardrail end	Possible	Snow	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Cloudy
4611	12/24/2009 8:50:00 AM	Daylight	No collision between 2 MV in transport	Bridge rail	Possible	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
4612	11/26/2010 4:35:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4613	12/3/2009 7:10:00 AM	Dawn	No collision between 2 MV in transport	Guardrail end	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
4614	11/23/2009 6:25:00 PM	Dark - roadway	Wild animal hit -	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit -	Wild animal hit	Wild animal hit -	Wild animal hit -	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
		not lighted	damage only					damage only		damage only	damage only	
4616	3/7/2012 6:30:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4617	12/9/2009 6:45:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
4618	12/8/2009 11:45:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Bridge rail	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Over-correcting/over-steering	Snow
4620	5/21/2011 6:23:00 AM	Dawn	Wild animal hit - damage only	Animal - wild	No injury	Wet	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4622	9/6/2011 8:43:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4624	12/2/2009 6:21:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	No injury	Ice	Non-junction	Overtaking /passing	None	Pedestrian, bicyclist, other non-occupants in road	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
4625	9/18/2012 7:43:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4626	1/10/2011 1:05:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface,	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
											vehicle, object, non-motorist, etc.	
4627	3/18/2010 7:40:00 PM	Dusk	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4628	3/5/2012 6:45:00 AM	Dawn	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4629	11/29/2009 3:00:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4633	9/6/2011 4:25:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4640	8/30/2010 6:00:00 AM	Dawn	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4647	11/27/2010 12:45:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4650	6/15/2009 9:50:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4651	6/13/2011 3:10:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4652	12/2/2009 7:05:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy,	Driving too fast for conditions	Sleet, hail freezing rain or drizzle

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										snow, slush, etc.		
4653	11/17/2009 6:00:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4655	11/9/2010 8:15:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4666	2/1/2010 8:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Oil	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear

Interstate Segment – Benson Road Interchange Area NB



Crash Summary - Benson Rd. interchange area, NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4670	12/9/2010 6:30:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4681	5/9/2010 1:30:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4697	2/5/2012 8:14:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Dry	Wild animal hit - damage only	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4799	11/30/2009 6:30:00 PM	Dusk	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear

Interstate Segment – Benson Road to I-90 NB

N

Crash Summary - Benson Rd. to I-90 NB

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4824	6/27/2010 11:55:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4830	8/30/2010 1:07:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Other traffic barrier	No injury	Dry	Non-junction	Straight ahead	Tires	None	None	Clear
4832	7/29/2009 5:00:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Wet	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Rain
4841	11/22/2010 7:30:00 AM	Dawn	No collision between 2 MV in transport	Delineator post	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Sleet, hail freezing rain or drizzle

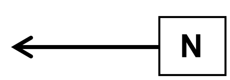
Interstate Ramp – Benson Road SB Off Ramp

N

Crash Summary - Benson SB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4809	3/29/2010 8:10:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear

Interstate Ramp – Benson Road SB On Ramp



No crashes recorded for this segment/intersection during 2009-2012 time period.

Interstate Ramp – Rice Street SB Off Ramp

No crashes recorded for this segment/intersection during 2009-2012 time period.

Interstate Ramp – Rice Street SB On Ramp

N

Crash Summary - Rice St. SB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4532	8/7/2009 1:00:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Oil	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
4544	11/18/2009 7:45:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchange area	Straight ahead	None	None	Running off road	Clear
4548	6/23/2012 3:43:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Over-correcting/over-steering	Clear
4550	5/24/2009 4:10:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear

Interstate Ramp – 10th Street SB Off Ramp

N

Crash Summary - 10th St. SB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
3808	7/1/2011 8:20:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3829	1/19/2011 7:47:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	None	Other	Clear
3840	6/17/2012 6:53:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Failed to yield to vehicle	Clear

Interstate Ramp – 10th Street SB On Ramp

N

Crash Summary - 10th St. SB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3299	4/23/2011 10:39:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Slowing in traffic lane	None	None	None	Cloudy
3312	4/29/2009 7:43:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	None	Cloudy
3321	12/10/2010 4:55:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
3325	7/20/2011 1:10:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
3349	2/22/2010 5:20:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
3405	4/5/2011 6:40:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchange area	Straight ahead	None	None	Running off road	Clear
3475	5/12/2011 9:15:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear

Interstate Ramp – 26th Street SB Off Ramp

N

Crash Summary - 26th St. SB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2323	11/29/2010 3:50:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2328	11/3/2011 11:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	None	Clear

Interstate Ramp – 26th Street SB On Ramp

N

Crash Summary - 26th St. SB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2302	5/17/2009 4:00:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Running off road	Clear

Interstate Ramp – Cliff Avenue SB Off Ramp

N

Crash Summary - Cliff Ave. SB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2003	1/8/2010 7:00:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
2006	12/3/2011 2:33:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Wet	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Cloudy

Interstate Ramp – Cliff Avenue SB On Ramp

N

Crash Summary - Cliff Ave. SB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1883	6/29/2009 7:57:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear

Interstate Ramp – Minnesota Avenue SB Off Ramp

N

Crash Summary, Minnesota Ave. SB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1265	9/15/2009 3:28:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1266	6/28/2012 9:04:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
1280	8/26/2009 4:37:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	None	Clear
1291	2/20/2010 8:25:00 AM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Dry	Interchange area	Straight ahead	None	None	Failure to keep in proper lane	Clear

Interstate Ramp – Minnesota Avenue SB On Ramp

N

Crash Summary, Minnesota Ave. SB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1214	3/27/2010 12:40:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
1229	10/12/2011 4:00:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear

Interstate Ramp – Western Avenue SB Off Ramp

N

No crashes recorded for this segment/intersection during 2009-2012 time period.

Interstate Ramp – Western Avenue SB On Ramp

N

Crash Summary - Western Ave. SB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
815	12/9/2009 12:37:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
841	6/4/2010 12:05:00 PM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Dry	Interchang e area	Straight ahead	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
846	1/15/2010 4:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear

Interstate Ramp – Louise Avenue SB Off Ramp

N

Crash Summary - Louise Ave. SB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
279	12/10/2012 8:20:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchange area	Stopped in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
285	3/9/2010 11:03:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Wet	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Failure to keep in proper lane	Cloudy
286	11/5/2009 5:10:00 PM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Dry	Interchange area	Changing lanes	None	None	Running off road	Clear
301	2/1/2011 11:13:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchange area	Stopped in traffic lane	None	None	None	Clear

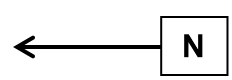
Interstate Ramp - Louise Avenue SB On Ramp

N

Crash Summary - Louise Ave. SB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
156	4/30/2011 8:53:00 PM	Dark - roadway not lighted	No collision between 2 MV in transport	Rock	No injury	Dry	Interchang e area	Straight ahead	None	None	Running off road	Clear
166	10/21/2009 7:20:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchang e area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
205	5/17/2012 8:12:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Slowing in traffic lane	None	None	None	Clear
213	5/28/2012 4:26:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
263	5/2/2012 5:20:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear

Interstate Ramp – Louise Avenue NB Off Ramp



Crash Summary - Louise Ave. NB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
125	3/19/2009 12:11:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	Steering	None	None	Clear
126	4/27/2012 2:56:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Wet	Interchange area	Straight ahead	None	None	Exceeded posted speed limit	Cloudy
127	10/23/2012 7:21:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
129	1/9/2010 11:20:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchange area	Stopped in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
148	10/20/2009 10:50:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
150	2/18/2010 5:41:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
151	6/6/2010 12:39:00 AM	Dark - roadway not lighted	No collision between 2 MV in transport	Culvert	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Running off road	Clear
154	12/21/2010 1:42:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear

Interstate Ramp – Louise Avenue NB Loop Ramp

N

No crashes recorded for this segment/intersection during 2009-2012 time period.

Interstate Ramp – Louise Avenue NB On Ramp

N

Crash Summary - Louise Ave. NB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
120	2/10/2010 2:23:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Snow bank	No injury	Wet	Interchang e area	Straight ahead	None	None	Drinking	Cloudy
144	2/6/2010 5:26:00 PM	Daylight	No collision between 2 MV in transport	Overturn/r ollover	No injury	Wet	Interchang e area	Straight ahead	None	None	Driving too fast for conditions	Snow
211	9/4/2009 10:08:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	Shoulders none, low, soft, high	Over-correcting/o ver-steering	Clear

Interstate Ramp – Western Avenue NB Off Ramp

N

Crash Summary - Western Ave. NB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
789	4/27/2009 10:25:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Cloudy

Interstate Ramp – Western Avenue NB On Ramp

N

Crash Summary - Western Ave. NB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
817	7/5/2012 2:02:00 PM	Daylight	No collision between 2 MV in transport	Other non-collision	No injury	Dry	Non-junction	Straight ahead	Wheels	None	None	Clear
831	8/26/2011 6:15:00 PM	Daylight	No collision between 2 MV in transport	Fence	No injury	Dry	Interchange area	Straight ahead	None	None	Running off road	Clear

Interstate Ramp – Minnesota Avenue NB Off Ramp

Crash Summary - Minnesota Ave. NB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1129	1/11/2011 12:45:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Clear
1131	12/26/2010 1:47:00 PM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Wet	Interchange area	Straight ahead	None	None	Fatigued/asleep	Clear
1149	4/5/2012 5:10:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1154	7/6/2010 1:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
1156	12/11/2012 6:10:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Stopped in traffic lane	None	None	None	Clear
1160	1/8/2010 10:30:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchange area	Stopped in traffic lane	None	None	None	Clear

Interstate Ramp – Minnesota Avenue NB On Ramp

N

Crash Summary - Minnesota Ave. NB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1175	1/16/2012 4:57:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Slowing in traffic lane	None	None	Followed too closely	Clear

Interstate Ramp – Cliff Avenue NB Off Ramp

N

Crash Summary - Cliff Ave. NB off ramp

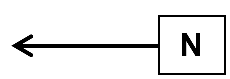
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1676	11/5/2012 7:58:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
1677	1/28/2011 9:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Incapacitating	Wet	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1678	1/31/2011 3:54:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1686	1/18/2011 7:58:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
1688	4/12/2010 8:20:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1690	4/23/2012 7:31:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Failed to yield to vehicle	Clear

Interstate Ramp – Cliff Avenue NB On Ramp

N

No crashes recorded for this segment/intersection during 2009-2012 time period.

Interstate Ramp – 26th Street NB Off Ramp



Crash Summary - 26th Street NB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2284	5/17/2010 6:07:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2322	5/18/2011 4:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Stopped in traffic lane	None	None	None	Clear
2337	4/8/2009 10:00:00 AM	Daylight	No collision between 2 MV in transport	Other post, pole, or support	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
2338	12/2/2009 8:39:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
2376	4/16/2010 4:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
2377	6/14/2012 6:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2429	1/5/2011 3:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2430	2/15/2011 2:09:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2431	5/12/2012 10:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2432	12/22/2009 6:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear

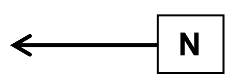
Interstate Ramp – 26th Street NB On Ramp

N

Crash Summary - 26th St. NB on

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2294	2/4/2012 9:47:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchange area	Straight ahead	None	None	Other	Cloudy
2296	2/16/2012 4:58:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchange area	Straight ahead	None	None	Exceeded posted speed limit	Clear
2297	12/27/2012 10:15:00 AM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Snow	Interchange area	Straight ahead	None	None	Running off road	Snow
2298	3/10/2010 9:15:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Wet	Interchange area	Straight ahead	None	None	Running off road	Rain
2315	7/29/2011 5:00:00 PM	Daylight	No collision between 2 MV in transport	Other movable object	No injury	Dry	Interchange area	Straight ahead	None	Debris	None	Clear

Interstate Ramp – 10th Street NB Off Ramp



10th St. NB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3320	11/10/2011 3:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3330	7/6/2011 5:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3359	6/16/2009 5:21:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3414	4/20/2011 12:54:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	No injury	Dry	Interchange area	Straight ahead	None	None	Drinking	Clear
3417	12/15/2011 7:56:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3418	3/28/2012 2:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3425	11/26/2011 4:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Cloudy
3450	8/26/2012 7:30:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3464	6/29/2009 4:38:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Failed to yield to vehicle	Clear

Interstate Ramp – 10th Street NB On Ramp

N

Crash Summary - 10th St. NB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3832	6/23/2012 6:29:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Interchange area	Starting in traffic lane	Other	None	None	Clear
3881	1/1/2011 10:10:00 AM	Daylight	No collision between 2 MV in transport	Concrete traffic barrier	No injury	Frost	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Over-correcting/over-steering	Cloudy
3970	10/14/2009 10:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Cloudy
3983	1/7/2010 6:50:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	Possible	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Blowing snow

Interstate Ramp – Rice Street NB Off Ramp

N

Crash Summary - Rice St. NB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
4555	10/23/2012 6:03:00 AM	Dark - roadway not lighted	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Slowing in traffic lane	None	None	None	Fog, smog, smoke

Interstate Ramp – Rice Street NB On Ramp

N

Crash Summary - Rice St. NB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4553	12/27/2010 3:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Other	Clear
4563	12/8/2009 11:35:00 AM	Daylight	No collision between 2 MV in transport	Tree/shrubbery	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow

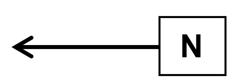
Interstate Ramp – Benson Road NB Off Ramp

N

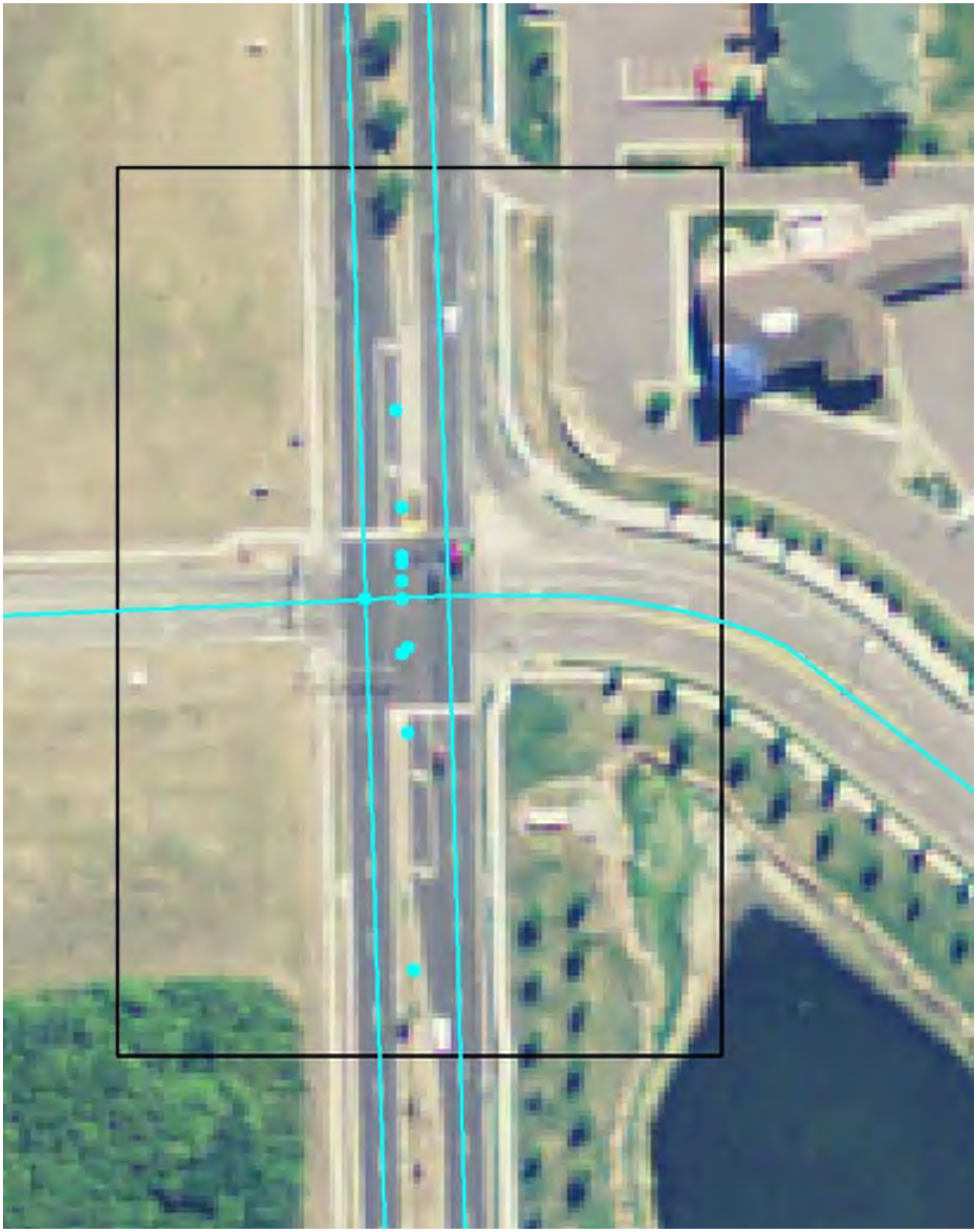
Crash Summary - Benson Rd. NB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
4669	12/30/2010 4:25:00 PM	Dark - roadway not lighted	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Sleet, hail freezing rain or drizzle
4672	8/15/2011 3:57:00 PM	Daylight	No collision between 2 MV in transport	Fire/explosion	No injury	Dry	Interchange area	Straight ahead	Unknown	None	None	Clear
4685	12/16/2010 6:50:00 AM	Dawn	Sideswipe, same direction	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Failure to keep in proper lane	Clear
4691	4/7/2010 7:55:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
4692	1/17/2011 8:00:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Slowing in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Rain
4696	8/18/2011 4:20:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Wet	Interchange area	Changing lanes	None	None	Improper lane change	Cloudy
4698	6/11/2012 8:30:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	None	Clear
4704	1/31/2011 5:06:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Stopped in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow

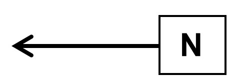
Interstate Ramp – Benson Road NB On Ramp



No crashes recorded for this segment/intersection during 2009-2012 time period.



Arterial Intersection – 57th/Solberg



Crash Summary - 57th/Solberg

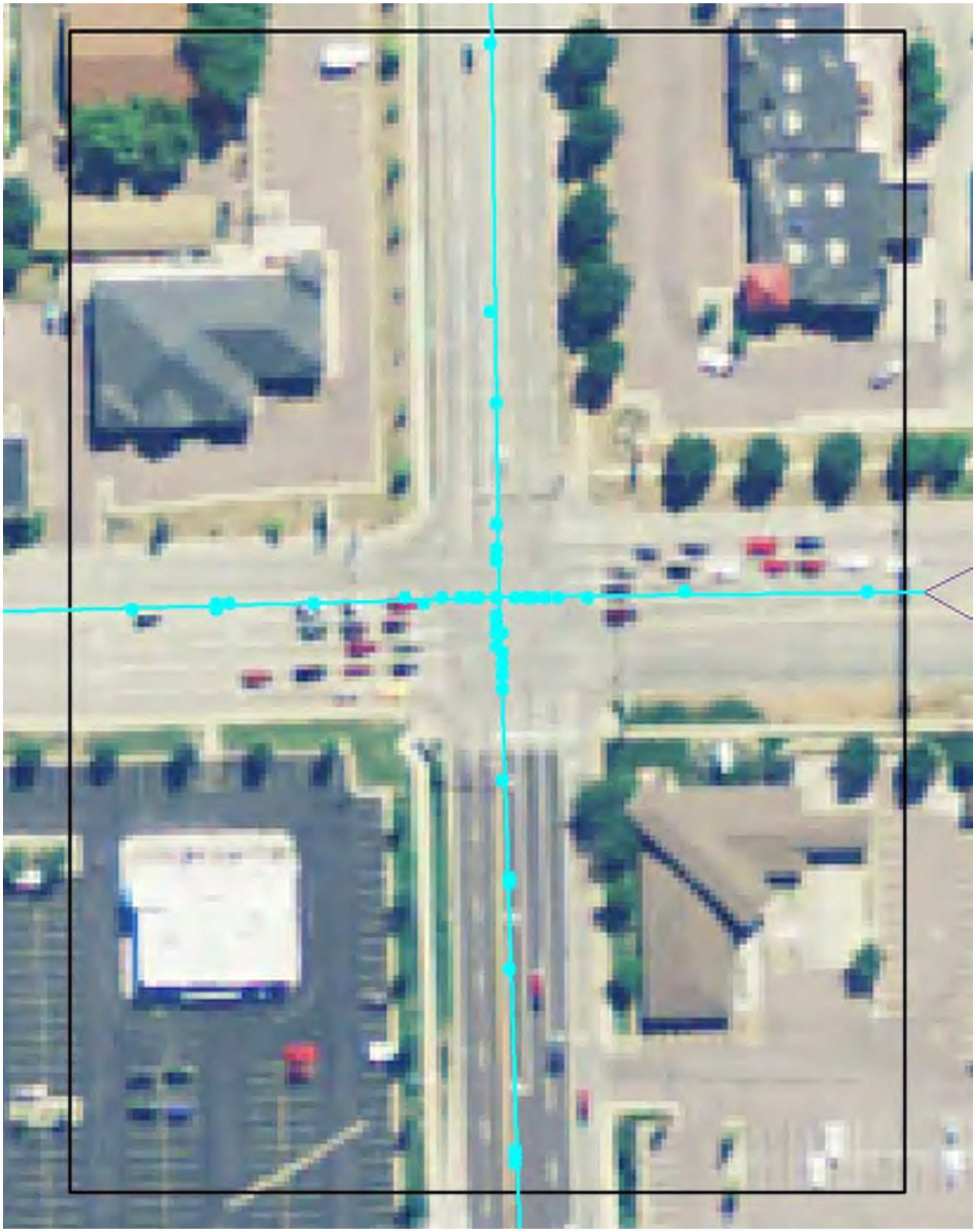
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
454	5/17/2012 3:36:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
455	6/21/2011 1:46:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Wet	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
456	2/1/2011 12:27:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Intersection related	Straight ahead	None	None	None	Cloudy
457	8/2/2012 9:40:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
458	9/24/2009 5:13:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Illness heart attack, stroke, etc.	Clear
459	8/6/2010 6:57:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
460	11/2/2010 12:08:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Improper turn	Clear
461	2/28/2011 7:09:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
462	5/5/2011 9:02:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Distracted list distraction in narrative	Clear
463	10/5/2011 9:34:00 AM	Daylight	Angle	Motor vehicle in	No injury	Dry	Four-way intersection	Turning left	None	None	Improper turn	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
				transport								
464	11/10/2011 6:41:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
465	3/21/2012 5:40:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
466	2/8/2010 8:02:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
467	11/5/2011 1:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
468	4/13/2009 11:30:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
469	9/11/2011 1:21:00 PM	Daylight	No collision between 2 MV in transport	Other movable object	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
470	9/1/2011 4:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
471	5/28/2009 5:01:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
472	11/3/2011 5:50:00 PM	Dusk	Rear-end front to	Motor vehicle in	Possible	Dry	Non-junction	Straight ahead	None	None	Distracted list	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
			rear	transport							distraction in narrative	
475	2/24/2012 5:16:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Slush	Intersection related	Straight ahead	None	None	Other	Blowing snow

Arterial Intersection – 69th/Solberg

No crashes recorded for this segment/intersection during 2009-2012 time period.



Arterial Intersection – 57th/Louise

Crash Summary - 57th/Louise

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
391	7/9/2012 3:48:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear
440	4/13/2011 7:48:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
480	11/1/2012 6:34:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Other	Cloudy
499	10/7/2010 12:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
501	11/10/2011 7:32:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
502	6/28/2011 12:05:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Entering traffic lane	None	None	Failed to yield to vehicle	Clear
503	4/22/2009 7:47:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
504	5/15/2010 3:56:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Driveway access related	Slowing in traffic lane	None	None	None	Clear
505	4/12/2010 11:40:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Other	Cloudy
506	12/23/2010 12:11:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
508	10/7/2009 6:24:00 PM	Daylight	No collision between 2 MV in transport	Pedestrian	Non-incapacitating	Dry	Non-junction	Not applicable	Not applicable	Not applicable	Not applicable	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
509	9/8/2010 11:53:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
510	8/1/2012 1:15:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Turning left	None	None	Failed to yield to vehicle	Clear
511	7/19/2011 5:32:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Turning left	None	None	Failed to yield to vehicle	Clear
512	12/9/2011 6:02:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
513	11/13/2011 11:46:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear
514	7/4/2012 2:57:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Driveway access	Changing lanes	None	None	Improper lane change	Clear
515	10/11/2011 2:42:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
516	12/12/2010 1:49:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Intersection related	Slowing in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
517	3/5/2009 7:36:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
518	6/14/2012 12:28:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Slowing in traffic lane	None	None	Followed too closely	Cloudy
492	12/21/2011 4:15:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
494	9/24/2011 2:49:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear

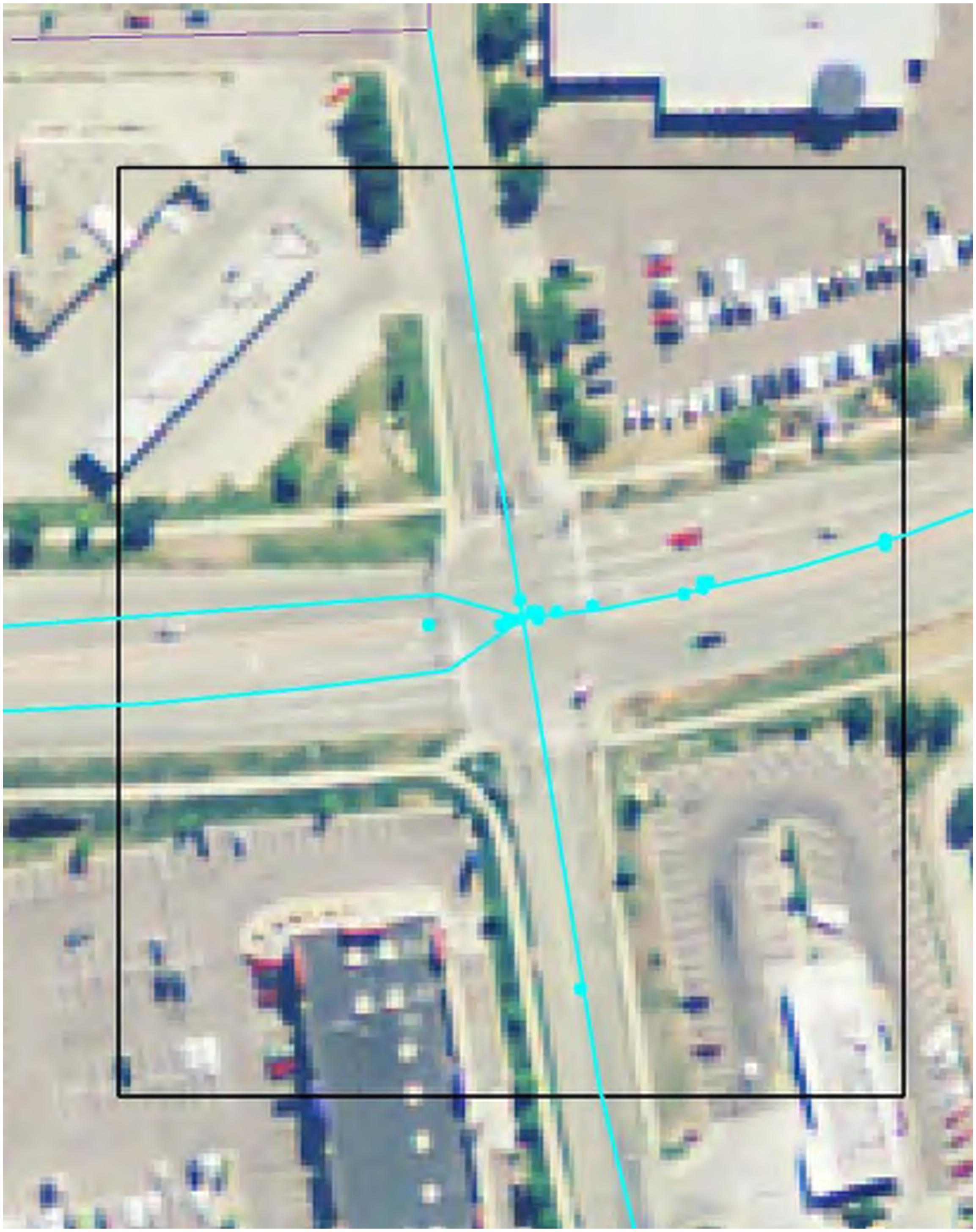
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
497	3/22/2011 4:57:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
519	10/27/2009 7:34:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
520	11/15/2011 2:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
521	7/4/2012 4:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
522	12/17/2010 10:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Frost	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
523	5/18/2009 12:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
524	8/16/2009 2:28:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Incapacitating	Wet	Intersection related	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
525	10/28/2011 2:52:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Turning left	None	None	Failure to keep in proper lane	Cloudy
526	9/7/2012 9:31:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Turning left	None	None	None	Clear
527	3/3/2009 6:28:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
528	3/24/2009	Daylight	Angle	Motor	No injury	Dry	Four-way	Straight	None	None	Disregarde	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	1:52:00 PM			vehicle in transport			intersection	ahead			d traffic signs or signals	
529	4/20/2009 10:07:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
530	5/8/2009 3:24:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Unknown	Cloudy
531	6/21/2009 8:28:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Turning right	None	None	Improper turn	Cloudy
532	8/24/2009 10:06:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning right	None	None	Failed to yield to vehicle	Clear
533	9/12/2009 6:56:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	None	Improper turn	Fog, smog, smoke
534	12/2/2009 7:44:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Blowing snow
535	12/7/2009 3:52:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
536	1/5/2010 6:26:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning left	None	None	None	Clear
537	1/7/2010 1:38:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Ice	Four-way intersection	Turning left	None	None	Unknown	Cloudy
538	2/17/2010 3:39:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning right	None	None	None	Clear
539	9/12/2010 6:09:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	None	Clear
540	10/24/2010	Daylight	Angle	Motor	No injury	Dry	Four-way	Turning	None	None	Failure to	Cloudy

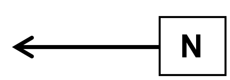
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	3:56:00 PM			vehicle in transport			intersection	left			keep in proper lane	
541	7/5/2011 8:33:00 PM	Dusk	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
542	12/13/2011 7:41:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Rain
543	1/17/2012 5:45:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Slush	Four-way intersection	Turning right	None	None	Failed to yield to vehicle	Clear
544	3/8/2012 2:50:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
545	4/2/2012 11:58:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Distracted list distraction in narrative	Clear
546	6/14/2012 10:45:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
547	12/5/2012 4:55:00 PM	Dusk	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
548	10/15/2012 5:57:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
549	12/9/2012 11:57:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Turning left	None	None	Unknown	Snow
550	9/15/2011 10:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
551	5/12/2012	Daylight	Rear-end	Motor	Non-	Dry	Intersectio	Straight	None	None	Followed	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	4:20:00 PM		front to rear	vehicle in transport	incapacitating		n related	ahead			too closely	
552	1/25/2010 4:41:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Blowing snow
553	5/19/2012 9:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
554	12/4/2012 6:08:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Other	Clear
555	6/21/2010 1:16:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
561	6/13/2010 2:53:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
562	7/19/2010 10:03:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
564	2/22/2012 2:10:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
571	9/9/2011 3:36:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Turning left	None	None	Failed to yield to vehicle	Clear
576	12/29/2009 2:34:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Snow	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Cloudy
587	11/5/2010 6:27:00 PM	Dark - lighted	Rear-end front to	Motor vehicle in	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
		roadway	rear	transport							distraction in narrative	
590	8/27/2012 2:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Distracted list distraction in narrative	Clear
609	10/9/2009 4:31:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Driveway access	Turning left	None	None	None	Clear
610	2/5/2011 12:09:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
611	11/26/2012 5:11:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
612	12/17/2012 5:49:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Frost	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
626	5/30/2012 4:23:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
629	10/19/2012 4:41:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
630	12/13/2010 3:13:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
682	8/3/2012 5:47:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear



Arterial Intersection – 59th/Louise



Crash Summary - 59th/Louise

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCONT	DRIVERCO	WEATHER
370	1/31/2012 5:15:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
310	6/6/2012 12:31:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
311	12/10/2012 5:38:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Slowing in traffic lane	None	None	Distracted list distraction in narrative	Clear
312	6/5/2012 4:22:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
314	6/13/2012 5:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
315	3/6/2009 5:10:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
316	2/27/2010 12:34:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
317	1/14/2012 5:22:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Other fixed object wall, building, tunnel, etc.	No injury	Wet	Non-junction	Straight ahead	None	None	Drinking	Cloudy
318	4/14/2012 9:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
319	11/16/2012 3:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Slowing in traffic lane	None	None	Followed too closely	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
320	12/5/2009 4:46:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
321	4/6/2012 12:48:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Other	Clear
324	9/30/2012 12:43:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
325	11/28/2011 5:47:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
328	8/24/2011 8:07:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
330	11/15/2010 2:38:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Intersection related	Straight ahead	Cargo	None	Running off road	Clear
331	1/6/2010 7:36:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
333	9/23/2011 12:20:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
334	5/8/2009 8:17:00 PM	Dusk	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Distracted list distraction in narrative	Rain

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
335	5/4/2009 1:09:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Unknown	Clear
336	7/12/2009 7:58:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
337	8/25/2009 2:09:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
338	1/26/2010 5:15:00 PM	Dusk	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
339	3/13/2010 6:59:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Rain
340	5/8/2010 11:24:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Four-way intersection	Turning left	None	None	Distracted list distraction in narrative	Clear
341	8/7/2010 3:37:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
342	9/14/2010 5:11:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	None	Clear
343	12/6/2010 12:26:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
344	2/1/2011 5:29:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
345	7/17/2011 12:06:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
346	7/20/2011 6:27:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Dry	Four-way intersection	Turning left	None	None	Unknown	Clear
347	10/22/2011	Daylight	Angle	Motor	Non-	Dry	Four-way	Turning	None	None	Failed to	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	4:22:00 PM			vehicle in transport	incapacitating		intersection	left			yield to vehicle	
348	11/16/2011 8:14:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Unknown	Cloudy
349	11/12/2011 2:23:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	None	Failed to yield to vehicle	Cloudy
350	12/2/2011 11:31:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
351	12/30/2011 1:29:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
352	3/8/2012 2:25:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
353	5/10/2012 12:10:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
354	5/24/2012 7:30:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Rain
355	11/28/2012 9:36:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	None	Clear
356	4/1/2010 1:04:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Stopped in traffic lane	None	None	None	Cloudy
358	10/21/2009 8:06:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Wet	Non-junction	Straight ahead	None	None	None	Rain
359	6/25/2011 6:51:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy

Arterial Intersection – I-229 SB/Louise

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Crash Summary - I-229 SB/Louise

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
197	6/10/2010 4:55:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
203	7/12/2012 5:27:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
204	6/28/2012 8:07:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
205	5/17/2012 8:12:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Slowing in traffic lane	None	None	None	Clear
206	10/10/2010 12:46:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Making U-turn	None	None	Failed to yield to vehicle	Clear
207	5/26/2011 5:23:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
208	11/8/2011 5:25:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
209	12/13/2012 7:14:00 AM	Dark - unknown roadway lighting	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Cloudy
213	5/28/2012 4:26:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
214	4/30/2009 5:31:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Other	Clear
216	5/25/2012 1:57:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
											in narrative	
218	8/24/2010 5:11:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Failed to yield to vehicle	Clear
219	9/7/2011 5:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
220	10/16/2012 8:01:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Cloudy
221	9/17/2009 5:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Unknown	Cloudy
222	2/23/2010 7:55:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
223	9/24/2009 5:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Other	Cloudy
224	9/30/2009 1:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
225	1/26/2010 4:12:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
226	5/24/2009 10:20:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
227	9/30/2009 8:50:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
228	10/31/2009 11:38:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
229	12/9/2009	Daylight	Angle	Motor	Possible	Slush	Interchang	Straight	None	None	Failed to	Clear

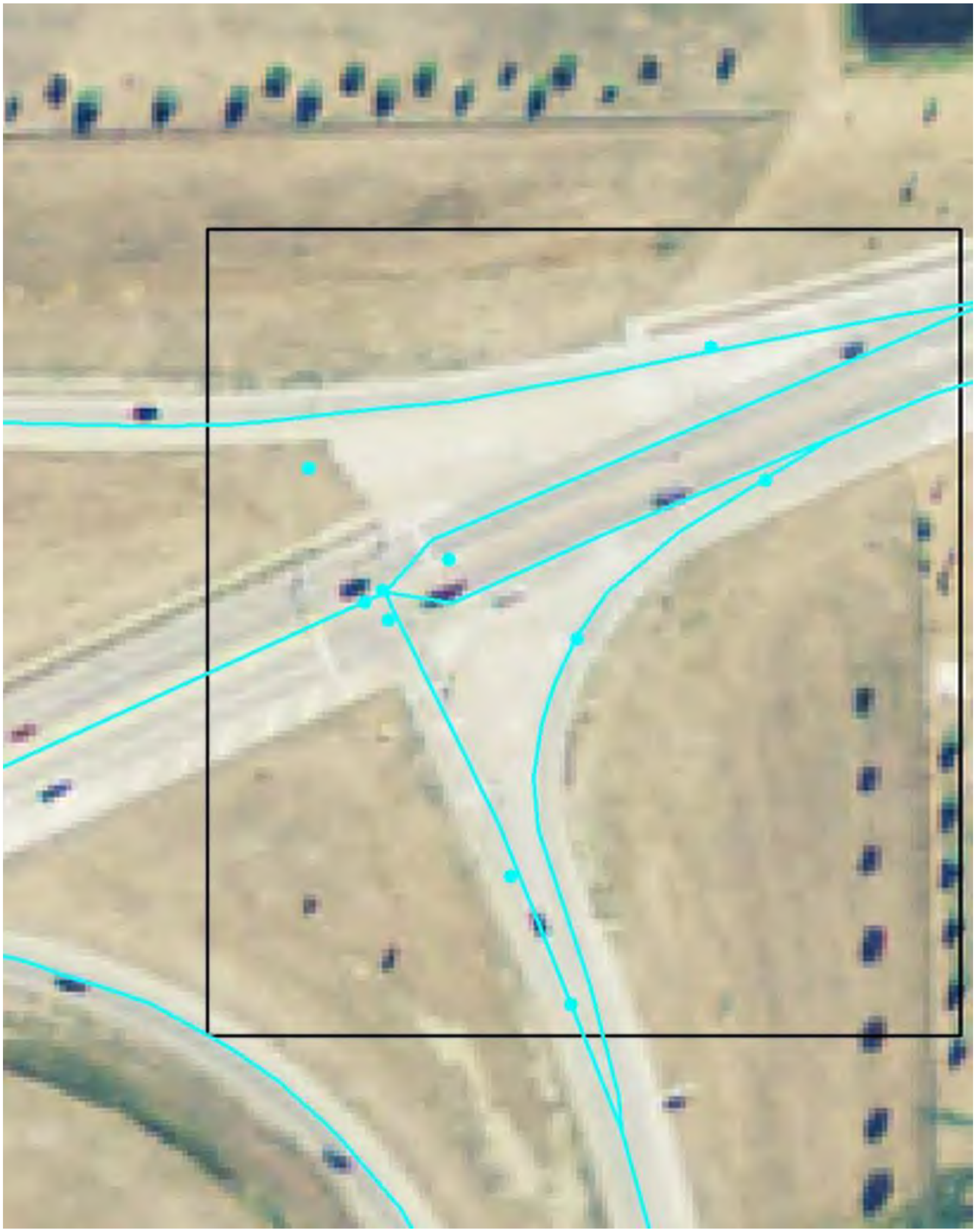
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	2:49:00 PM			vehicle in transport			e area	ahead			yield to vehicle	
230	6/14/2010 9:10:00 PM	Dusk	Angle	Motor vehicle in transport	Possible	Wet	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Cloudy
231	7/18/2010 5:30:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
232	8/5/2010 7:53:00 AM	Daylight	No collision between 2 MV in transport	Traffic signal support/sig nal	No injury	Dry	Interchang e area	Turning right	None	None	Running off road	Clear
233	8/9/2010 5:03:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning right	None	None	Improper turn	Cloudy
234	11/23/2010 3:00:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Interchang e area	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
235	1/25/2011 8:36:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
236	3/29/2011 2:15:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning right	None	None	Improper turn	Cloudy
237	4/18/2011 5:16:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Cloudy
238	7/30/2011 5:09:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
239	8/10/2011 3:57:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Cloudy
240	8/29/2011 3:45:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	Unknown	Cloudy
241	10/28/2011 2:06:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
242	11/1/2011	Dark -	Angle	Motor	No injury	Dry	Interchang	Straight	None	None	Unknown	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	7:05:00 PM	lighted roadway		vehicle in transport			e area	ahead				
243	12/16/2011 6:31:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Incapacitating	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
244	12/17/2011 3:35:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning right	None	None	Failure to keep in proper lane	Clear
245	12/28/2011 1:48:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
246	1/24/2012 6:40:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Wet	Interchange area	Turning right	None	None	Drinking	Clear
247	1/26/2012 11:40:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Curb	No injury	Dry	Interchange area	Straight ahead	None	None	Drinking	Cloudy
248	6/18/2012 5:51:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
249	6/29/2012 12:04:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
250	8/29/2012 7:30:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
251	9/9/2012 12:11:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
252	7/27/2009 9:28:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
253	3/16/2010 6:55:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Cloudy
254	2/1/2011	Daylight	Rear-end	Motor	Possible	Ice	Interchang	Straight	None	Road	None	Cloudy

OBJE(	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE'	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON'	DRIVERCO	WEATHER
	1:38:00 PM		front to rear	vehicle in transport			e area	ahead		surface condition wet, icy, snow, slush, etc.		
255	2/2/2011 12:27:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchang e area	Straight ahead	None	None	Driving too fast for conditions	Clear
256	6/30/2009 5:13:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Slowing in traffic lane	None	None	Distracted list distraction in narrative	Clear
257	1/21/2012 7:23:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
258	10/11/2011 4:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
259	5/6/2010 9:50:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Straight ahead	None	None	Followed too closely	Rain
260	10/18/2011 7:16:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
263	5/2/2012 5:20:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
264	12/6/2010 5:17:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
265	2/2/2011 3:56:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchang e area	Stopped in traffic lane	None	Road surface condition	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										wet, icy, snow, slush, etc.		
266	6/12/2010 9:53:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
267	12/14/2011 8:40:00 PM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	Possible	Wet	Interchange area	Changing lanes	None	None	Improper lane change	Cloudy
268	9/1/2011 7:55:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
269	12/21/2012 1:37:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
270	12/21/2012 1:37:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
271	6/15/2012 11:59:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
274	7/21/2010 4:13:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
275	1/31/2012 4:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
276	8/18/2011 5:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
280	3/11/2010 12:38:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Rain
281	8/9/2012	Daylight	Sideswipe,	Motor	Possible	Dry	Interchang	Changing	None	None	Failed to	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	6:51:00 PM		same direction	vehicle in transport			e area	lanes			yield to vehicle	
282	11/2/2012 9:37:00 PM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchang e area	Changing lanes	None	None	Improper lane change	Clear
283	5/21/2010 12:41:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy



Arterial Intersection – I-229 NB/Louise

N

Crash Summary - I-229 NB/Louise

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
118	6/26/2009 1:24:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Cloudy
120	2/10/2010 2:23:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Snow bank	No injury	Wet	Interchange area	Straight ahead	None	None	Drinking	Cloudy
125	3/19/2009 12:11:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	Steering	None	None	Clear
126	4/27/2012 2:56:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Wet	Interchange area	Straight ahead	None	None	Exceeded posted speed limit	Cloudy
129	1/9/2010 11:20:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchange area	Stopped in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
132	2/23/2012 11:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Slush	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Blowing snow
133	1/13/2012 10:44:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
138	7/17/2012 8:51:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
139	10/7/2009 11:00:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	None	Clear
140	2/27/2010 2:14:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
											signals	
141	1/16/2012 7:53:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Cloudy
142	12/13/2010 8:42:00 AM	Daylight	No collision between 2 MV in transport	Motor vehicle used as equipment snowplow plowing	No injury	Snow	Interchange area	Making U-turn	None	None	Improper turn	Cloudy
144	2/6/2010 5:26:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	No injury	Wet	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Snow

Arterial Intersection – 69th/Louise

N

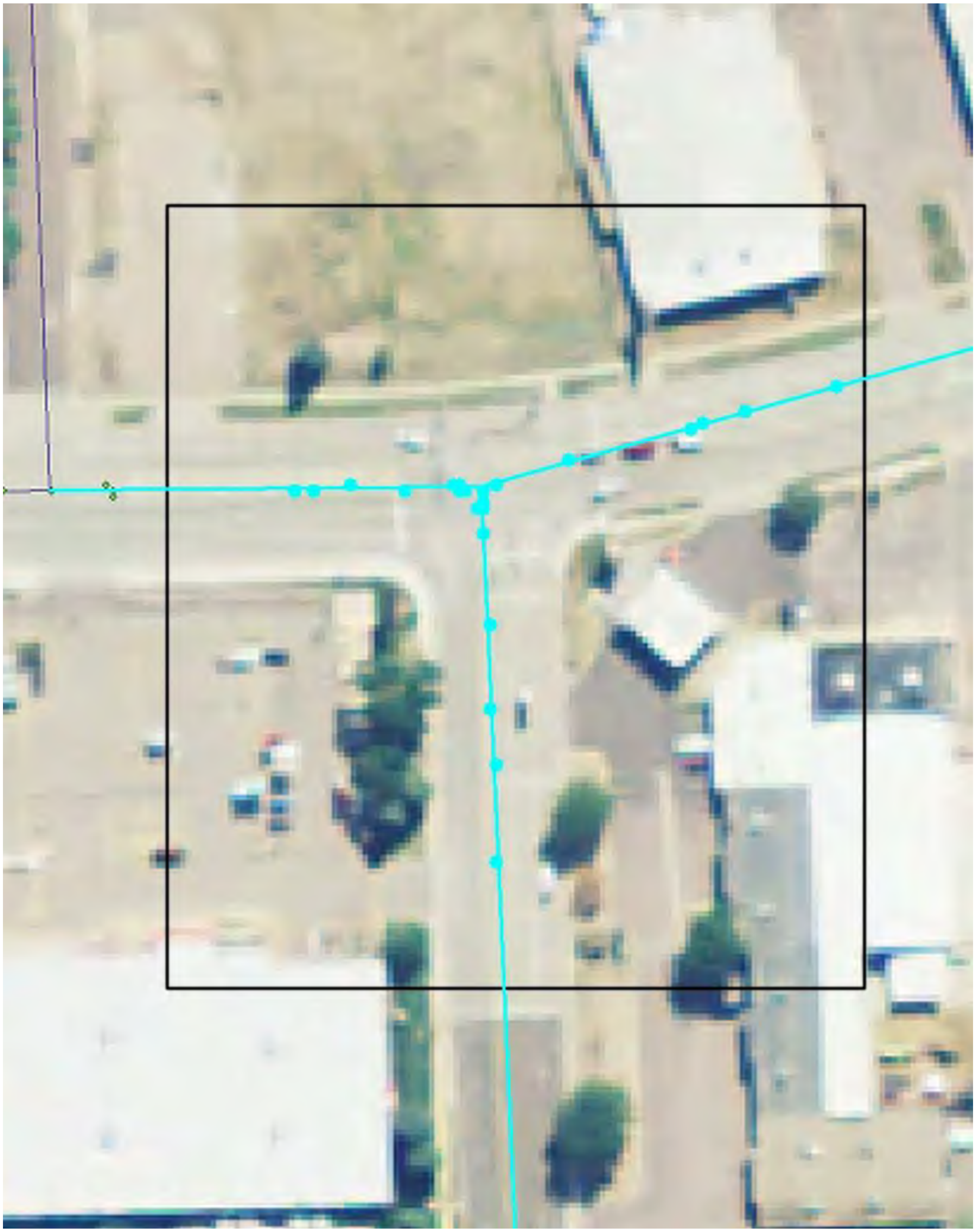
Crash Summary - 69th/Louise

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
17	2/22/2011 7:41:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Wet	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
18	12/16/2011 5:12:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersectio n related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
22	1/18/2011 8:44:00 PM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	No injury	Ice	Driveway access	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
23	1/25/2011 3:42:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersectio n related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
24	6/23/2009 7:27:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersectio n related	Straight ahead	None	None	Followed too closely	Clear
25	7/1/2009 6:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersectio n related	Straight ahead	None	None	Followed too closely	Clear
26	1/22/2012 10:38:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Ice	Intersectio n related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Cloudy
27	2/11/2012 1:00:00 PM	Daylight	Rear-end front to	Motor vehicle in	No injury	Dry	Intersectio n related	Straight ahead	None	None	Followed too closely	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			rear	transport								
28	11/10/2012 8:07:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Backing	None	None	Improper backing	Rain
29	3/18/2009 8:25:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
30	5/21/2009 3:53:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
31	6/26/2009 12:45:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	None	Cloudy
32	12/7/2009 6:38:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
33	1/26/2010 1:35:00 PM	Daylight	No collision between 2 MV in transport	Snow bank	No injury	Ice	Four-way intersection	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Over-correcting/over-steering	Clear
34	7/28/2010 12:21:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
35	7/26/2010 9:20:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
36	6/12/2011 12:52:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
37	10/18/2011 8:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
38	12/27/2011 1:53:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
											signals	
39	1/10/2012 1:23:00 PM	Daylight	Angle	Motor vehicle in transport	Fatal injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
40	6/14/2012 4:34:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
41	10/11/2011 8:01:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
42	2/11/2012 11:20:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
43	8/12/2009 11:28:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
44	12/21/2009 5:16:00 PM	Dark - unknown roadway lighting	Rear-end front to rear	Motor vehicle in transport	Possible	Other	Intersection related	Straight ahead	None	None	Other	Sleet, hail freezing rain or drizzle
45	10/24/2010 7:02:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
46	8/17/2010 7:30:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
47	5/29/2009 12:36:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
48	2/25/2010 1:09:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Driveway access	Straight ahead	None	None	Followed too closely	Cloudy
49	7/6/2011	Daylight	Rear-end	Motor	Non-	Dry	Intersectio	Straight	None	None	Distracted	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	9:59:00 AM		front to rear	vehicle in transport	incapacitati ng		n related	ahead			list distraction in narrative	
50	8/6/2011 8:34:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersectio n related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
51	2/24/2012 5:05:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersectio n related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow



Arterial Intersection – 49th/Western

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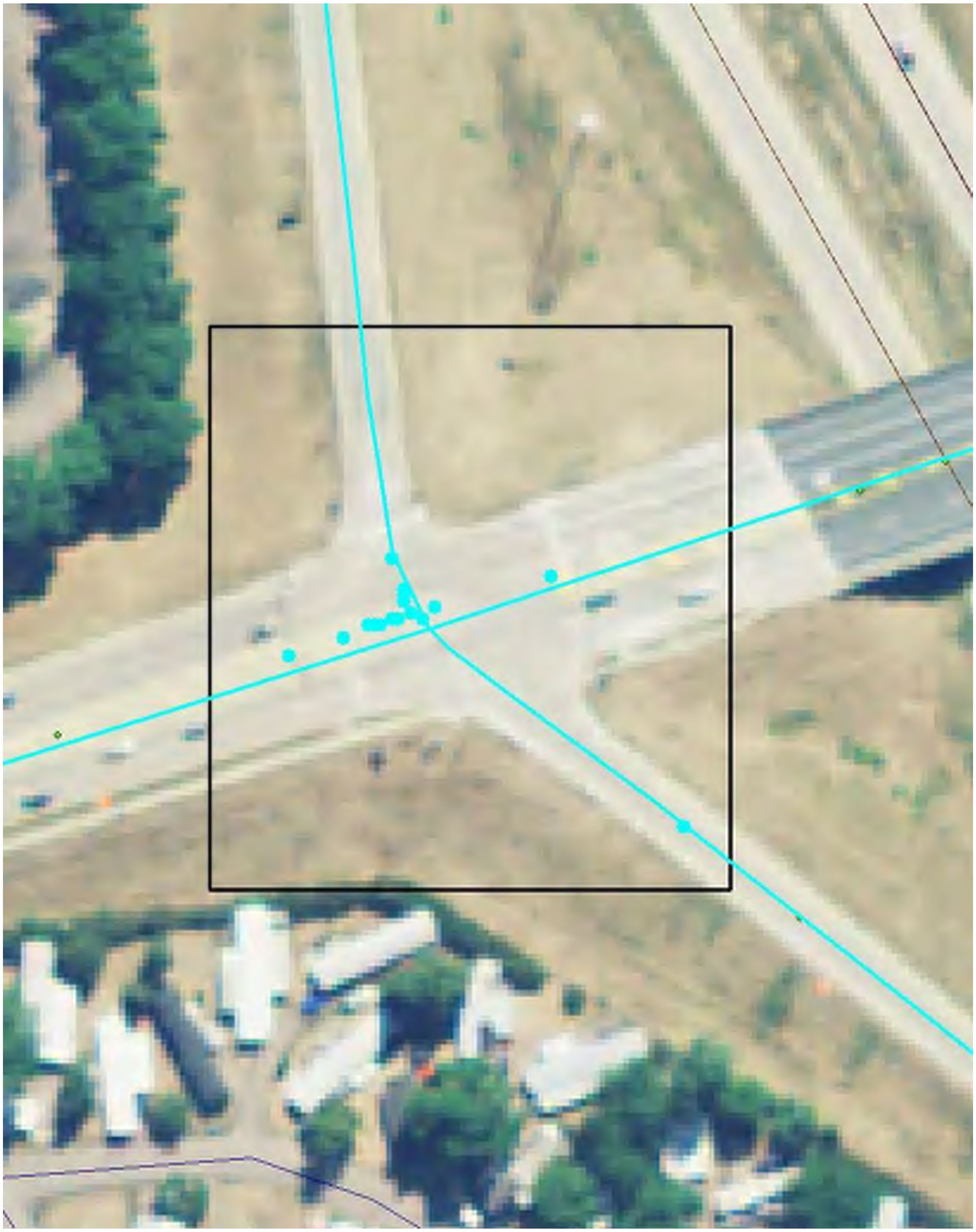
Crash Summary - 49th/Western

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1044	6/20/2009 1:19:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
1045	11/27/2009 10:46:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Non-junction	Straight ahead	None	None	Other	Clear
1046	4/19/2009 4:10:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Driveway access related	Straight ahead	None	None	Drinking	Clear
1047	9/11/2012 5:10:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
1048	8/27/2009 7:41:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Improper lane change	Clear
1066	7/7/2011 2:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
1080	6/17/2010 3:51:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Other	Clear
1081	10/28/2011 3:32:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
1082	6/29/2009 5:40:00 PM	Daylight	No collision between 2 MV in transport	Pedalcycle	Non-incapacitating	Dry	Intersection related	Straight ahead	None	Pedestrian, bicyclist, other non-occupants in road	Disregarded traffic signs or signals	Clear
1085	10/14/2009 5:53:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersection related	Straight ahead	None	None	Other	Cloudy
1086	7/7/2010 4:17:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Other fixed object wall, building,	Possible	Dry	Intersection related	Straight ahead	None	None	Unknown	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
				tunnel, etc.								
1088	12/16/2010 2:58:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Wet	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1089	8/17/2010 2:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Slowing in traffic lane	None	None	Distracted list distraction in narrative	Cloudy
1090	9/2/2009 7:16:00 AM	Daylight	No collision between 2 MV in transport	Pedalcycle	Possible	Dry	Intersection related	Not applicable	Not applicable	Not applicable	Not applicable	Cloudy
1091	4/29/2009 7:03:00 AM	Dawn	Angle	Motor vehicle in transport	Possible	Wet	T-intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Rain
1092	8/5/2009 4:12:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Turning left	None	None	Unknown	Clear
1093	7/22/2010 12:10:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Wet	T-intersection	Turning left	None	None	Disregarded traffic signs or signals	Cloudy
1094	7/20/2011 1:05:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
1095	4/14/2012 9:59:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	T-intersection	Turning left	None	None	Improper turn	Clear
1096	10/26/2012 12:56:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Turning left	None	None	None	Cloudy
1097	1/19/2012 10:03:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
1098	7/26/2011 5:38:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1100	6/15/2010 3:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
1101	10/10/2010 4:00:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear
1102	11/2/2009 8:10:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Construction - pavement cutout/road materials	No injury	Dry	Intersection related	Turning right	None	Other	Failure to keep in proper lane	Clear
1103	10/20/2010 1:07:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1111	4/20/2012 10:18:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Improper lane change	Clear
1115	5/4/2009 5:53:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
1118	11/7/2012 5:05:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Slowing in traffic lane	None	None	Followed too closely	Clear
1119	4/25/2012 3:52:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Driveway access	Turning right	None	None	Improper lane change	Cloudy
1120	5/14/2012 4:51:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear

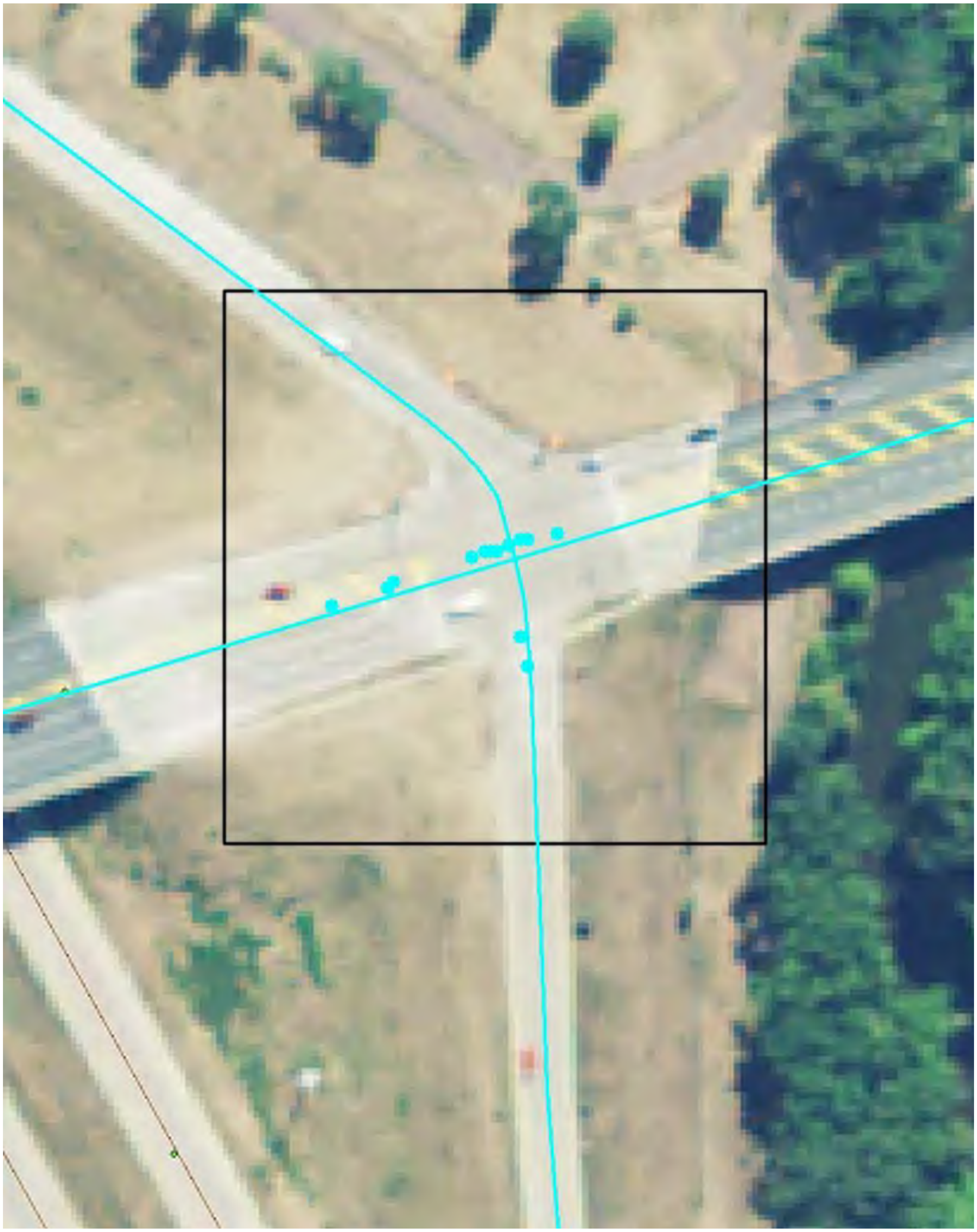


Arterial Intersection – I-229 SB/Western

Crash Summary - I-229 SB/Western

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
855	1/1/2011 3:20:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Slush	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Clear
857	7/18/2009 1:19:00 PM	Daylight	No collision between 2 MV in transport	Pedestrian	Incapacitating	Dry	Interchange area	Not applicable	Not applicable	Not applicable	Not applicable	Clear
858	8/11/2009 9:02:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
859	8/21/2009 5:57:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
860	1/20/2010 10:53:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Slush	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Sleet, hail freezing rain or drizzle
861	2/15/2011 9:22:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Unknown	Clear
862	2/13/2012 8:11:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
863	10/4/2010 4:19:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
864	2/24/2010 9:59:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
865	12/3/2012 12:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
866	4/29/2010	Daylight	Rear-end	Motor	Possible	Dry	Interchang	Straight	None	None	Followed	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	4:47:00 PM		front to rear	vehicle in transport			e area	ahead			too closely	
868	9/5/2009 6:47:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
846	1/15/2010 4:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
849	7/6/2012 7:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
869	12/19/2011 7:14:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Cloudy
870	1/3/2011 5:32:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Other	Cloudy
871	4/14/2011 5:33:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
872	11/26/2012 5:34:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
873	3/4/2011 4:14:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
875	10/31/2009 1:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
878	5/11/2011 5:01:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear



Arterial Intersection – I-229 NB/Western

Crash Summary - I-229 NB/Western

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
788	7/20/2010 6:00:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Changing lanes	None	None	Improper lane change	Clear
789	4/27/2009 10:25:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Cloudy
790	3/17/2011 10:07:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
791	12/17/2010 12:43:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
792	7/5/2010 4:04:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Cloudy
793	3/12/2011 10:11:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
794	3/18/2011 9:11:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
795	6/6/2011 3:23:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Turning left	None	None	None	Clear
796	10/1/2012 12:02:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
797	12/31/2012 11:32:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
798	5/10/2012 7:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
799	5/12/2009	Daylight	Rear-end	Motor	Possible	Dry	Interchang	Straight	None	None	Followed	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	2:52:00 PM		front to rear	vehicle in transport			e area	ahead			too closely	
800	5/27/2009 3:48:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	None	Cloudy
801	8/13/2009 2:03:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitati ng	Dry	Interchang e area	Straight ahead	None	None	Other	Clear
802	12/13/2011 5:33:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Rain
803	11/16/2010 4:15:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Non-incapacitati ng	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
807	10/29/2012 4:49:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	None	Clear

Arterial Intersection – 57th/Western

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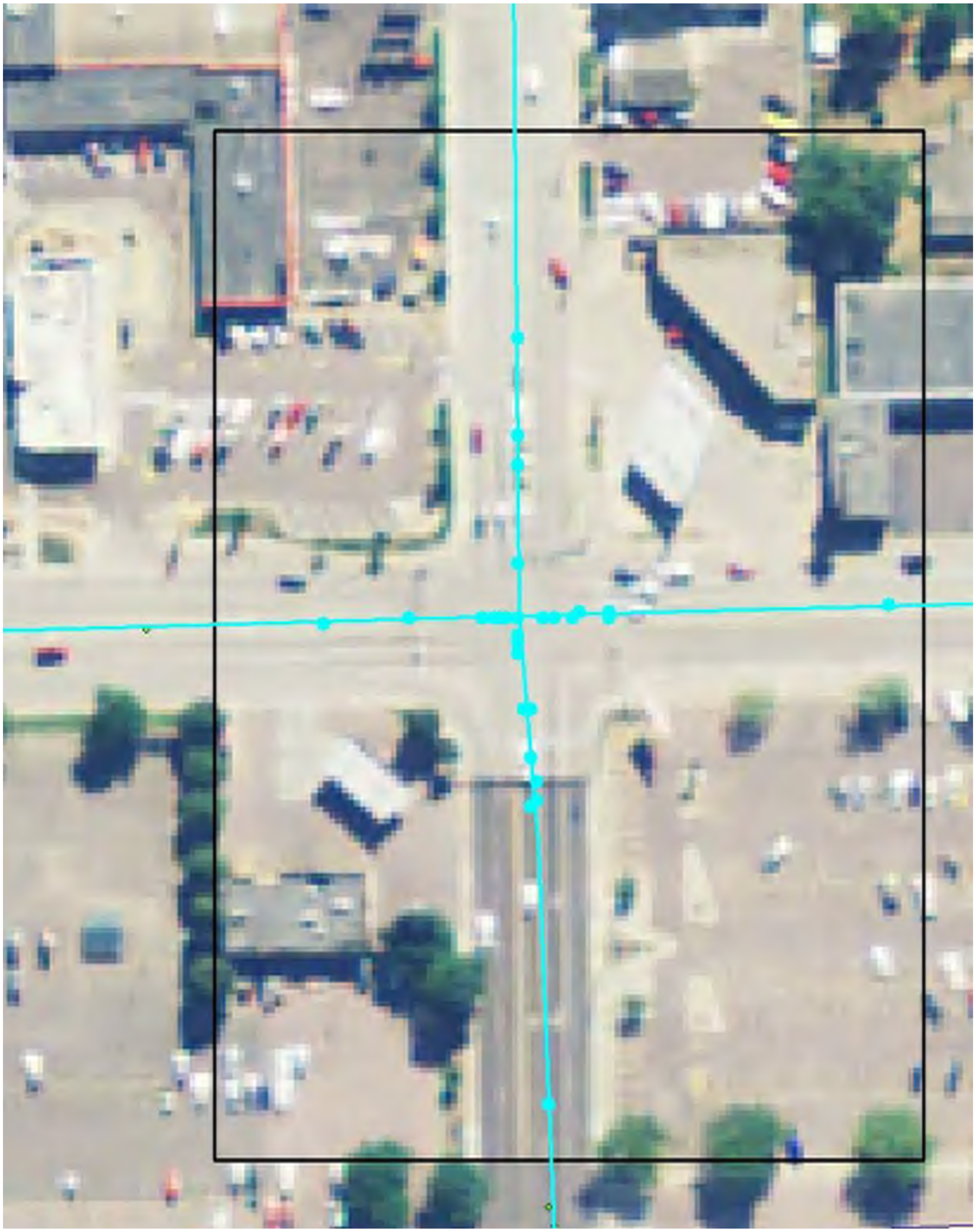
Crash Summary - 57th/Western

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
495	11/7/2012 5:24:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Driveway access	Straight ahead	None	None	Failed to yield to vehicle	Clear
574	7/29/2011 9:42:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Straight ahead	None	None	Failed to yield to vehicle	Clear
624	6/27/2011 5:26:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Other	Clear
625	7/2/2012 3:22:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
639	6/8/2010 5:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Unknown	Cloudy
640	9/2/2009 8:42:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Disregarded traffic signs or signals	Rain
643	11/19/2009 4:49:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Other	Cloudy
644	11/14/2012 6:23:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
645	3/2/2011 8:13:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
646	1/5/2012 4:58:00 PM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Failure to keep in proper lane	Clear
647	5/22/2012 8:54:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
648	4/22/2009 8:56:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
649	12/12/2010 5:13:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Ice	Intersection related	Straight ahead	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
650	3/9/2011 6:48:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Snow
651	6/12/2009 1:48:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning right	None	None	Failed to yield to vehicle	Cloudy
652	6/18/2009 2:54:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
653	8/28/2009 2:14:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
654	12/30/2009 9:00:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
655	1/6/2010 7:44:00 AM	Dawn	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Snow
656	4/9/2010 12:47:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
657	3/31/2010	Daylight	Angle	Motor	No injury	Dry	Four-way	Straight	None	None	Disregarde	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	1:44:00 PM			vehicle in transport			intersection	ahead			d traffic signs or signals	
658	8/13/2010 1:47:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
659	11/1/2010 10:39:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Cloudy
660	11/24/2010 6:26:00 AM	Dawn	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
661	1/18/2011 9:21:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
662	2/17/2011 1:49:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
663	2/24/2011 8:03:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
664	7/6/2011 6:00:00 AM	Dawn	Angle	Motor vehicle in transport	Incapacitat ing	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
665	11/9/2011 3:24:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Four-way intersection	Turning left	None	None	Improper turn	Clear
666	12/16/2011 8:04:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
667	3/30/2012 3:14:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
668	7/2/2012 3:48:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
669	9/18/2012 7:52:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
670	9/28/2012 5:59:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
671	11/14/2012 7:49:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	None	Improper turn	Clear
672	12/10/2012 2:54:00 PM	Daylight	Angle	Motor vehicle in transport	Fatal injury	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
673	4/2/2009 1:23:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
674	6/22/2009 10:09:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Improper lane change	Clear
675	11/8/2012 1:41:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Driveway access	Straight ahead	None	None	Failed to yield to vehicle	Clear
676	6/15/2012 2:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
677	6/20/2011 3:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
678	4/29/2011 4:16:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
680	12/6/2012 8:28:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Turning left	None	None	Improper turn	Clear
681	11/21/2011 3:28:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
693	5/5/2010 4:19:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	Brakes	None	None	Cloudy



Arterial Intersection – 41st/Minnesota

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Crash Summary - 41st/Minnesota

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1432	11/30/2011 9:49:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
1720	2/25/2012 2:24:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
1721	4/18/2009 11:11:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Failed to yield to vehicle	Cloudy
1722	4/10/2010 2:23:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
1745	1/16/2012 5:20:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Drinking	Cloudy
1761	10/25/2010 9:12:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Wet	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
1762	1/25/2011 3:05:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
1796	12/12/2010 11:29:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Ice	Intersection related	Straight ahead	None	None	Driving too fast for conditions	Clear
1797	1/25/2011 8:39:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning right	None	None	Failed to yield to vehicle	Cloudy
1799	12/11/2009 11:30:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Frost	Non-junction	Straight ahead	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-	Clear

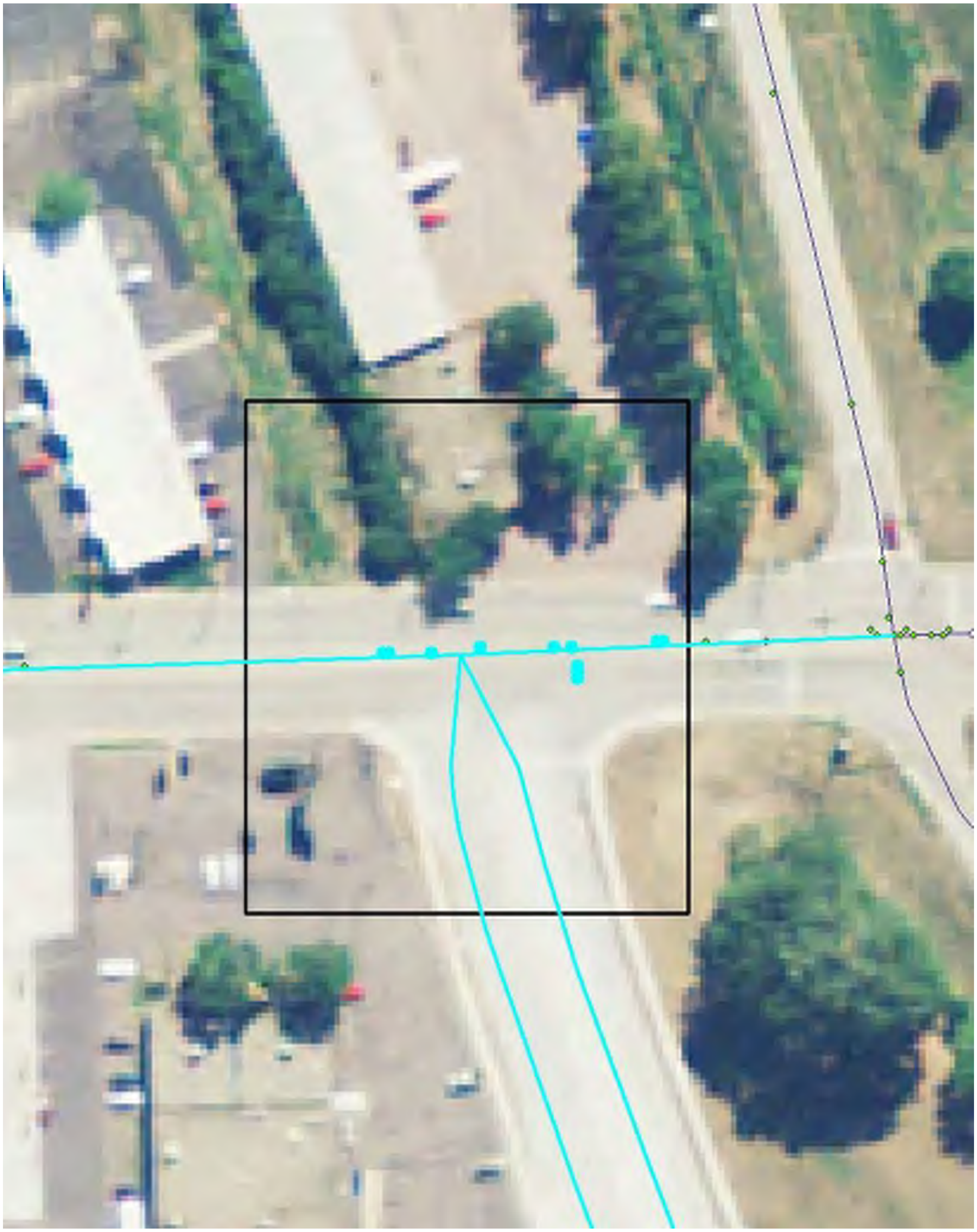
OBJE(	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE'	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON'	DRIVERCO	WEATHER
											motorist, etc.	
1800	3/18/2012 2:16:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Drinking	Clear
1801	12/7/2009 10:45:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
1802	5/17/2011 12:47:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
1803	12/2/2011 12:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1804	3/5/2010 9:53:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
1805	7/2/2012 5:01:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1806	2/5/2011 6:13:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Slush	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
1807	11/18/2012 12:25:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
1808	7/2/2011 12:00:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Improper lane change	Clear
1809	7/17/2010 9:34:00 PM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Failed to yield to vehicle	Cloudy
1810	7/14/2010 6:53:00 PM	Daylight	Rear-end front to	Motor vehicle in	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list	Clear

OBJE(	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			rear	transport							distraction in narrative	
1811	7/8/2010 3:15:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Improper lane change	Clear
1812	11/29/2010 3:35:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Snow	Intersection related	Straight ahead	Unknown	Road surface condition wet, icy, snow, slush, etc.	Disregarded traffic signs or signals	Cloudy
1813	6/30/2011 12:13:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Backing	None	None	Improper backing	Clear
1814	12/30/2011 3:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
1815	6/5/2009 11:21:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Other	Clear
1816	8/17/2009 3:24:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	None	Clear
1817	6/25/2010 7:03:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
1818	8/3/2010 11:51:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
1819	11/3/2010 6:45:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
1820	2/23/2011 12:12:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
1821	4/20/2011 12:01:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Wet	Four-way intersection	Straight ahead	None	Road surface condition wet, icy,	None	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURF	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
										snow, slush, etc.		
1822	5/3/2011 7:25:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
1823	5/13/2011 6:32:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning left	None	None	Improper turn	Cloudy
1824	8/18/2011 11:22:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
1825	10/28/2011 7:38:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
1826	11/23/2011 5:20:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
1827	2/22/2012 3:49:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
1828	8/3/2012 7:17:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
1829	8/20/2012 1:31:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
1830	8/21/2012 12:43:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
1831	9/20/2012 10:15:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
1832	1/10/2011 6:30:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow

OBJE(	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE'	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON'	DRIVERCO	WEATHER
1833	7/22/2011 10:48:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
1834	11/11/2009 8:05:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Straight ahead	None	None	Failed to yield to vehicle	Clear
1835	6/14/2010 4:48:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Driveway access	Turning left	None	None	Failed to yield to vehicle	Rain
1836	6/27/2009 4:58:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1837	12/2/2009 12:45:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Dry	Driveway access	Straight ahead	None	None	Failed to yield to vehicle	Clear
1838	5/6/2010 12:39:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning right	None	None	Failed to yield to vehicle	Cloudy
1839	6/11/2012 5:08:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
1843	5/26/2009 9:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Other	Cloudy
1844	8/27/2009 4:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
1846	5/24/2010 11:40:00 AM	Daylight	No collision between 2 MV in transport	Traffic signal support/signal	No injury	Dry	Intersection related	Turning right	None	None	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Cloudy
1847	10/22/2010	Daylight	Rear-end	Motor	Non-	Dry	Intersectio	Straight	None	None	Distracted	Clear

OBJE(	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE'	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON'	DRIVERCO	WEATHER
	8:50:00 AM		front to rear	vehicle in transport	incapacitating		n related	ahead			list distraction in narrative	
1849	2/24/2012 6:02:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	No injury	Frost	Intersection related	Straight ahead	None	None	Followed too closely	Clear
1865	12/3/2009 5:42:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Frost	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
1879	10/30/2009 9:55:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Rain

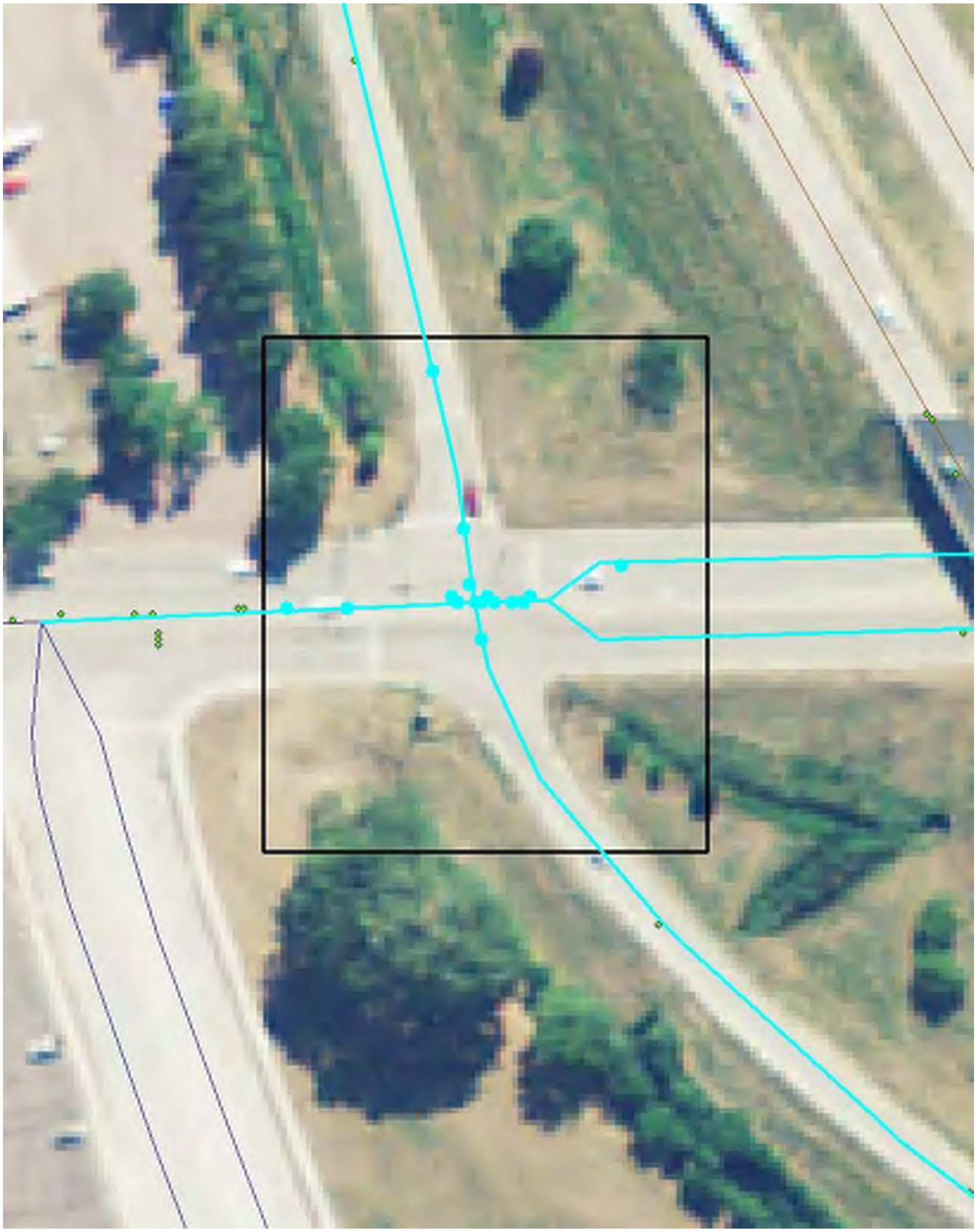


Arterial Intersection – 49th/Minnesota

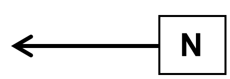
Crash Summary - 49th/Minnesota

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1308	12/29/2009 5:32:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Snow	Driveway access related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1314	6/24/2009 4:10:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Clear
1316	10/19/2009 12:16:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
1317	10/26/2009 5:03:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Incapacitating	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1286	10/17/2009 10:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
1287	4/19/2012 5:21:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
1293	5/4/2012 3:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
1294	2/21/2012 3:13:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Failed to yield to vehicle	Clear
1295	12/11/2009 2:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Failed to yield to vehicle	Clear
1296	10/17/2009 10:23:00 AM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
1297	11/13/2009	Daylight	Angle	Motor	Possible	Dry	T-	Turning	None	None	Failed to	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	3:37:00 PM			vehicle in transport			intersection	left			yield to vehicle	
1298	12/11/2009 1:49:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Slush	T-intersection	Turning right	None	None	Failure to keep in proper lane	Clear
1299	9/8/2010 12:52:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Turning left	None	None	Other	Clear
1300	6/24/2011 9:35:00 AM	Daylight	No collision between 2 MV in transport	Pedalcycle	Possible	Dry	T-intersection	Turning right	None	Pedestrian, bicyclist, other non-occupants in road	None	Clear
1301	8/6/2012 5:06:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Turning right	None	None	Failed to yield to vehicle	Clear
1302	9/25/2012 7:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Followed too closely	Clear
1303	11/9/2012 6:13:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
1306	12/13/2010 3:54:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Slush	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy



Arterial Intersection – I-229 SB/Minnesota

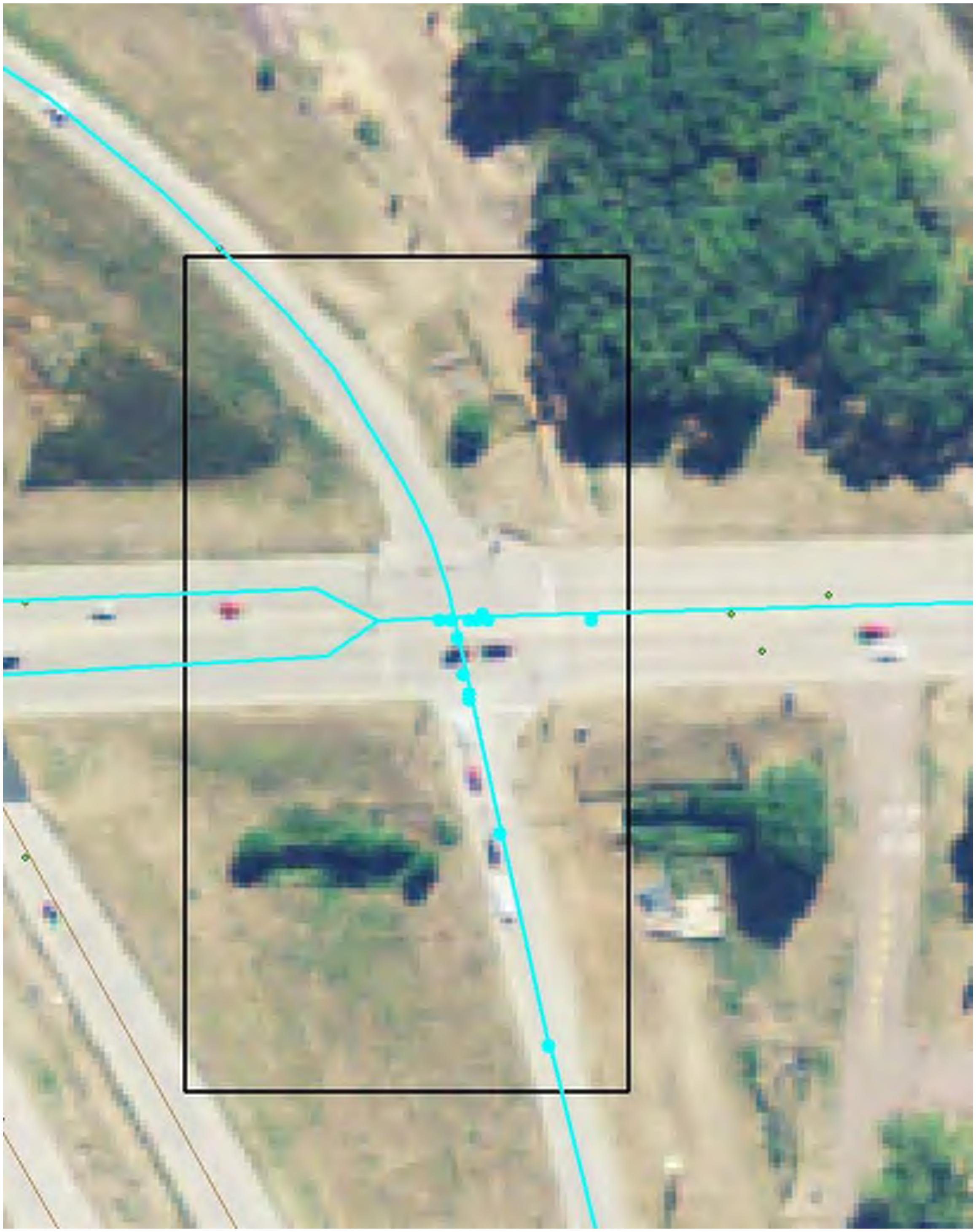


Crash Summary - I-229 SB/Minnesota

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1231	2/28/2011 12:34:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Changing lanes	None	None	Improper lane change	Clear
1234	5/15/2009 3:48:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1235	2/1/2012 8:04:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
1238	11/18/2010 5:51:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Changing lanes	None	None	Followed too closely	Clear
1241	11/22/2011 5:41:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1242	12/10/2009 12:33:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Snow	Interchange area	Stopped in traffic lane	None	None	None	Clear
1243	1/25/2011 6:10:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail end	No injury	Wet	Interchange area	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Running off road	Cloudy
1244	11/28/2011 5:02:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1245	4/26/2010 1:42:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Interchange area	Unknown	None	None	None	Cloudy
1246	5/18/2010 6:45:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1247	7/10/2010 3:21:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1248	8/17/2010 10:20:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning right	None	None	Improper turn	Clear
1249	10/20/2010 5:48:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
1250	2/1/2011 4:05:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Non-junction	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1251	1/31/2011 8:53:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Disregarded traffic signs or signals	Snow
1252	8/10/2011 7:00:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
1253	11/6/2011 12:08:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	Unknown	Unknown	Cell phone	Clear
1254	1/23/2012 12:03:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Ice	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Cloudy
1255	5/23/2012 6:33:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
1256	8/16/2012 6:00:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
1258	1/31/2012 8:17:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Failure to keep in proper lane	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1260	2/1/2011 1:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
1261	6/22/2010 4:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Other	Cloudy
1262	7/8/2010 5:41:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
1265	9/15/2009 3:28:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1266	6/28/2012 9:04:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
1281	5/23/2011 5:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
1284	4/21/2010 3:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear



Arterial Intersection – I-229 NB/Minnesota

Crash Summary - I-229 NB/Minnesota

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1151	6/21/2009 7:04:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Driveway access	Turning left	None	None	Failed to yield to vehicle	Rain
1154	7/6/2010 1:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
1156	12/11/2012 6:10:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Stopped in traffic lane	None	None	None	Clear
1157	12/7/2011 10:25:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Other	Clear
1158	1/18/2012 8:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1159	3/12/2012 6:24:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Other	Clear
1160	1/8/2010 10:30:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchang e area	Stopped in traffic lane	None	None	None	Clear
1161	1/27/2012 7:35:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1162	10/28/2009 8:34:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Wet	Interchang e area	Straight ahead	None	None	Drinking	Rain
1164	3/4/2009 6:33:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
1165	7/11/2012 8:16:00 PM	Daylight	No collision between 2 MV in transport	Pedalcycle	Non-incapacitating	Dry	Interchang e area	Turning right	None	Pedestrian, bicyclist, other non-	Failed to yield to vehicle	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
										occupants in road		
1166	3/5/2009 1:57:00 PM	Daylight	No collision between 2 MV in transport	Fence	No injury	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
1167	4/6/2009 6:14:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Making U-turn	None	None	Improper turn	Clear
1168	1/24/2011 10:27:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
1169	7/29/2010 5:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Distracted list distraction in narrative	Rain

Arterial Intersection – 57th/Minnesota

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Crash Summary - 57th/Minnesota

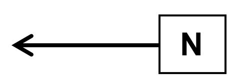
OBJE(	ACCIDENTI	LIGHTCONI	MANNEROF	FIRSTHARM	INJURYSEV	ROADSURF/	JUNCTION	VEHICLEM/	VEHCONTR	DRIVERCON	WEATHER
603	12/30/2009 4:33:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Slush	Driveway access	Turning right	None	Improper turn	Cloudy
620	9/11/2009 11:02:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	Distracted list distraction in narrative	Cloudy
692	12/17/2011 6:07:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Clear
696	1/20/2012 2:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Slush	Intersection related	Straight ahead	None	Driving too fast for conditions	Cloudy
697	12/2/2009 7:55:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Ice	Intersection related	Straight ahead	None	Driving too fast for conditions	Snow
699	3/17/2012 2:00:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Utility pole	No injury	Dry	Intersection related	Straight ahead	None	Running off road	Clear
700	10/8/2009 7:47:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	Followed too closely	Cloudy
701	7/27/2012 5:36:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	Followed too closely	Clear
702	5/10/2009 3:18:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	Disregarded traffic signs or signals	Clear
703	7/4/2009 11:42:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	Disregarded traffic signs or signals	Clear
704	7/27/2009 5:04:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	Failed to yield to vehicle	Clear
705	8/10/2009 3:08:00 AM	Dark - lighted	Angle	Motor vehicle in	Possible	Dry	Four-way intersection	Straight ahead	None	Disregarded traffic signs	Clear

OBJE(	ACCIDENTI	LIGHTCONI	MANNEROF	FIRSTHARM	INJURYSEV	ROADSURF/	JUNCTION	VEHICLEM/	VEHCONTR	DRIVERCON	WEATHER
		roadway		transport						or signals	
706	6/19/2009 11:23:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	Failed to yield to vehicle	Clear
707	9/9/2009 5:20:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	Failed to yield to vehicle	Clear
708	10/17/2009 11:59:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	Improper turn	Cloudy
709	10/26/2009 5:32:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Incapacitati ng	Dry	Four-way intersection		None	Disregarded traffic signs or signals	Clear
710	1/8/2010 2:10:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Motor vehicle used as equipment snowplow plowing	No injury	Snow	Four-way intersection	Straight ahead	None	None	Clear
711	6/30/2010 10:06:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	Improper turn	Clear
712	7/10/2010 9:31:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Cloudy
713	10/4/2010 11:56:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	Failed to yield to vehicle	Clear
714	10/5/2010 6:09:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	Failed to yield to vehicle	Clear
715	10/18/2010 2:55:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	Failed to yield to vehicle	Clear
716	1/31/2011 6:05:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	Driving too fast for conditions	Cloudy
717	5/2/2011 12:55:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Clear
718	11/10/2011	Dark -	Angle	Motor	Non-	Dry	Four-way	Turning left	None	Failed to	Clear

OBJE(	ACCIDENTI	LIGHTCONI	MANNEROF	FIRSTHARM	INJURYSEV	ROADSURF/	JUNCTION	VEHICLEM/	VEHCONTR	DRIVERCON	WEATHER
	5:23:00 PM	lighted roadway		vehicle in transport	incapacitating		intersection			yield to vehicle	
719	11/18/2011 8:42:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	Disregarded traffic signs or signals	Clear
720	9/21/2012 11:38:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Changing lanes	None	None	Clear
721	12/17/2012 3:02:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	Disregarded traffic signs or signals	Cloudy
722	1/10/2011 8:36:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Intersection related	Turning right	None	Driving too fast for conditions	Cloudy
723	12/7/2011 11:34:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	Distracted list distraction in narrative	Clear
724	5/14/2012 11:15:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	Distracted list distraction in narrative	Clear
725	11/9/2011 4:58:00 PM	Dusk	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	Improper lane change	Clear
726	9/10/2012 9:50:00 AM	Daylight	No collision between 2 MV in transport	Tree/shrubbery	Incapacitating	Dry	Non-junction	Straight ahead	Fuel system	Not applicable	Clear
728	11/27/2012 1:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	Followed too closely	Clear
730	5/15/2012 5:47:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	Followed too closely	Clear
732	7/1/2010 7:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	Followed too closely	Clear
733	7/19/2010 5:31:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	Distracted list distraction	Clear

OBJE	ACCIDENT	LIGHTCON	MANNEROF	FIRSTHARM	INJURYSEV	ROADSURF	JUNCTION	VEHICLEM	VEHCONTR	DRIVERCON	WEATHER
										in narrative	
735	8/22/2011 3:57:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	Followed too closely	Cloudy
738	2/24/2010 12:09:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	Followed too closely	Clear
739	9/8/2010 4:06:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	Distracted list distraction in narrative	Rain
740	10/19/2010 5:50:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Cloudy
749	6/26/2012 6:24:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Turning right	None	None	Clear
760	1/9/2012 9:18:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Clear

Arterial Intersection – 33rd/Cliff

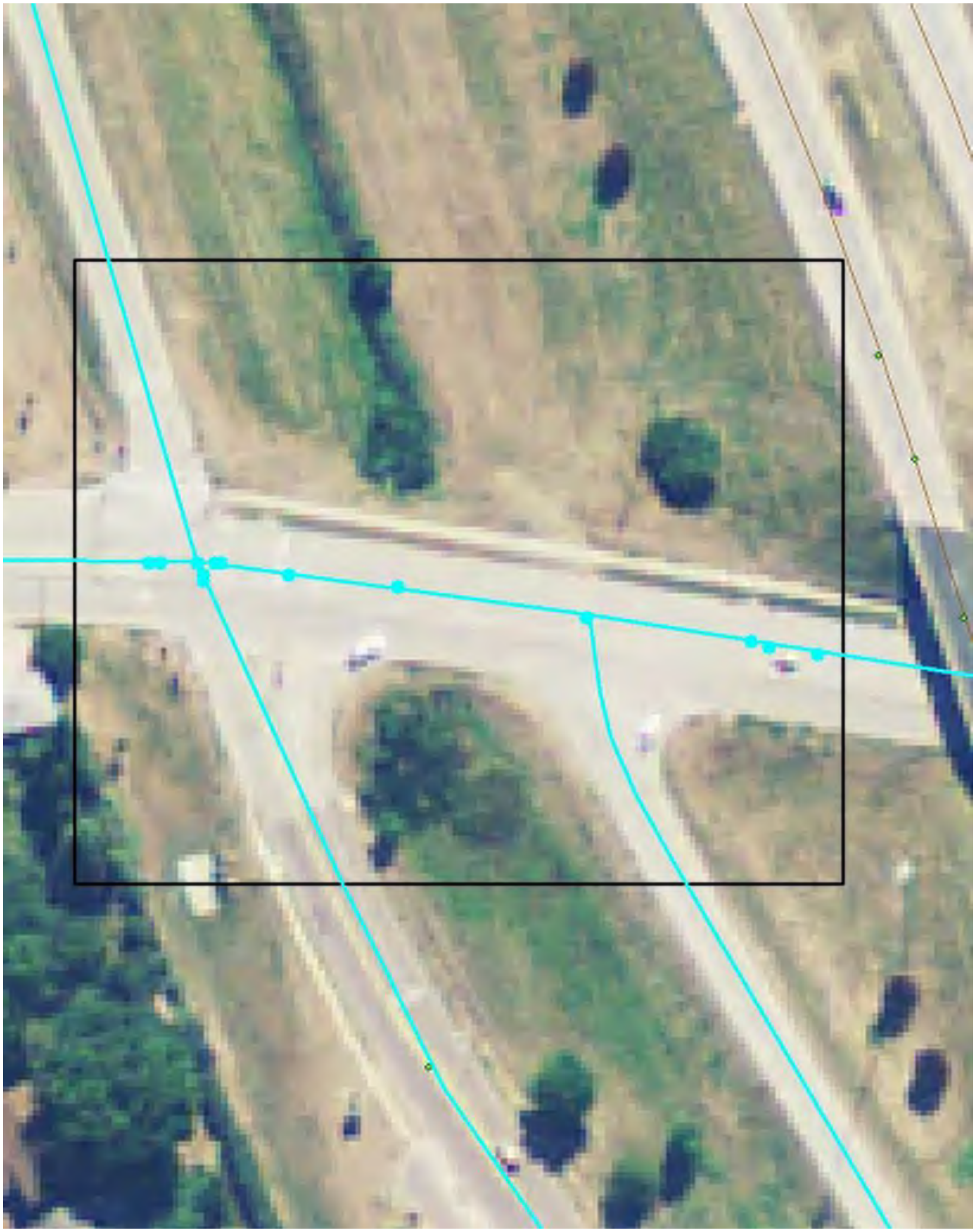


Crash Summary - 33rd/Cliff

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2209	3/12/2012 3:32:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
2223	8/27/2010 10:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	None	Clear
2224	9/1/2010 8:38:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2225	6/20/2009 9:06:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2226	12/9/2009 3:35:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2227	1/20/2010 7:50:00 AM	Dawn	Angle	Motor vehicle in transport	No injury	Ice	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Sleet, hail freezing rain or drizzle
2228	9/29/2010 4:19:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2229	10/8/2010 5:11:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
2230	12/4/2010 11:14:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
2231	5/2/2011 4:11:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Other	Clear
2232	6/13/2011	Daylight	No collision	Pedalcycle	Non-	Dry	Four-way	Not	Not	Not	Not	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	7:13:00 PM		between 2 MV in transport		incapacitating		intersection	applicable	applicable	applicable	applicable	
2233	12/10/2011 11:09:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Other	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
2234	5/14/2012 2:41:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
2235	5/23/2012 11:38:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	None	None	Cloudy
2236	5/18/2012 10:35:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Failed to yield to vehicle	Clear
2237	7/29/2012 9:13:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
2238	4/25/2012 3:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Slowing in traffic lane	None	None	Followed too closely	Clear
2239	5/15/2012 5:27:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	None	Clear
2240	4/28/2010 8:36:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Drinking	Clear
2241	5/2/2012 9:13:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Curb	Non-incapacitating	Dry	Intersection related	Turning left	None	None	Failure to keep in proper lane	Clear
2242	8/11/2010 1:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	None	Clear
2245	2/26/2012 11:30:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Intersection related	Straight ahead	None	Other	Followed too closely	Blowing snow
2248	1/6/2010	Daylight	Sideswipe,	Motor	No injury	Ice	Intersectio	Straight	None	None	Driving too	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	7:49:00 AM		same direction	vehicle in transport			n related	ahead			fast for conditions	



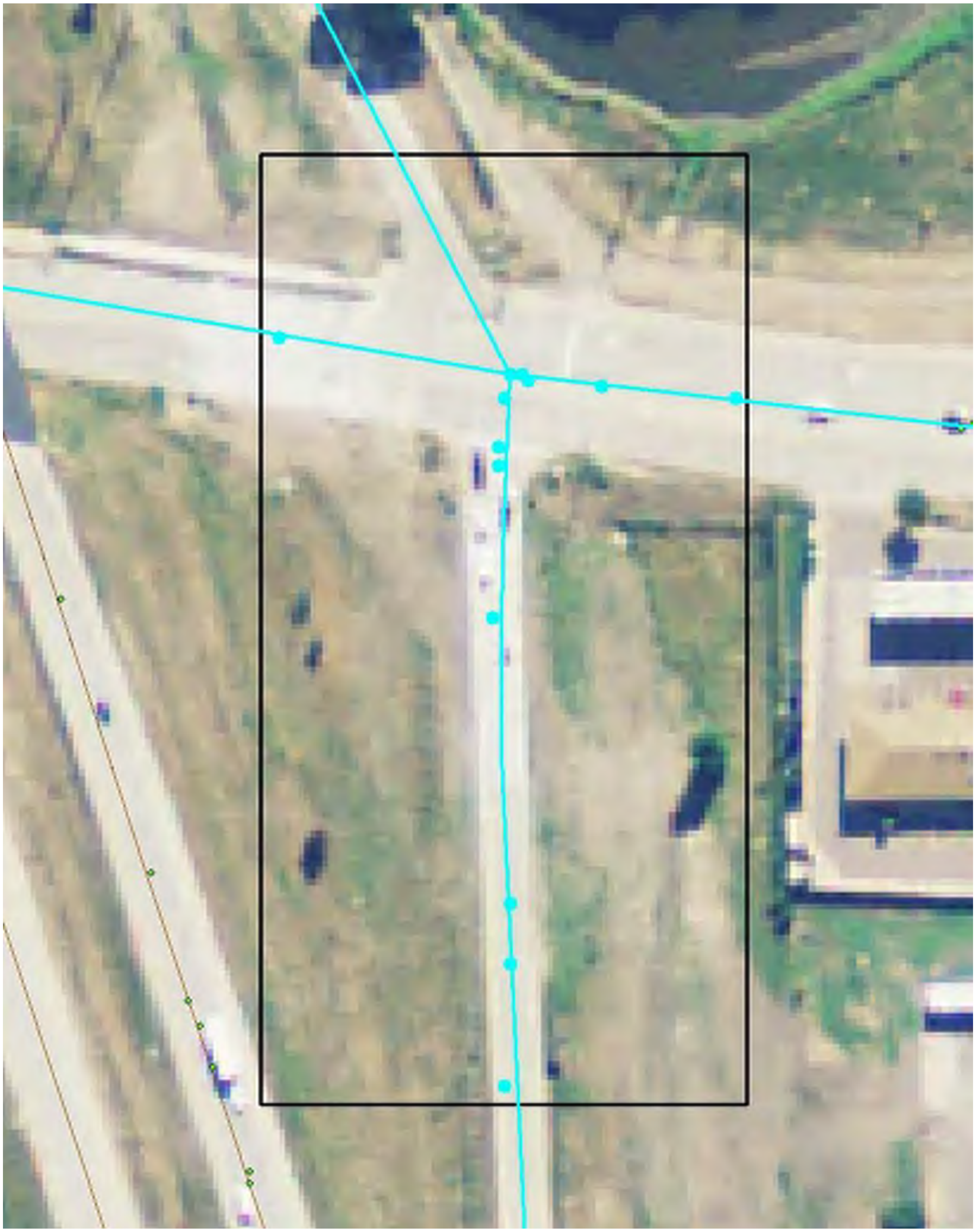
Arterial Intersection – I-229 SB/Cliff

Crash Summary - I-229 SB/Cliff

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1942	7/7/2011 5:31:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1971	11/14/2012 8:03:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1975	8/28/2010 10:23:00 PM	Dark - lighted roadway	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Failure to keep in proper lane	Clear
1976	8/1/2012 12:00:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Changing lanes	None	None	Failure to keep in proper lane	Clear
1977	10/9/2009 8:55:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Cloudy
1978	12/14/2009 8:04:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1979	8/6/2010 9:36:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Stopped in traffic lane	None	None	None	Clear
1980	10/19/2010 12:19:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1981	7/25/2011 4:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
1982	6/6/2012 8:42:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Turning right	None	None	None	Cloudy
1983	8/30/2009 12:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
1920	5/6/2010 5:19:00 PM	Daylight	Rear-end front to	Motor vehicle in	No injury	Dry	Interchange area	Straight ahead	None	None	None	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			rear	transport								
1922	8/10/2012 4:48:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Drinking	Clear
1924	10/31/2011 7:19:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
1930	6/2/2009 4:56:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	None	Clear
1931	6/29/2009 5:16:00 PM	Daylight	No collision between 2 MV in transport	Overturn/r ollover	Non-incapacitati ng	Dry	Interchang e area	Straight ahead	None	Debris	Distracted list distraction in narrative	Clear
1932	1/28/2010 5:12:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
1933	4/16/2010 5:12:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
1934	3/12/2012 5:25:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
1935	8/16/2012 4:45:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
1984	9/21/2012 2:27:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Failed to yield to vehicle	Clear
1985	6/5/2009 9:20:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning right	None	None	Improper turn	Clear
1986	7/4/2010 4:09:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Interchang e area	Straight ahead	Brakes	None	Disregarde d traffic signs or signals	Clear
1987	9/13/2010 5:07:00 PM	Daylight	Angle	Motor vehicle in	No injury	Dry	Interchang e area	Turning left	None	None	Failed to yield to	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
				transport							vehicle	
1988	8/26/2011 3:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
1989	12/31/2011 4:53:00 PM	Dusk	Angle	Motor vehicle in transport	No injury	Wet	Interchange area	Turning left	None	None	Failed to yield to vehicle	Rain
1990	3/6/2012 6:45:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
1991	4/15/2012 8:29:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Wet	Interchange area	Turning right	None	None	Improper lane change	Cloudy
1992	7/28/2012 10:56:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Interchange area	Turning left	None	None	Failed to yield to vehicle	Cloudy
1993	8/1/2012 11:59:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
1994	8/2/2012 4:21:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
1996	10/27/2009 7:58:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
1997	5/5/2009 5:58:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear



Arterial Intersection – I-229 NB/Cliff

N

Crash Summary - I-229 NB/Cliff

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1429	3/6/2010 10:23:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
1625	9/24/2011 1:51:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitat ing	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
1672	2/28/2011 10:50:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Straight ahead	None	None	Other	Clear
1675	4/17/2012 8:10:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	Brakes	None	Followed too closely	Cloudy
1676	11/5/2012 7:58:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
1677	1/28/2011 9:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Incapacitat ing	Wet	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
1678	1/31/2011 3:54:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1679	7/6/2009 4:11:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Failed to yield to vehicle	Clear
1680	9/16/2009 3:30:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	Headlights	None	Disregarde d traffic signs or signals	Clear
1681	12/2/2009 8:35:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitati ng	Ice	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
1682	2/19/2010	Daylight	Angle	Motor	Possible	Wet	Interchang	Straight	None	None	Disregarde	Cloudy

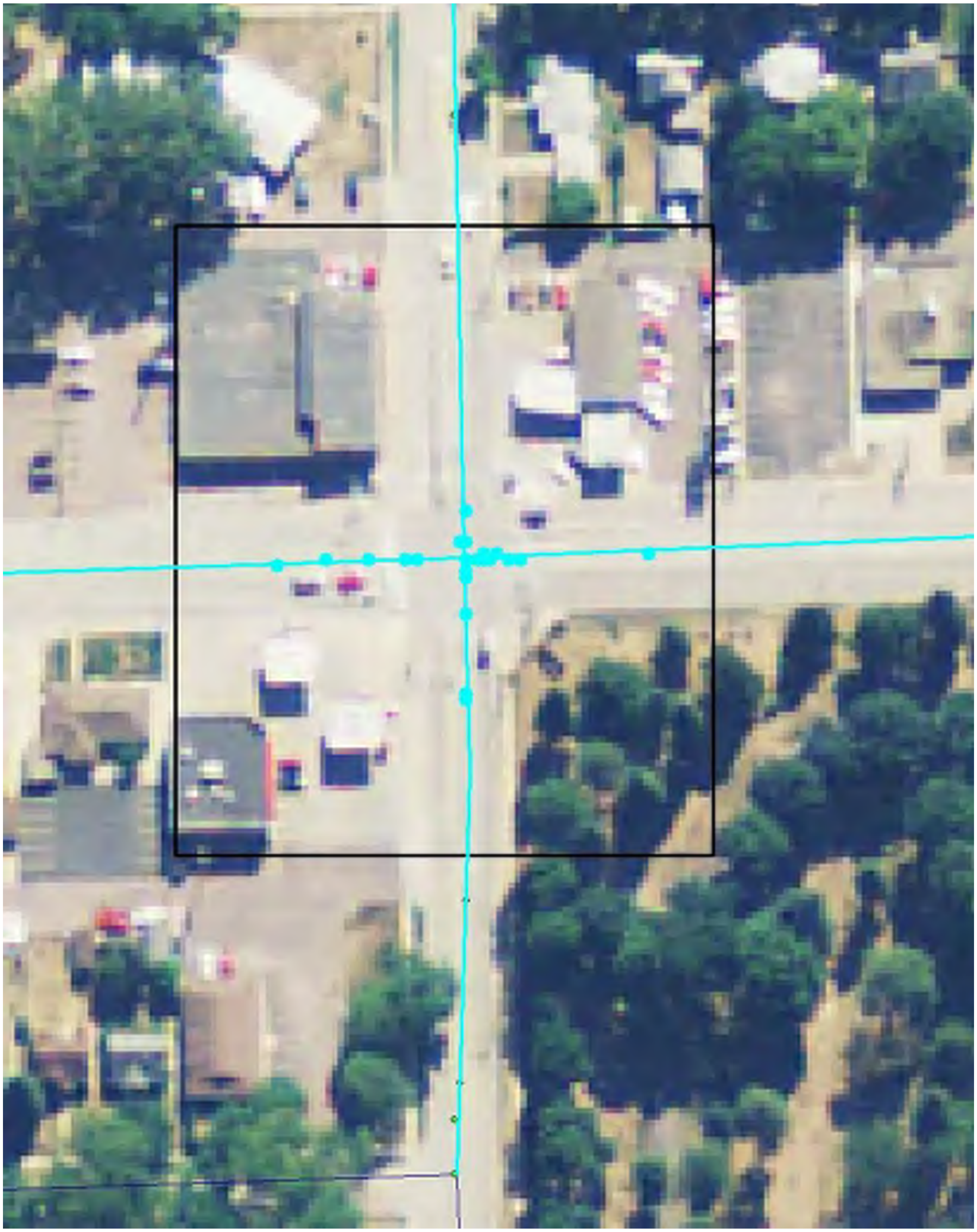
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	3:17:00 PM			vehicle in transport			e area	ahead			d traffic signs or signals	
1683	4/21/2010 6:20:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
1684	1/20/2011 2:00:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Curb	Possible	Frost	Interchang e area	Leaving traffic lane	Other	Unknown	Disregarde d traffic signs or signals	Clear
1685	12/4/2012 3:16:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Interchang e area	Straight ahead	None	None	Unknown	Clear
1686	1/18/2011 7:58:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
1687	12/14/2010 6:30:00 AM	Dark - roadway not lighted	Rear-end front to rear	Motor vehicle in transport	Non-incapacitati ng	Ice	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
1688	4/12/2010 8:20:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
1689	4/17/2012 9:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
1690	4/23/2012 7:31:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Failed to yield to vehicle	Clear
1858	10/31/2011 7:15:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear

Arterial Intersection – 49th/Cliff

Crash Summary - 49th/Cliff

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
1067	4/1/2010 1:57:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
1072	9/30/2010 9:21:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1073	7/3/2009 7:39:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	T-intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
1074	1/29/2010 7:50:00 AM	Daylight	No collision between 2 MV in transport	Utility pole	No injury	Wet	T-intersection	Straight ahead	None	Non-contact vehicle caused evasive action	Running off road	Clear
1075	5/10/2010 12:00:00 PM	Daylight	No collision between 2 MV in transport	Jackknife	No injury	Wet	T-intersection	Straight ahead	None	Other	Other	Cloudy
1076	7/15/2010 5:08:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Turning left	None	None	None	Clear
1077	3/15/2012 7:45:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
1078	7/27/2011 9:58:00 AM	Daylight	No collision between 2 MV in transport	Pedalcycle	Non-incapacitating	Dry	Intersection related	Not applicable	Not applicable	Not applicable	Not applicable	Clear
1079	9/21/2010 8:05:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Other	Clear
1083	11/5/2009 6:42:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
1084	5/11/2011 7:39:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
1110	11/6/2012 6:45:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1112	11/14/2012 8:16:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
1116	10/13/2010 5:17:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear



Arterial Intersection – 26th/Cliff

N

Crash Summary - 26th/Cliff

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2391	10/5/2009 3:25:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Turning left	None	None	None	Cloudy
2392	12/29/2009 10:17:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Four-way intersection	Backing	None	None	Improper backing	Clear
2393	9/22/2010 11:26:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
2394	10/15/2010 7:38:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Improper turn	Clear
2395	1/31/2011 12:27:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2396	3/10/2011 7:26:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Pedestrian	Possible	Dry	Four-way intersection	Turning right	None	Pedestrian, bicyclist, other non-occupants in road	None	Clear
2397	7/19/2012 9:39:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	Unknown	None	Unknown	Clear
2398	12/9/2012 11:26:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Slush	Four-way intersection	Slowing in traffic lane	None	None	Driving too fast for conditions	Snow
2399	12/26/2009 10:43:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2400	5/31/2012	Daylight	Rear-end	Motor	No injury	Dry	Intersectio	Straight	None	None	Followed	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	5:30:00 PM		front to rear	vehicle in transport			n related	ahead			too closely	
2401	3/3/2010 5:10:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	Fuel system	None	Followed too closely	Clear
2404	12/17/2010 3:44:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Intersection related	Turning right	None	None	Unknown	Clear
2339	5/8/2012 4:52:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
2359	5/11/2012 6:47:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Other	Cloudy
2368	11/5/2009 4:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Other	Clear
2370	6/4/2010 6:47:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Improper lane change	Clear
2372	8/9/2011 3:48:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
2374	12/18/2012 6:55:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Intersection related	Straight ahead	None	None	Driving too fast for conditions	Cloudy
2375	5/25/2011 12:12:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
2380	12/2/2009 7:48:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Ice	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
2384	11/11/2009 3:11:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Other	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2385	5/26/2011 4:08:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2386	5/2/2012 12:15:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
2387	11/9/2010 10:43:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
2388	1/11/2011 3:30:00 PM	Daylight	No collision between 2 MV in transport	Snow bank	Possible	Ice	Intersection related	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2389	11/9/2012 9:51:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2390	2/4/2011 7:55:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Traffic signal support/signal	No injury	Wet	Intersection related	Straight ahead	None	None	Running off road	Cloudy
2428	2/1/2011 6:52:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Intersection related	Starting in traffic lane	None	Other	None	Clear
2437	6/30/2010 1:41:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
2438	1/18/2011 5:53:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Slush	Intersection related	Straight ahead	None	None	Driving too fast for conditions	Snow
2468	12/3/2010 2:06:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Other	Cloudy
2516	5/20/2010 5:03:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2534	11/29/2012 4:38:00 PM	Dusk	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear

Arterial Intersection – 26th/Van Eps

N

Crash Summary - 26th/Van Eps

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2417	1/7/2011 2:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Other	Clear
2418	10/9/2010 5:16:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2419	7/31/2012 7:38:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
2420	10/12/2011 6:37:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	None	Followed too closely	Cloudy
2421	5/5/2010 8:08:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear

Arterial Intersection – 26th/Yeager

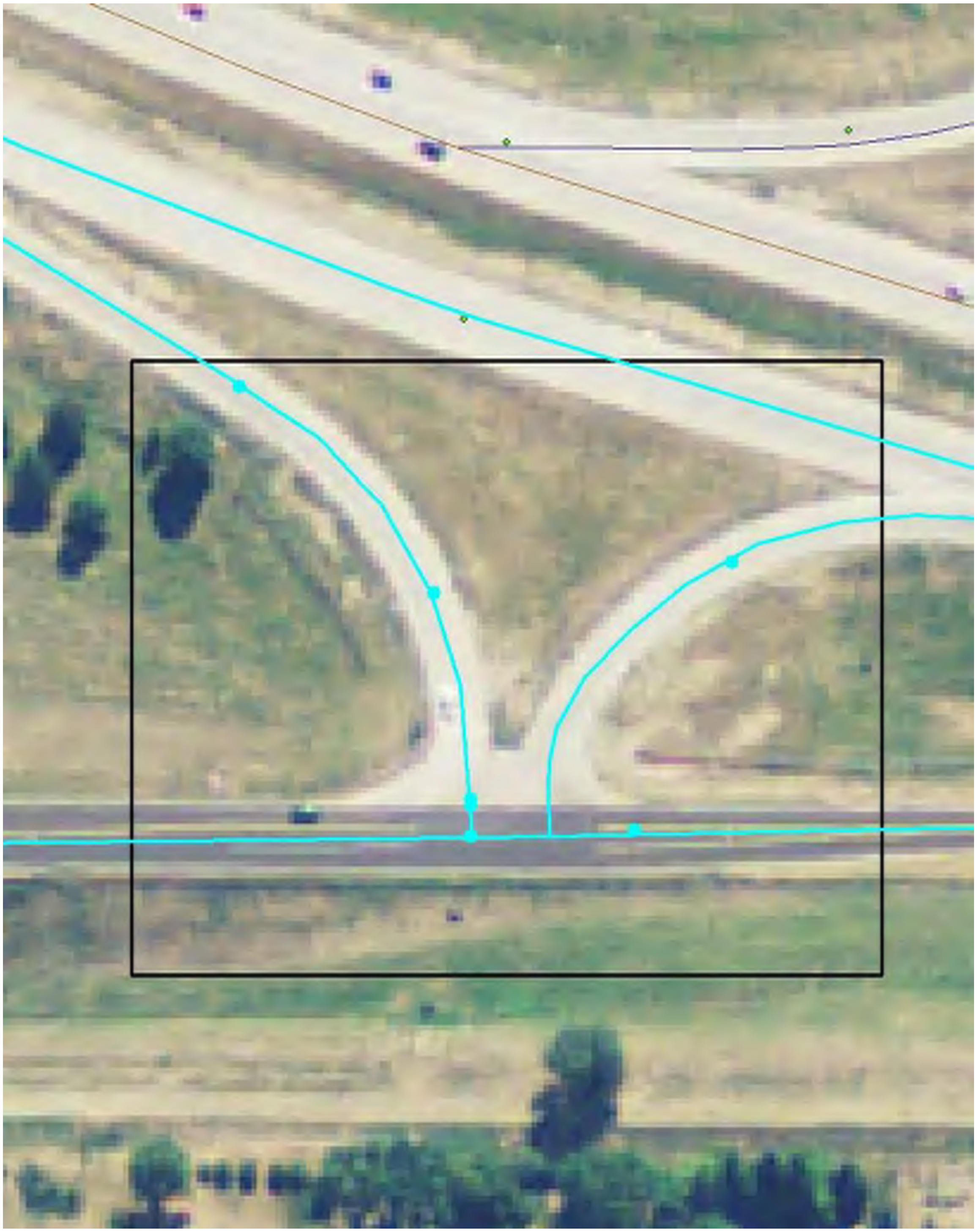
N

Crash Summary - 26th/Yeager

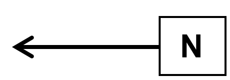
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2427	3/9/2011 8:17:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Drinking	Clear
2439	10/10/2011 5:03:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2440	6/19/2010 12:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
2443	5/8/2009 2:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Rain
2444	6/30/2009 11:29:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	No injury	Dry	T-intersection	Turning left	None	None	Drinking	Clear
2445	10/30/2009 7:59:00 AM	Dawn	Angle	Motor vehicle in transport	No injury	Wet	T-intersection	Straight ahead	None	None	Unknown	Rain
2446	12/4/2009 7:07:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2447	1/11/2010 5:44:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Wet	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2448	6/7/2010 10:40:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
2449	10/18/2010 9:56:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2450	12/19/2011	Dark -	Angle	Motor	Possible	Dry	T-	Turning	None	None	Failed to	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	6:54:00 PM	lighted roadway		vehicle in transport			intersection	left			yield to vehicle	
2451	12/21/2011 5:16:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2452	1/17/2012 4:15:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2453	4/26/2012 1:52:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Incapacitating	Dry	T-intersection	Straight ahead	None	None	Unknown	Cloudy
2454	12/20/2012 12:12:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2455	8/20/2012 4:19:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Stopped in traffic lane	None	None	None	Clear
2456	9/24/2009 5:28:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Slowing in traffic lane	None	None	Followed too closely	Clear
2457	12/30/2009 8:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Cloudy
2458	7/18/2012 6:22:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	Brakes	None	None	Clear
2459	10/21/2011 4:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2460	3/4/2010 7:51:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2461	6/24/2010 8:48:00 AM	Daylight	Rear-end front to	Motor vehicle in	Non-incapacitati	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
			rear	transport	ng							
2462	1/19/2012 6:13:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	None	Clear
2463	4/6/2012 5:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2464	11/19/2010 5:20:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
2465	1/19/2012 7:24:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
2466	10/8/2010 4:51:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear

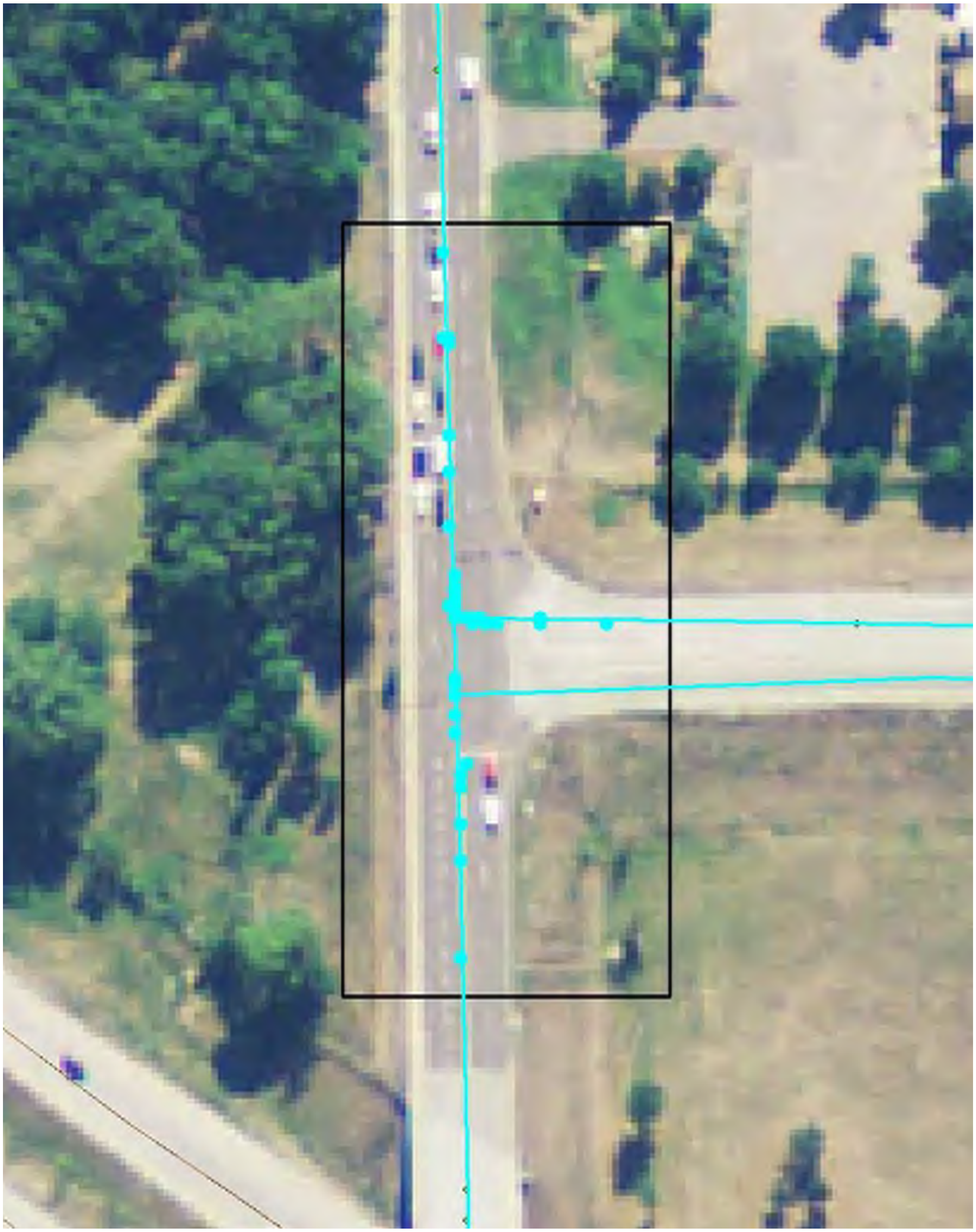


Arterial Intersection – I-229 SB/Yeager



Crash Summary - I-229 SB/Yeager

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2302	5/17/2009 4:00:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Running off road	Clear
2307	10/3/2011 3:58:00 PM	Daylight	No collision between 2 MV in transport	Pedestrian	Non-incapacitating	Dry	Non-junction	Straight ahead	None	Pedestrian, bicyclist, other non-occupants in road	Not applicable	Clear
2316	4/15/2010 1:45:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
2317	8/18/2010 5:00:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
2318	12/11/2010 1:05:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Disregarded traffic signs or signals	Snow
2319	10/17/2012 4:31:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Cloudy
2320	7/3/2012 11:25:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2323	11/29/2010 3:50:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
2328	11/3/2011 11:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	None	Clear



Arterial Intersection – I-229 NB/26th

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Crash Summary - I-229 NB/26th

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2376	4/16/2010 4:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
2377	6/14/2012 6:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2429	1/5/2011 3:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2430	2/15/2011 2:09:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2431	5/12/2012 10:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2432	12/22/2009 6:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2467	12/28/2011 3:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Cloudy
2470	11/25/2011 11:55:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Stopped in traffic lane	None	None	None	Cloudy
2472	1/31/2012 3:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
2476	12/1/2010 6:49:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
2477	12/22/2009 3:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchange area	Turning right	None	None	Distracted list distraction in narrative	Cloudy
2478	12/24/2009 12:57:00	Daylight	Rear-end front to	Motor vehicle in	Possible	Slush	Interchange area	Straight ahead	None	None	Distracted list	Cloudy

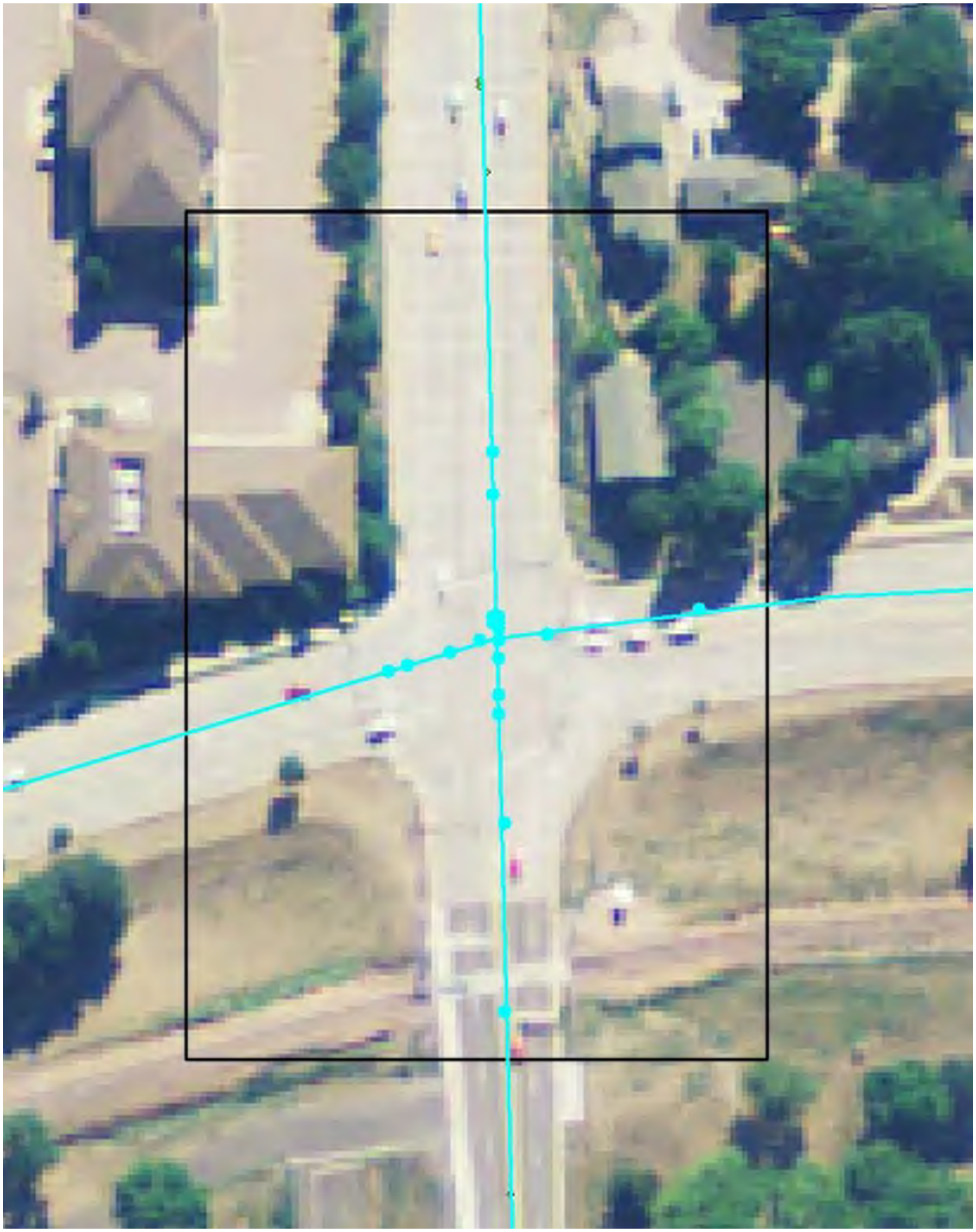
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	PM		rear	transport							distraction in narrative	
2479	8/24/2010 12:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	None	Clear
2480	9/2/2010 10:44:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
2481	1/15/2011 9:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchang e area	Stopped in traffic lane	None	None	None	Cloudy
2482	6/16/2011 6:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
2483	11/12/2012 1:09:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Other	Clear
2487	12/20/2011 5:47:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
2488	7/5/2009 10:49:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Other	Clear
2489	11/10/2009 7:23:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Turning right	None	None	Followed too closely	Clear
2490	9/3/2009 7:45:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Non-junction	Changing lanes	None	Road surface condition wet, icy, snow, slush, etc.	Improper lane change	Cloudy
2491	7/11/2012 6:24:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitati ng	Dry	Non-junction	Straight ahead	None	None	Failed to yield to vehicle	Clear
2492	3/7/2011 10:11:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow,	Followed too closely	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
										slush, etc.		
2493	5/1/2009 7:46:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
2494	11/10/2010 10:05:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Interchange area	Straight ahead	Brakes	None	Followed too closely	Cloudy
2495	12/29/2009 12:21:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Frost	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Clear
2496	3/13/2009 5:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Other	Clear
2497	8/27/2011 4:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Turning right	None	None	None	Clear
2498	12/28/2012 11:57:00 AM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Wet	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
2499	10/7/2010 12:52:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
2500	4/14/2009 6:16:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Drinking	Clear
2501	1/31/2011 4:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchange area	Turning right	None	None	Driving too fast for conditions	Snow
2502	2/1/2011 11:25:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2503	9/8/2011 11:12:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Unknown	Clear
2504	10/22/2011	Daylight	Angle	Motor	No injury	Dry	Interchang	Straight	None	None	Unknown	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	11:39:00 AM			vehicle in transport			e area	ahead				
2505	2/2/2012 12:50:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
2506	2/11/2012 5:09:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Turning right	None	None	Distracted list distraction in narrative	Clear
2507	10/14/2012 4:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2508	7/24/2012 7:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Stopped in traffic lane	None	None	None	Clear
2509	6/19/2009 9:26:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2510	9/15/2010 5:01:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Straight ahead	None	None	Followed too closely	Rain
2511	10/10/2009 9:51:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2512	1/28/2012 8:06:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Cell phone	Clear
2513	7/28/2012 9:27:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
2514	10/14/2012 4:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
											in narrative	
2515	1/31/2011 9:15:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Slush	Interchang e area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2518	1/13/2010 8:40:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Stopped in traffic lane	None	None	None	Clear
2519	7/14/2011 5:46:00 PM	Daylight	No collision between 2 MV in transport	Fence	No injury	Dry	Non-junction	Straight ahead	None	None	Illness heart attack, stroke, etc.	Cloudy
2520	12/4/2011 12:37:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	Body, doors, hood	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Clear
2521	12/26/2009 3:28:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Driveway access	Turning right	None	Other	Failed to yield to vehicle	Cloudy
2522	7/15/2010 5:57:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
2523	6/29/2012 4:57:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
2524	8/20/2012 7:42:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2525	5/7/2009 8:15:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Non-junction	Straight ahead	Brakes	None	Unknown	Cloudy
2526	8/14/2012 8:30:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2527	5/28/2009 4:08:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear



Arterial Intersection – 26th/Southeastern

N

Crash Summary - 26th/Southeastern

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2382	12/4/2012 6:40:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
2528	9/23/2009 6:51:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	None	Cloudy
2535	12/8/2009 11:10:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	Tires	None	Driving too fast for conditions	Snow
2536	12/22/2010 10:41:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Other fixed object wall, building, tunnel, etc.	Possible	Slush	Non-junction	Straight ahead	None	None	Other	Cloudy
2537	11/2/2012 7:48:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
2538	12/17/2010 5:32:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Slush	Intersection related	Straight ahead	None	None	Followed too closely	Clear
2539	6/28/2011 12:50:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2540	11/14/2010 10:46:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
2541	8/31/2011 8:11:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	None	Cloudy
2542	8/1/2011 5:08:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Turning right	None	None	Followed too closely	Clear
2543	5/23/2009 6:45:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or	Rain

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
											signals	
2544	12/26/2009 10:08:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	None	Driving too fast for conditions	Snow
2545	2/1/2010 5:28:00 PM	Dusk	Angle	Motor vehicle in transport	Possible	Slush	Four-way intersection	Straight ahead	None	None	Driving too fast for conditions	Snow
2546	2/20/2010 9:09:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Disregarded traffic signs or signals	Cloudy
2547	2/14/2011 3:04:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2548	3/28/2011 9:16:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
2549	6/13/2011 9:33:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
2550	8/6/2011 5:10:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	None	Failure to keep in proper lane	Clear
2551	8/5/2011 3:01:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	Work zone construction/maintenance/utility	Failed to yield to vehicle	Cloudy
2552	12/14/2011 5:40:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
2553	1/17/2012 10:37:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	None	Followed too closely	Snow
2554	10/5/2012 9:11:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2555	5/10/2010 3:41:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Followed too closely	Rain

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
2556	12/11/2009 5:18:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Ice	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Clear
2557	1/6/2010 7:46:00 AM	Dusk	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Snow	Intersection related	Straight ahead	Steering	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Cloudy
2558	8/10/2011 8:00:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2559	12/22/2011 5:42:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
2560	12/18/2012 7:45:00 AM	Dawn	Angle	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Over-correcting/over-steering	Snow
2561	12/23/2009 5:05:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Slush	Intersection related	Straight ahead	None	None	Driving too fast for conditions	Snow
2562	11/29/2010 5:00:00 PM	Dusk	Angle	Motor vehicle in transport	No injury	Snow	Intersection related	Straight ahead	None	None	Driving too fast for conditions	Snow
2563	12/17/2009 2:49:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2564	12/12/2011 6:45:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	Unknown	None	Unknown	Cloudy
2565	12/2/2009	Dark -	Angle	Motor	No injury	Ice	Non-	Straight	None	None	Driving too	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	8:35:00 PM	lighted roadway		vehicle in transport			junction	ahead			fast for conditions	
2566	6/27/2010 3:23:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	Unknown	None	Unknown	Clear
2567	9/10/2010 8:05:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Exceeded posted speed limit	Rain
2569	12/28/2009 10:30:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Slush	Intersection related	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
2570	1/31/2011 1:03:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Intersection related	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
2598	2/1/2010 12:42:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Intersection related	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Cloudy
2609	3/29/2012 4:54:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
2622	10/12/2012 11:50:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Improper lane change	Clear

Arterial Intersection – 18th/Southeastern

N

Crash Summary - 18th/Southeastern

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2762	8/9/2012 1:02:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper passing	Clear
2763	9/20/2011 12:14:00 PM	Daylight	No collision between 2 MV in transport	Light/luminaire support	Incapacitating	Dry	Non-junction	Straight ahead	None	None	Running off road	Cloudy
2767	10/13/2010 11:13:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Cell phone	Clear
2768	5/3/2012 7:46:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
2770	6/22/2011 9:20:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Non-junction	Making U-turn	None	None	Improper turn	Cloudy
2771	2/7/2011 5:24:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Slowing in traffic lane	None	None	Followed too closely	Cloudy
2772	12/1/2009 7:15:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
2773	7/2/2010 4:13:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Overtaking /passing	None	None	None	Clear
2774	1/16/2011 10:01:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Backing	None	None	Improper backing	Cloudy
2775	6/24/2011 4:41:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear

Arterial Intersection – 18th/Cleveland

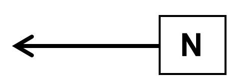
N

Crash Summary - 18th/Cleveland

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2782	8/1/2009 9:47:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
2790	10/29/2009 8:15:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Traffic signal support/signal	No injury	Wet	Intersection related	Turning right	None	None	Improper turn	Rain
2791	12/3/2010 10:28:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
2792	10/8/2009 6:43:00 PM	Dusk	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Unknown	Clear
2793	7/6/2010 11:10:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
2794	8/30/2010 12:10:00 PM	Daylight	No collision between 2 MV in transport	Traffic signal support/signal	Possible	Dry	Four-way intersection	Turning left	None	None	Running off road	Clear
2795	11/15/2010 7:10:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2796	5/20/2011 4:41:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
2797	7/20/2011 5:37:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning right	None	None	Unknown	Clear
2798	10/7/2011 3:03:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2799	8/8/2012 5:11:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2800	10/13/2012 3:40:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2801	11/16/2012 12:18:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
2802	12/22/2010 2:09:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Traffic signal support/signal	No injury	Frost	Intersection related	Turning left	None	None	Unknown	Cloudy
2803	8/5/2012 7:16:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
2804	10/15/2010 3:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
2807	11/1/2011 12:04:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
2815	9/29/2012 2:30:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Backing	None	None	Improper backing	Clear

Arterial Intersection – 12th/Lowell



Crash Summary - 12th/Lowell

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
3128	3/28/2011 3:17:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Failed to yield to vehicle	Cloudy
3129	8/25/2011 7:37:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Other	Clear
3130	10/18/2012 4:07:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Rain
3136	7/13/2010 4:39:00 PM	Daylight	No collision between 2 MV in transport	Pedalcycle	Possible	Dry	Intersection related	Not applicable	Not applicable	Not applicable	Not applicable	Clear

Arterial Intersection – 12th/Cleveland

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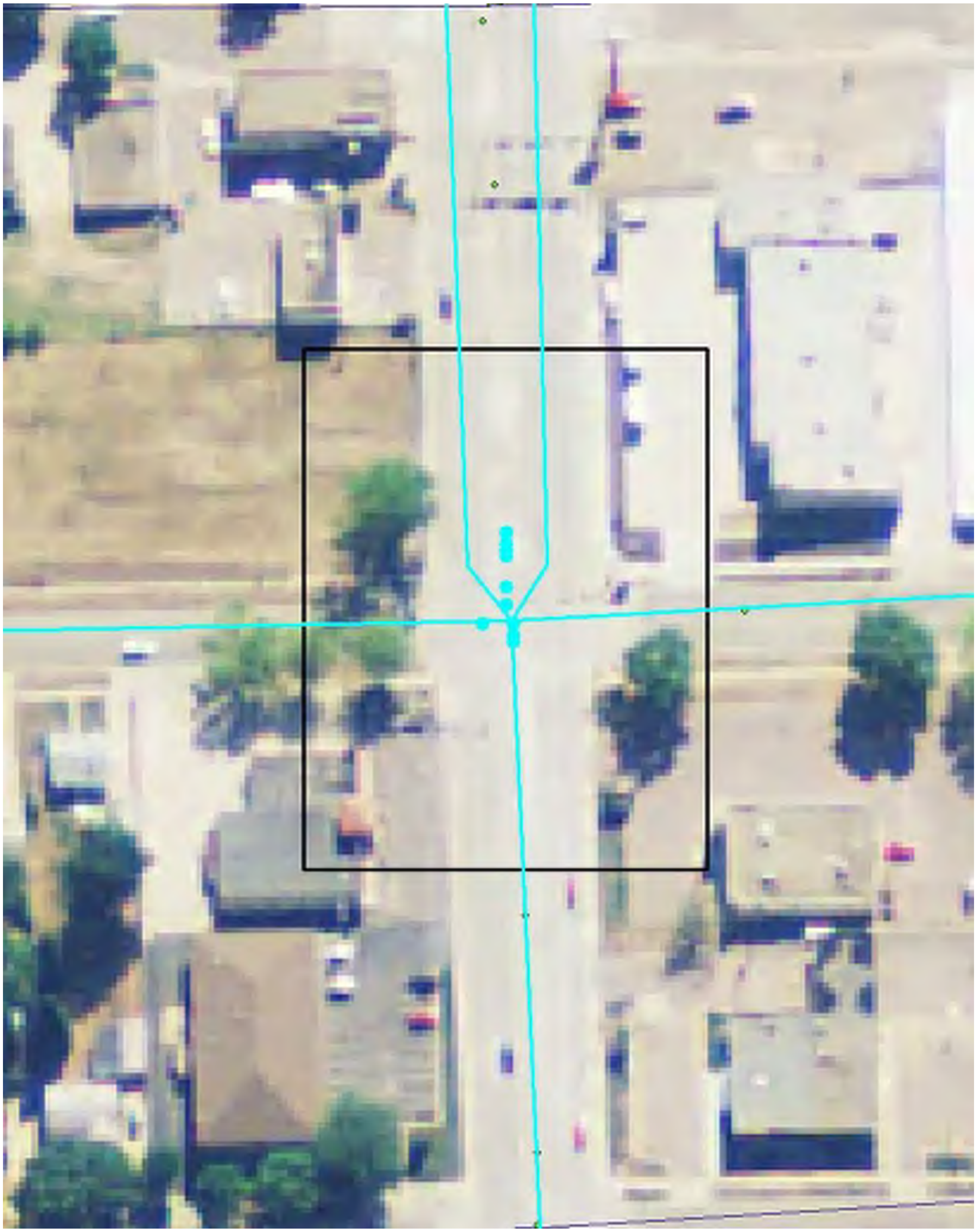
Crash Summary - 12th/Cleveland

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3127	1/31/2011 8:30:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Driveway access	Slowing in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
3134	9/9/2011 3:48:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersectio n related	Straight ahead	None	None	Other	Clear
3144	11/4/2010 7:34:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersectio n related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3156	6/5/2009 10:07:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
3157	10/16/2009 12:10:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Slowing in traffic lane	Brakes	None	None	Cloudy
3158	12/14/2009 12:23:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
3159	12/20/2009 10:20:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Snow
3160	1/6/2010 7:28:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Snow
3161	7/20/2010 10:23:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Failed to yield to vehicle	Clear
3162	12/16/2010 9:11:00 AM	Daylight	Angle	Motor vehicle in	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
				transport							signs or signals	
3163	6/5/2011 3:01:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
3164	7/27/2011 12:42:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
3165	10/14/2011 9:20:00 AM	Daylight	No collision between 2 MV in transport	Utility pole	No injury	Dry	Four-way intersection	Turning right	None	None	Improper turn	Clear
3166	8/2/2012 10:45:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
3167	10/11/2012 8:40:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	None	None	Cloudy
3168	1/22/2010 6:46:00 AM	Dark - roadway not lighted	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Sleet, hail freezing rain or drizzle
3192	11/30/2010 7:53:00 AM	Dawn	No collision between 2 MV in transport	Other post, pole, or support	No injury	Snow	Intersection related	Straight ahead	None	None	Driving too fast for conditions	Clear

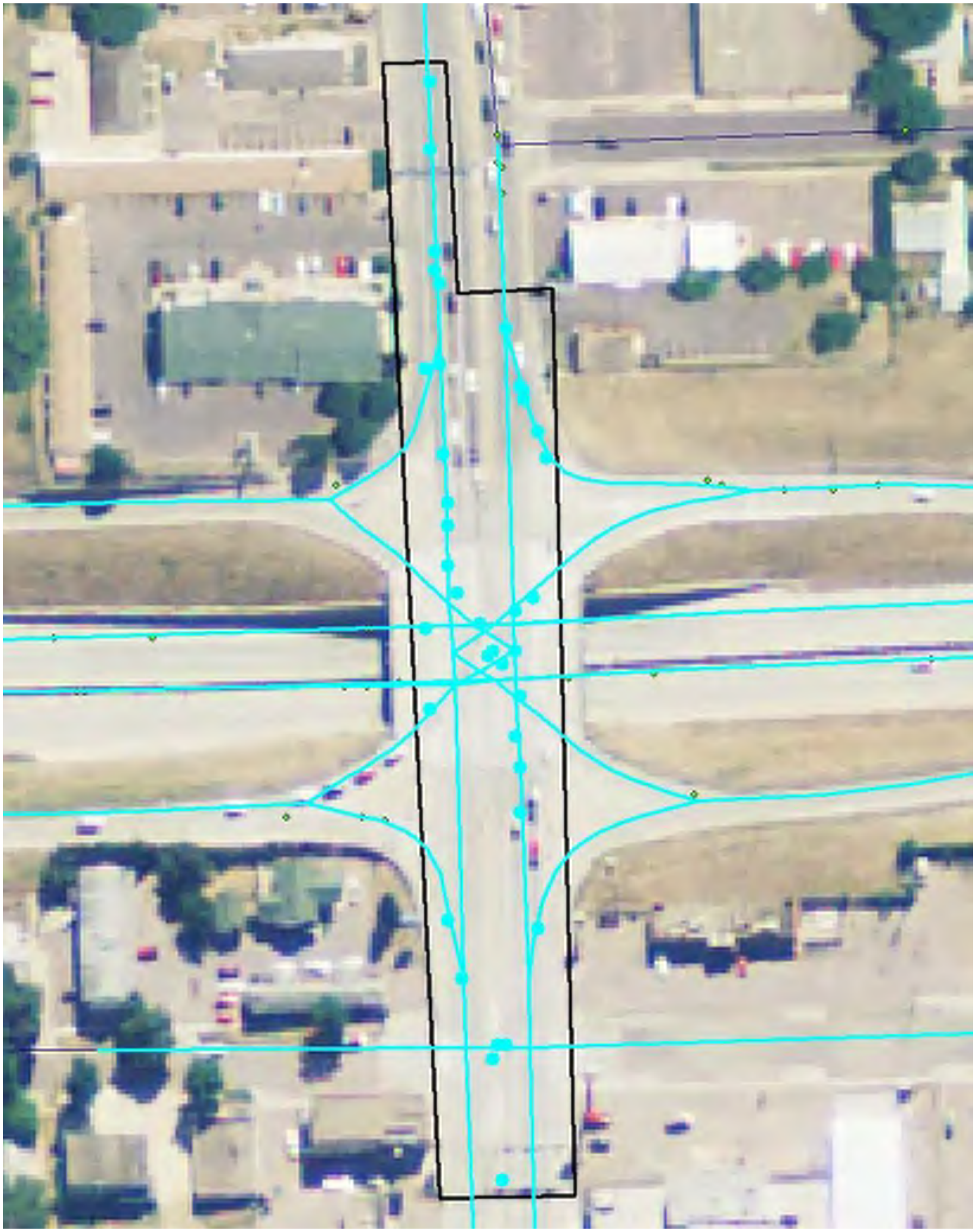


Arterial Intersection – 10th/Lowell

Crash Summary - 10th/Lowell

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3638	8/13/2010 5:29:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
3639	12/9/2011 3:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3640	3/31/2009 5:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersection related	Straight ahead	None	None	Other	Cloudy
3641	6/8/2009 7:00:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
3642	10/9/2009 5:05:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Driving too fast for conditions	Clear
3643	4/14/2010 2:17:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
3644	8/14/2010 12:23:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Making U-turn	None	None	Failed to yield to vehicle	Clear
3645	8/28/2010 10:20:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
3646	1/21/2011 8:10:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Slush	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
3647	1/31/2011 11:21:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
3648	3/2/2011	Daylight	Angle	Motor	Possible	Dry	Four-way	Straight	None	None	Disregarde	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	1:18:00 PM			vehicle in transport			intersection	ahead			d traffic signs or signals	
3653	6/30/2010 2:14:00 PM	Daylight	No collision between 2 MV in transport	Curb	No injury	Dry	Intersection related	Turning left	None	None	Drinking	Clear
3654	5/31/2012 12:43:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Non-junction	Turning left	None	None	Failed to yield to vehicle	Cloudy
3655	8/20/2012 5:37:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3656	5/15/2009 12:29:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3657	10/1/2011 1:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3658	4/28/2012 5:14:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
3659	4/19/2010 5:09:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
3660	9/22/2010 12:58:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Rain
3679	6/11/2011 7:12:00 PM	Daylight	No collision between 2 MV in transport	Tree/shrubbery	No injury	Dry	Intersection related	Turning right	None	None	Disregarded traffic signs or signals	Clear



Arterial Intersection – I-229/10th

Crash Summary - I-229/10th

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
3621	1/11/2011 2:57:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3624	10/11/2010 8:15:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	None	Clear
3625	11/4/2011 5:36:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
3626	1/29/2010 1:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3628	5/22/2012 10:51:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
3629	1/24/2010 4:02:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Incapacitating	Dry	Interchange area	Straight ahead	None	None	Exceeded posted speed limit	Clear
3630	7/21/2010 5:36:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3631	3/31/2009 6:41:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Rain
3632	6/29/2009 11:35:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3633	2/16/2010 8:58:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction	Clear

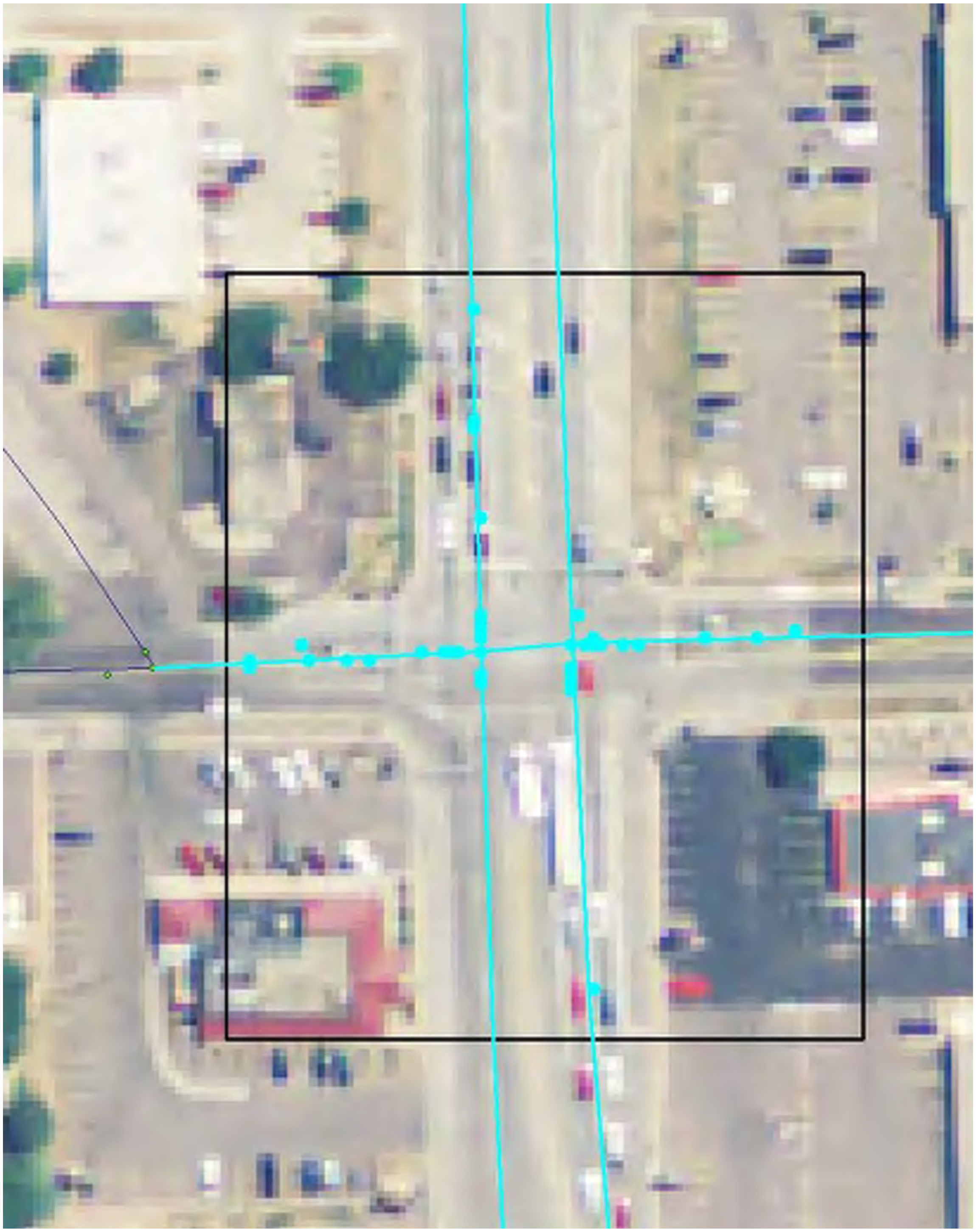
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
											in narrative	
3634	5/17/2010 8:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3635	8/3/2010 11:09:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Unknown	Cloudy
3636	2/12/2011 11:06:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Stopped in traffic lane	None	None	None	Clear
3637	3/10/2011 2:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3649	1/12/2011 9:02:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Ice	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
3650	3/15/2012 9:42:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
3651	2/9/2011 5:28:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
3652	3/6/2009 7:59:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Wet	Interchange area	Turning left	None	None	Illness heart attack, stroke, etc.	Clear
3661	7/31/2009 11:10:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Unknown	Clear
3662	7/10/2010 10:54:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Wet	Intersection related	Turning right	None	None	Drinking	Rain
3663	2/15/2012 6:15:00 PM	Dark - lighted	No collision between 2	Pedalcycle	Non-incapacitati	Dry	Intersection related	Turning right	Unknown	Pedestrian, bicyclist,	Failed to yield to	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
		roadway	MV in transport		ng					other non-occupants in road	vehicle	
3664	2/15/2011 11:43:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Interchange area	Changing lanes	None	None	Improper lane change	Clear
3665	7/9/2011 4:10:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3668	12/28/2009 7:25:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Snow bank	No injury	Snow	Non-junction	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist, etc.	Clear
3669	12/20/2009 2:33:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Stopped in traffic lane	None	None	None	Cloudy
3672	7/1/2009 1:53:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Followed too closely	Clear
3599	12/5/2009 3:37:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Stopped in traffic lane	None	None	None	Cloudy
3600	6/17/2011 5:33:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3601	6/12/2012 4:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Stopped in traffic lane	None	None	None	Clear
3610	8/15/2012 10:34:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Guardrail face	Possible	Dry	Interchange area	Straight ahead	None	None	Over-correcting/over-steering	Clear
3611	1/22/2011	Daylight	Rear-end	Motor	No injury	Wet	Interchang	Stopped in	None	None	None	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
	4:35:00 PM		front to rear	vehicle in transport			e area	traffic lane				
3612	1/23/2011 2:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
3613	12/14/2011 2:08:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Stopped in traffic lane	None	None	None	Cloudy
3614	11/2/2012 6:39:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
3680	12/28/2009 11:41:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Snow	Intersectio n related	Turning right	None	None	Driving too fast for conditions	Clear
3681	7/2/2009 7:08:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchang e area	Turning left	None	None	None	Clear
3683	8/24/2012 12:59:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Cloudy
3685	9/6/2011 5:46:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Bridge rail	No injury	Dry	Interchang e area	Straight ahead	None	None	None	Clear
3710	8/20/2012 1:46:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Possible	Dry	Interchang e area	Changing lanes	None	None	Improper turn	Clear
3715	9/23/2011 3:45:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
3716	9/16/2009 7:43:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	None	Clear
3717	5/14/2010 8:04:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
3718	11/12/2012 8:10:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
											narrative	
3719	6/12/2009 10:17:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Driving too fast for conditions	Cloudy
3720	7/26/2009 12:54:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	Other	None	Followed too closely	Clear
3721	6/1/2012 1:57:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Rain
3722	7/9/2011 3:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
3723	11/16/2009 6:54:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3724	9/16/2011 4:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Other	Cloudy
3727	2/24/2012 7:40:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Snow	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear
3728	3/7/2012 11:22:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
3729	6/26/2010 2:47:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
3732	10/1/2009 12:55:00	Daylight	Rear-end front to	Motor vehicle in	No injury	Wet	Interchange area	Turning right	None	Road surface	None	Rain

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	PM		rear	transport						condition wet, icy, snow, slush, etc.		
3733	2/27/2012 3:47:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Clear
3734	9/5/2011 7:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear
3735	7/1/2011 2:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Failed to yield to vehicle	Clear
3736	4/18/2009 11:25:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
3737	5/21/2009 5:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Slowing in traffic lane	None	None	None	Cloudy
3738	2/24/2012 8:25:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Ice	Interchang e area	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Clear



Arterial Intersection – 10th/Cleveland

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Crash Summary - 10th/Cleveland

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3666	4/22/2009 8:57:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Incapacitating	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
3582	9/19/2012 8:18:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access	Overtaking/passing	Unknown	None	Improper passing	Clear
3593	5/29/2010 12:20:00 PM	Daylight	No collision between 2 MV in transport	Pedestrian	Incapacitating	Dry	Non-junction	Not applicable	Not applicable	Not applicable	Not applicable	Clear
3602	10/29/2009 7:42:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersection related	Straight ahead	None	None	Followed too closely	Rain
3675	7/30/2011 10:07:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
3684	11/4/2010 10:38:00 AM	Daylight	No collision between 2 MV in transport	Other movable object	Possible	Dry	Intersection related	Straight ahead	None	None	Illness heart attack, stroke, etc.	Clear
3686	12/22/2010 12:33:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Improper lane change	Cloudy
3687	2/13/2012 7:45:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Intersection related	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
3688	12/17/2009 10:40:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3689	1/5/2011 12:17:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Incapacitating	Wet	Driveway access related	Turning right	None	None	Followed too closely	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3690	11/15/2011 5:13:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
3691	2/9/2011 1:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Failed to yield to vehicle	Clear
3692	8/24/2011 5:31:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Improper lane change	Clear
3693	9/2/2012 6:31:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Drugs-Other	Clear
3694	5/30/2012 9:47:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Driving too fast for conditions	Cloudy
3695	7/11/2012 6:04:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
3696	8/31/2012 7:03:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
3697	4/19/2012 9:35:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Wet	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Rain
3698	4/7/2009 12:24:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Followed too closely	Clear
3699	4/24/2009 5:06:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
3700	10/3/2009 8:45:00 PM	Dark - lighted roadway	Head-on front to front	Motor vehicle in transport	Possible	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Rain
3701	4/6/2010 11:20:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Rain

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
3702	12/23/2010 8:29:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	None	None	Snow
3703	1/12/2011 6:10:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Snow	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
3704	9/25/2011 9:42:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failure to keep in proper lane	Clear
3705	9/29/2011 7:34:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
3706	12/28/2011 10:59:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
3707	5/29/2012 1:34:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
3708	7/8/2012 6:39:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
3709	7/17/2012 12:04:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
3741	9/21/2011 7:58:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Improper lane change	Cloudy
3742	2/7/2011 7:50:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Turning left	None	None	Distracted list distraction in narrative	Clear
3743	5/1/2009 4:59:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
3744	5/15/2009 3:10:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Drinking	Clear
3745	11/12/2009	Dark -	Angle	Motor	No injury	Dry	Four-way	Straight	None	None	Unknown	Cloudy

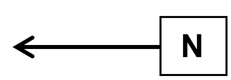
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	9:50:00 PM	lighted roadway		vehicle in transport			intersection	ahead				
3746	12/17/2009 8:20:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
3747	9/30/2010 6:38:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
3748	10/23/2010 5:41:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
3749	6/12/2011 5:04:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Illegally in roadway	Clear
3750	7/13/2011 2:26:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Rain
3751	8/12/2011 2:36:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitat ing	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
3752	9/28/2011 5:15:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
3753	10/12/2011 4:55:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Four-way intersection	Changing lanes	None	None	Improper lane change	Clear
3754	12/4/2011 1:36:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
3755	12/10/2011 1:26:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic signs or signals	Clear
3756	12/20/2011 8:21:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitati ng	Dry	Four-way intersection	Straight ahead	None	None	Failed to yield to vehicle	Clear
3757	6/15/2012 1:25:00 AM	Dark - lighted	Angle	Motor vehicle in	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarde d traffic	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
		roadway		transport							signs or signals	
3758	9/11/2009 3:49:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersection related	Straight ahead	None	None	Other	Cloudy
3759	5/26/2010 1:25:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Incapacitating	Dry	Intersection related	Straight ahead	None	None	Physical impairment	Cloudy
3760	11/30/2010 12:30:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Followed too closely	Snow
3761	1/13/2011 6:05:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Slush	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Other	Cloudy
3762	8/24/2012 8:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3763	5/10/2010 12:24:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Followed too closely	Rain
3764	5/18/2009 3:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3765	12/12/2009 12:26:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
3766	5/18/2009 12:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Other	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
3767	9/18/2010 1:35:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Slowing in traffic lane	None	None	Distracted list distraction in narrative	Cloudy
3768	1/11/2011 5:30:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Slush	Intersection related	Straight ahead	None	None	Driving too fast for conditions	Cloudy
3779	1/28/2010 8:14:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
3780	8/11/2011 11:25:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Utility pole	No injury	Dry	Intersection related	Turning left	None	None	Over-correcting/over-steering	Clear
3791	1/31/2011 8:48:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Intersection related	Straight ahead	None	None	Unknown	Snow
3792	4/19/2011 9:02:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
3797	3/4/2012 7:34:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Other electronic device list in narrative	Clear
3813	11/21/2012 10:26:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Failure to keep in proper lane	Cloudy
3831	7/29/2009 2:11:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Wet	Driveway access	Turning left	None	None	Other	Clear
3833	5/18/2011 5:29:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Clear
3836	2/27/2012 7:18:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Other	Cloudy
3837	3/14/2010 3:22:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
3843	12/13/2009 12:06:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Slush	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Cloudy
3844	3/8/2009 9:47:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Fire/explosion	No injury	Dry	Non-junction	Straight ahead	Unknown	None	None	Cloudy

Arterial Intersection – 6th/Lowell



Crash Summary - 6th/Lowell

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4137	4/19/2010 12:41:00 PM	Daylight	No collision between 2 MV in transport	Pedalcycle	Incapacitating	Dry	Intersection related	Not applicable	Not applicable	Not applicable	Not applicable	Cloudy
4140	9/28/2012 7:49:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Drinking	Clear
4141	10/24/2010 3:21:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Changing lanes	None	None	Improper lane change	Cloudy
4142	12/13/2010 1:04:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Disregarded traffic signs or signals	Cloudy
4143	1/18/2011 5:25:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Snow	Four-way intersection	Turning left	None	Road surface condition wet, icy, snow, slush, etc.	Failed to yield to vehicle	Snow
4144	3/31/2011 4:50:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	None	Failed to yield to vehicle	Cloudy
4145	1/7/2012 10:12:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Failed to yield to vehicle	Clear

Arterial Intersection – 6th/Cleveland

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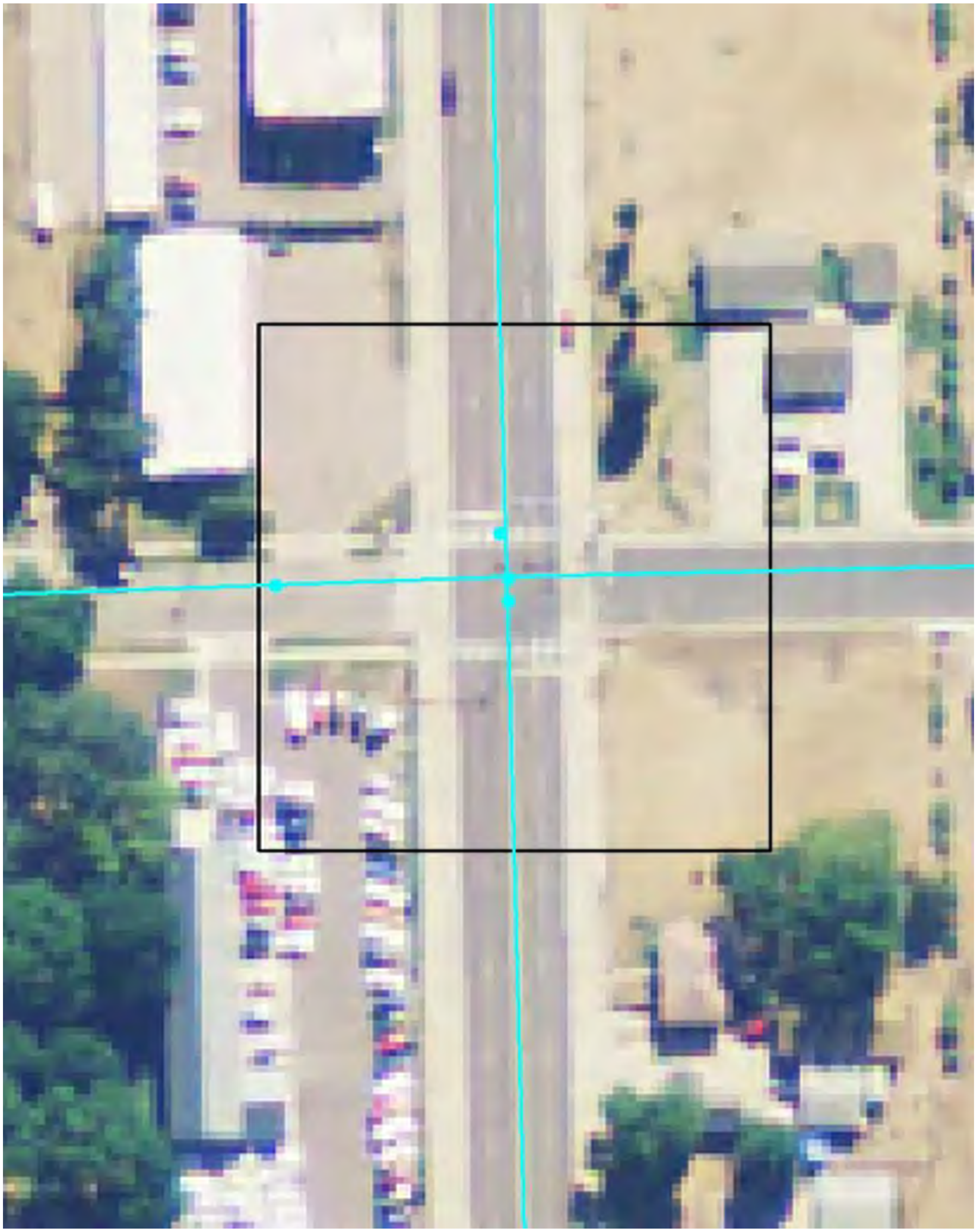
Crash Summary - 6th/Cleveland

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4008	9/8/2009 5:04:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Straight ahead	None	None	None	Clear
4066	6/4/2010 4:46:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
4148	3/14/2011 5:30:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
4149	3/12/2010 11:42:00 AM	Daylight	No collision between 2 MV in transport	Pedestrian	Incapacitating	Wet	Intersection related	Turning right	None	Pedestrian, bicyclist, other non-occupants in road	Failed to yield to pedestrian	Cloudy
4150	11/17/2009 4:11:00 PM	Daylight	Head-on front to front	Motor vehicle in transport	Incapacitating	Dry	Non-junction	Straight ahead	None	None	Illness heart attack, stroke, etc.	Clear
4151	7/9/2009 6:41:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access	Straight ahead	None	None	Other	Cloudy
4152	9/19/2011 8:42:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Improper lane change	Clear
4153	7/22/2009 5:11:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
4154	9/14/2012 7:43:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	None	Clear
4155	6/28/2009 5:42:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Driveway access related	Stopped in traffic lane	None	None	None	Clear
4156	1/18/2011 5:07:00 PM	Dark - lighted	Angle	Motor vehicle in	Non-incapacitati	Snow	Non-junction	Straight ahead	None	None	Swerving or avoiding	Snow

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
		roadway		transport	ng						due to wind, slippery surface, vehicle, object, non-motorist, etc.	
4157	2/20/2012 7:54:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Cloudy
4158	4/9/2009 4:25:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Overtaking /passing	None	None	Improper lane change	Clear
4159	11/29/2009 11:14:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
4160	1/22/2010 4:52:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	None	Rain
4161	3/13/2010 6:55:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	Disregarded traffic signs or signals	Rain
4162	2/2/2011 1:15:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Snow	Four-way intersection	Straight ahead	None	None	Failed to yield to vehicle	Clear
4163	3/25/2011 1:48:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	None	None	Cloudy
4164	1/2/2012 4:21:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Four-way intersection	Straight ahead	None	None	Unknown	Clear
4165	4/27/2012 5:55:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4166	8/28/2012 9:24:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Turning left	None	None	None	Cloudy
4167	8/30/2012 7:20:00 AM	Dawn	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
4168	5/13/2011 7:20:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
4169	8/16/2012 9:04:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Turning right	None	None	Improper turn	Clear
4170	10/16/2012 5:32:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
4171	11/7/2012 7:36:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	Brakes	None	None	Clear
4172	8/31/2010 7:40:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Clear
4173	11/1/2011 1:03:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
4174	3/2/2012 7:43:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Other electronic device list in narrative	Clear
4175	1/4/2011 2:02:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Non-junction	Changing lanes	None	None	Unknown	Clear
4176	9/16/2011 3:18:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in	Cloudy

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
											narrative	
4177	9/21/2012 3:22:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
4178	2/12/2012 7:00:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4255	1/3/2010 3:01:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Driveway access related	Straight ahead	None	None	Failed to yield to vehicle	Clear



Arterial Intersection – Rice/Wayland

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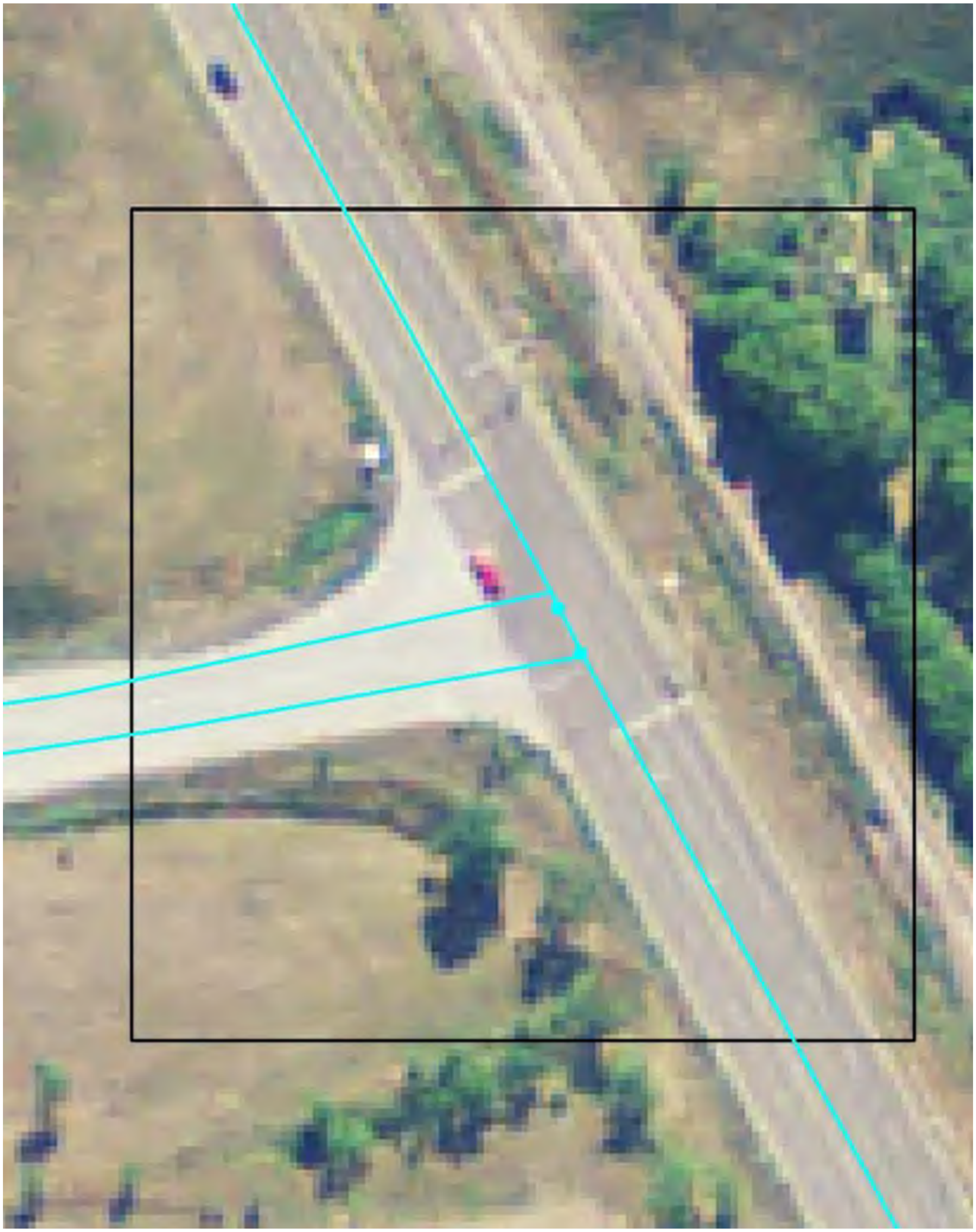
Crash Summary - Rice/Wayland

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4449	10/19/2011 7:30:00 AM	Dawn	No collision between 2 MV in transport	Pedalcycle	Non-incapacitating	Dry	Intersection related	Not applicable	Not applicable	Not applicable	Not applicable	Clear
4450	1/22/2012 1:43:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
4451	8/1/2009 10:09:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Improper turn	Clear
4452	10/15/2009 4:15:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Wet	Four-way intersection	Changing lanes	None	None	Improper lane change	Rain
4453	12/22/2009 10:21:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	T-intersection	Turning right	None	None	Improper turn	Cloudy
4454	1/6/2011 1:19:00 PM	Daylight	No collision between 2 MV in transport	Traffic signal support/signal	No injury	Wet	Four-way intersection	Turning right	None	None	Improper turn	Cloudy
4455	1/14/2011 9:22:00 AM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Slush	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
4456	1/9/2012 6:44:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	None	Improper turn	Clear
4457	1/16/2011 3:32:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
4470	4/2/2011 11:40:00 AM	Daylight	No collision between 2 MV in transport	Parked motor vehicle	No injury	Dry	Intersection related	Turning right	None	None	Running off road	Cloudy



Arterial Intersection – I-229 SB/Rice

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Crash Summary - I-229 SB/Rice

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4494	7/16/2010 11:34:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
4495	7/30/2010 4:45:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
4496	11/29/2010 8:01:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Interchange area	Straight ahead	None	None	None	Rain
4497	9/2/2011 6:16:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Backing	None	None	Other	Clear
4498	2/29/2012 7:18:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Slush	Interchange area	Straight ahead	Unknown	Unknown	Followed too closely	Sleet, hail freezing rain or drizzle

Arterial Intersection – I-229 NB/Rice

Crash Summary - I-229 NB/Rice

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4530	5/31/2011 3:30:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Unknown	Clear
4531	5/28/2009 3:12:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Clear
4533	12/7/2011 12:40:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
4534	7/24/2012 5:55:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Followed too closely	Clear
4535	6/30/2010 4:32:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Possible	Dry	Interchange area	Turning left	None	None	Over-correcting/over-steering	Clear
4536	7/29/2009 3:47:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Wet	Interchange area	Turning left	None	None	Failed to yield to vehicle	Cloudy
4537	11/22/2009 5:14:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
4538	12/28/2009 9:00:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Snow	Interchange area	Straight ahead	None	None	None	Cloudy
4539	12/31/2009 5:56:00 AM	Dark - lighted roadway	Angle	Motor vehicle in transport	Non-incapacitating	Snow	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
4540	9/24/2011 6:28:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
4541	3/16/2012 5:25:00 PM	Daylight	No collision between 2	Traffic signal	Incapacitating	Dry	Interchange area	Turning left	None	None	Disregarded traffic	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			MV in transport	support/sig nal							signs or signals	
4542	6/8/2010 10:21:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchang e area	Slowing in traffic lane	None	None	Other	Cloudy
4543	8/3/2010 5:20:00 AM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Stopped in traffic lane	None	None	None	Clear

Arterial Intersection – Rice/Bahnson

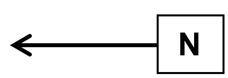
N

Crash Summary - Rice/Bahnson

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4572	11/30/2010 5:15:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Frost	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4573	12/7/2010 5:20:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4574	11/15/2012 7:36:00 PM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4579	3/6/2009 7:03:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Dry	Four-way intersection	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4580	9/22/2009 9:38:00 AM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Four-way intersection	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4581	11/13/2009 9:51:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	Wild animal hit	Wet	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4582	7/25/2011 2:11:00 PM	Daylight	No collision between 2 MV in transport	Railway vehicle	No injury	Dry	Railway crossing	Stopped in traffic lane	None	None	Failed to yield to vehicle	Clear
4583	10/4/2009 2:24:00 AM	Dark - lighted roadway	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear
4584	11/17/2009 3:23:00 AM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Cloudy
4585	11/9/2011 6:45:00 AM	Dark - roadway	Wild animal hit -	Animal - wild	No injury	Dry	Non-junction	Wild animal hit -	Wild animal hit	Wild animal hit -	Wild animal hit -	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
		not lighted	damage only					damage only		damage only	damage only	
4586	3/22/2011 3:37:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Rain
4588	11/3/2009 6:42:00 PM	Dark - roadway not lighted	Wild animal hit - damage only	Animal - wild	No injury	Dry	Non-junction	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear

Arterial Intersection – Benson/Cliff



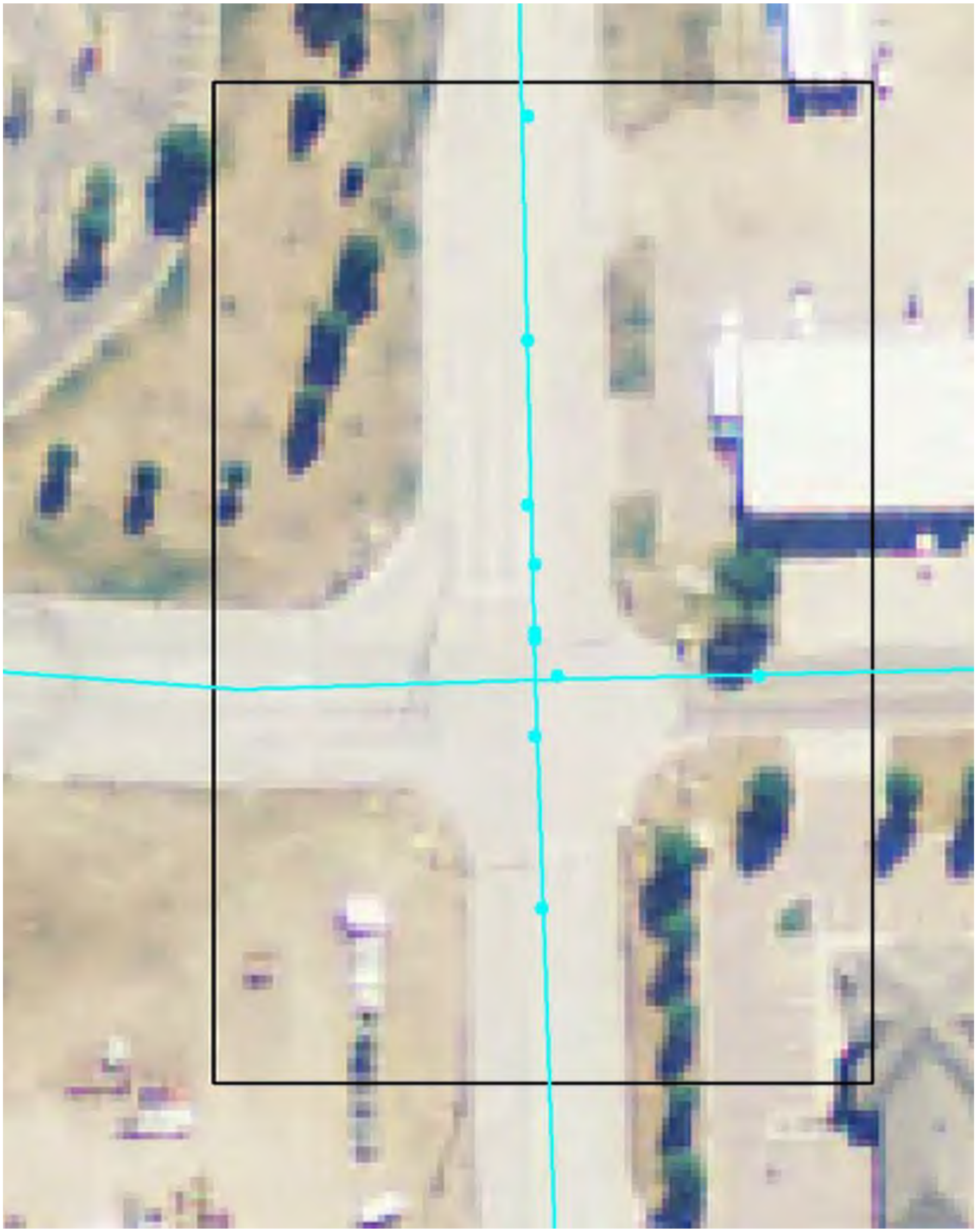
Crash Summary - Benson/Cliff

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4699	6/1/2009 4:47:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
4709	9/17/2012 9:47:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Unknown	Clear
4710	5/27/2009 12:34:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Intersection related	Straight ahead	None	None	Other	Cloudy
4713	8/19/2012 7:54:00 PM	Dusk	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Drinking	Clear
4718	6/23/2011 12:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
4719	6/9/2010 6:00:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
4720	1/28/2011 11:20:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Driveway access related	Straight ahead	None	None	Followed too closely	Clear
4721	2/11/2011 8:04:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
4722	4/27/2009 3:39:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Cloudy
4723	4/23/2009 6:02:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Cell phone	Clear
4724	7/19/2009 7:17:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
4725	3/4/2010	Daylight	Angle	Motor	No injury	Dry	Four-way	Turning	None	None	Failed to	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
	2:38:00 PM			vehicle in transport			intersection	left			yield to vehicle	
4726	8/6/2010 12:53:00 PM	Daylight	Angle	Motor vehicle in transport	Incapacitating	Dry	Four-way intersection	Turning left	None	None	Improper turn	Clear
4727	8/18/2010 7:31:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
4728	3/14/2011 8:50:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Improper turn	Clear
4729	10/23/2011 1:01:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Traffic signal support/signal	No injury	Wet	Four-way intersection	Turning left	None	None	Drinking	Rain
4730	1/11/2012 1:15:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
4731	5/9/2009 11:52:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
4732	1/19/2012 7:16:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
4733	4/28/2012 7:07:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
4734	6/27/2012 9:34:00 AM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Clear
4735	10/19/2012 3:12:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy
4736	12/20/2012 1:17:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Turning right	None	None	Improper turn	Clear

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4737	12/21/2012 6:20:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Pedalcycle	Non-incapacitating	Dry	Four-way intersection	Not applicable	Not applicable	Not applicable	Not applicable	Clear
4738	2/1/2010 10:41:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Intersection related	Turning right	None	Road surface condition wet, icy, snow, slush, etc.	Driving too fast for conditions	Snow
4739	6/15/2012 1:44:00 PM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	None	Clear
4740	5/1/2009 1:34:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Driveway access	Straight ahead	None	None	Improper lane change	Clear
4741	3/31/2009 11:40:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Wet	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
4742	5/23/2009 9:32:00 AM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
4743	12/20/2009 1:34:00 AM	Dark - lighted roadway	No collision between 2 MV in transport	Overturn/rollover	No injury	Wet	Four-way intersection	Turning right	None	None	Driving too fast for conditions	Fog, smog, smoke
4744	7/11/2012 9:05:00 AM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Four-way intersection	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
4745	2/9/2012 10:10:00 PM	Dark - lighted roadway	No collision between 2 MV in transport	Light/luminaire support	No injury	Dry	Non-junction	Straight ahead	Steering	None	None	Clear
4746	10/4/2012 12:15:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Driveway access	Turning left	None	None	Failed to yield to vehicle	Clear
4747	8/23/2010 7:50:00 PM	Dusk	Rear-end front to	Motor vehicle in	No injury	Wet	Non-junction	Straight ahead	None	Other	Driving too fast for	Rain

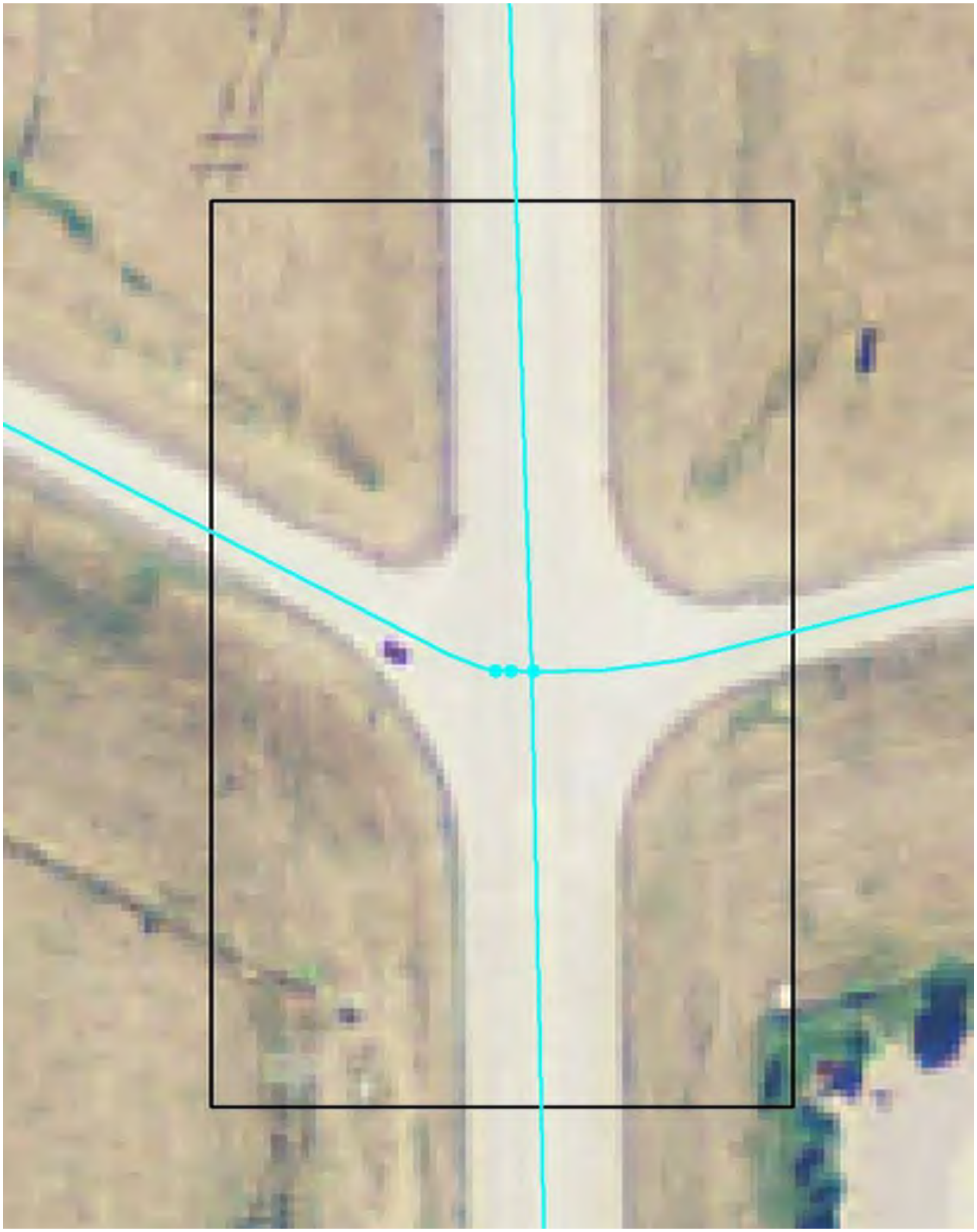
OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
			rear	transport							conditions	
4748	7/27/2011 11:30:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	None	Cloudy
4751	3/17/2011 11:49:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Unknown	Clear
4763	1/6/2010 11:01:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Snow	Non-junction	Straight ahead	None	None	Driving too fast for conditions	Snow
4768	10/24/2009 12:31:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Driveway access related	Straight ahead	None	None	Followed too closely	Cloudy
4775	3/2/2011 8:58:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	No injury	Dry	Intersection related	Straight ahead	None	None	Failure to keep in proper lane	Clear
4797	9/7/2010 1:15:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear



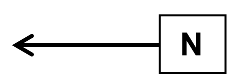
Arterial Intersection – Benson/Lewis

Crash Summary - Benson/Lewis

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
4706	2/12/2010 4:47:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Intersection related	Backing	Unknown	None	Unknown	Clear
4773	4/28/2010 12:48:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Intersection related	Backing	None	None	Improper backing	Clear
4776	5/12/2011 4:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Non-junction	Straight ahead	None	None	Distracted list distraction in narrative	Cloudy
4779	5/23/2012 4:44:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Non-incapacitating	Dry	Intersection related	Straight ahead	None	None	Followed too closely	Rain
4780	6/15/2011 8:41:00 AM	Daylight	No collision between 2 MV in transport	Light/luminaire support	Possible	Dry	Non-junction	Straight ahead	None	None	None	Clear
4781	1/4/2010 7:42:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Intersection related	Straight ahead	None	None	Distracted list distraction in narrative	Clear
4782	3/15/2010 2:17:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Non-junction	Straight ahead	None	None	Followed too closely	Clear
4783	5/23/2012 5:06:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Rain
4784	12/11/2012 5:10:00 PM	Dark - lighted roadway	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Non-junction	Straight ahead	None	None	Followed too closely	Cloudy
4785	2/25/2011 12:27:00 PM	Daylight	No collision between 2 MV in transport	Utility pole	No injury	Dry	Non-junction	Straight ahead	None	None	Running off road	Cloudy



Arterial Intersection – I-229 SB/Benson



Crash Summary - I-229 SB/Benson

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4766	7/7/2010 8:04:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
4767	7/11/2012 3:08:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchang e area	Turning left	None	None	Failed to yield to vehicle	Clear
4774	3/23/2011 7:16:00 AM	Dawn	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Straight ahead	None	None	Followed too closely	Cloudy
4778	3/2/2012 7:50:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	Possible	Dry	Interchang e area	Straight ahead	None	None	Distracted list distraction in narrative	Clear

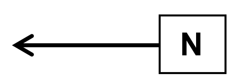
Arterial Intersection – I-229 NB/Benson

N

Crash Summary - I-229 NB/Benson

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4698	6/11/2012 8:30:00 AM	Daylight	Sideswipe, same direction	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	None	Clear
4704	1/31/2011 5:06:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Ice	Interchange area	Stopped in traffic lane	None	Road surface condition wet, icy, snow, slush, etc.	None	Snow
4771	5/23/2012 7:24:00 PM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchange area	Straight ahead	None	None	Followed too closely	Rain
4788	4/7/2011 4:03:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	Steering	None	None	Cloudy
4789	4/30/2010 1:00:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Clear
4790	8/6/2009 1:40:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Turning left	None	None	Failed to yield to vehicle	Cloudy
4791	12/26/2011 12:57:00 PM	Daylight	Angle	Motor vehicle in transport	Possible	Dry	Interchange area	Turning left	None	None	Disregarded traffic signs or signals	Cloudy
4792	2/4/2012 12:07:00 PM	Daylight	Angle	Motor vehicle in transport	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Clear
4793	7/23/2012 2:43:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Disregarded traffic signs or signals	Cloudy
4794	8/3/2012 10:45:00 AM	Daylight	Rear-end front to rear	Motor vehicle in transport	No injury	Dry	Interchange area	Straight ahead	None	None	Other	Clear

Arterial Intersection – Benson/Hall



No crashes recorded for this segment/intersection during 2009-2012 time period.

Arterial Intersection – 60th N./Lewis

Crash Summary - 60th St. N./Lewis

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSUR	JUNCTION	VEHICLEM	VEHCONT	ROADCON	DRIVERCO	WEATHER
4835	1/5/2011 7:55:00 AM	Dawn	Angle	Motor vehicle in transport	No injury	Frost	Four-way intersection	Straight ahead	None	None	Failed to yield to vehicle	Cloudy
4836	12/2/2011 5:23:00 PM	Dark - lighted roadway	Angle	Motor vehicle in transport	Possible	Dry	T-intersection	Turning left	None	None	Failed to yield to vehicle	Clear
4837	4/12/2012 6:35:00 PM	Daylight	Angle	Motor vehicle in transport	No injury	Wet	T-intersection	Turning left	None	None	Failed to yield to vehicle	Cloudy

APPENDIX G1. ITS ASSESSMENT

Current Operations Questionnaire

In order to evaluate current traffic operations and incident management, a questionnaire was provided to local agencies /companies. The questionnaire addressed the following topics:

- Incident and Emergency Response
- Freeway and Roadway Management
- Traveler Information
- Maintenance and Construction
- Scenarios

A total of 13 responses were received to the questionnaire from both public agencies and private companies. A summary of the responses are shown in ***APPENDIX G2***.

ITS Service Packages

The list of ITS Service Packages from the National ITS Architecture 7.0 were reviewed during the December 2014 Concept Workshop in order to identify Service Packages to be considered as a part of this study. Service Packages from the following Service Areas were reviewed:

- Archived Data Management
- Public Transportation
- Traveler Information
- Traffic Management
- Vehicle Safety
- Commercial Vehicle Operations
- Emergency Management
- Maintenance & Construction Management

Service Packages were identified from the Traveler Information, Traffic Management, Emergency Management and Maintenance & Construction Management Service Areas. The Service Packages that were identified to be considered are shown in ***TABLE 1***.

Table 1. Candidate ITS Service Packages

Service Packages
Traffic Management - ATMS
ATMS01 Network Surveillance
ATMS03 Traffic Signal Control
ATMS06 Traffic Information Dissemination
ATMS07 Regional Traffic Management
ATMS08 Traffic Incident Management System
ATMS22 Variable Speed Limits
ATMS24 Dynamic Roadway Warning
Traveler Information - ATIS
ATIS02 Interactive Traveler Information
ATIS06 Transportation Operations Data Sharing
Emergency Management - EM
EM01 Emergency Call-Taking and Dispatch
EM04 Roadway Service Patrols
EM06 Wide-Area Alert
Maintenance & Construction Management - MCO
MC01 Maintenance and Construction Vehicle and Equipment Tracking
MC03 Road Weather Data Collection
MC04 Weather Information Processing and Distribution
MC06 Winter Maintenance
MC07 Roadway Maintenance and Construction
MC08 Work Zone Management

A description of each of the Service Packages along with a Service Package Graphic is available on the National ITS Architecture 7.0 website: http://www.iteris.com/itsarch/html/mp/mpindex.htm

Potential ITS Solutions

Service Packages represent the collection of one or more ITS solutions that work together to deliver a given ITS service. Potential ITS solutions were identified in order to deliver the Service Packages identified during the December 2014 Concept Workshop. The potential ITS solutions that were identified may support more than one Service Package. Also, potential ITS solutions may be a primary element for a Service Package or be considered a secondary or support element. The potential ITS solutions identified for each Service Package are shown in ***TABLE 2***. The following section provides a description of each of the potential ITS solutions along with the Service Package that it supports. Descriptions of the potential solutions and cost estimates use general planning-level assumptions. The planning level unit costs were developed using information from the USDOT Office of Assistant Secretary for Research and Technologies Intelligent Transportation Systems Joint Program Office – Knowledge Resources website as well as cost information from ITS planning studies from Iowa and Nebraska in 2014. The planning-level cost estimates represent the capital cost to implement the ITS solution and do not include any maintenance and operations costs. Prior to implementing any of the potential ITS solutions, a systems engineering process is needed to define the user needs and required functionality.

Table 2. Potential ITS Solutions

Service Packages	CCTV Cameras	Traffic Detectors	Adaptive Signal Control Technology	Dynamic Message Signs	Highway Advisory Radio	Traffic Management Center	511/ATIS	Variable Speed Limit Signs	Road Weather Information Systems	Dynamic Road Warning Signs	Roadway Service Patrol Vehicles	Automated Vehicle Location	Automated Work Zones
Traffic Management - ATMS													
ATMS01 Network Surveillance	P	P				S							
ATMS03 Traffic Signal Control			P			S							
ATMS06 Traffic Information Dissemination				P	P	S							
ATMS07 Regional Traffic Management	S	S	S			P							
ATMS08 Traffic Incident Management System	S	S	S	S	S	P	S				S		
ATMS22 Variable Speed Limits		S				S		P	S				
ATMS24 Dynamic Roadway Warning		S							S	P			
Traveler Information - ATIS													
ATIS02 Interactive Traveler Information						S	P						
ATIS06 Transportation Operations Data Sharing						P							
Emergency Management - EM													
EM01 Emergency Call-Taking and Dispatch						S							
EM04 Roadway Service Patrols						S	S				P	S	
EM06 Wide-Area Alert				P	P	S	P						
Maintenance & Construction Management - MCO													
MC01 Maintenance and Construction Vehicle and Equipment Tracking						S						P	
MC03 Road Weather Data Collection						S			P	S			
MC04 Weather Information Processing and Distribution				S		S	S		P				
MC06 Winter Maintenance	S	S				P	S					S	
MC07 Roadway Maintenance and Construction						P	S						
MC08 Work Zone Management	S	S		S	S	S							P

P - Primary, S - Secondary

CCTV Cameras

There is currently limited camera coverage along I-229 and the intersecting corridors. More cameras are needed to monitor traffic and weather conditions, verify and monitor incidents, and monitor work zones, both along the I-229 corridor and in particular at the interchange ramps.

Service Packages

- Primary
  - ATMS01 – Network Surveillance
- Secondary
  - ATMS07 – Regional Traffic Management
  - ATMS08 – Traffic Incident Management
  - MC06 – Winter Maintenance
  - MC08 – Work Zone Management

Potential Solution

Typical camera spacing in urban areas is around 1 mile with addition of cameras at locations to address site-specific issues. The potential solution is to place a camera on all three approaches of the systems interchanges of I-229/I-29 and I-229/I-90, in between each service interchange and at the crossroad of each interchange. This potential solution would place around 21 cameras in order to provide coverage of the I-229 corridor. See ***Appendix G3*** for potential placement of the CCTV cameras.

Planning Level Cost Estimate

21 cameras x $30,000/camera = $630,000

Traffic Detectors

There is need for speed and vehicle occupancy data along I-229 and the intersecting corridors in order to monitor current traffic conditions. SDDOT currently has some automated traffic recorders on the freeway system in the Sioux Falls area, but these recorders do not provide real-time data. The City of Sioux Falls has traffic detection along the crossroads. The traffic detection is currently being used for traffic signal operations and not for real-time traffic information.

Service Packages

- Primary
  - ATMS01 – Network Surveillance
- Secondary
  - ATMS07 – Regional Traffic Management
  - ATMS08 – Traffic Incident Management
  - ATMS22 – Variable Speed Limits
  - ATMS24 – Dynamic Roadway Warning
  - MC06 – Winter Maintenance
  - MC08 – Work Zone Management

Potential Solution

Typical traffic sensor spacing on urban freeways is around 1 to 2 miles. The potential solution is to place a sensor on all three approaches of the systems interchanges of I-229/I-29 and I-229/I-90 and in between each service interchange (total of 13 sensors on I-229). See ***Appendix G3*** for potential placement of the traffic detectors.
The spacing of traffic sensors on arterials has a wide variation based on the type of technology and arterial characteristics including number of lanes and intersection spacing. The following are the proposed assumptions:

- Minnesota Avenue from 41st Street to 57th Street – 3 sensors
- 10th Street from Franklin Ave to Sycamore Ave – 5 sensors
- Benson Road from Cliff Ave to Sycamore Ave – 3 sensors

Benefits of the traffic sensors would not be fully utilized without connection to a traffic management center.
Alternative Solution: A potential alternative solution to traffic sensors is third party traffic probe data through a subscription service (e.g. INRIX, HERE).

Planning Level Cost Estimate

- I-229: 13 sensors x $20,000/sensor = $260,000
- Arterial Corridors: 11 sensors x $15,000/sensor = $165,000

Adaptive Signal Control Technology

There is a need to consider adaptive signal control technology (ASCT) on Western Avenue, 10th Street and Benson Road in order to meet the varying traffic flow needs.

Service Packages

- Primary
  - ATMS03 – Traffic Signal Control
- Secondary
  - ATMS07 – Regional Traffic Management
  - ATMS08 – Traffic Incident Management

Potential Solution

There are a variety of ASCTs and they each have different requirements. A systems engineering process should be conducted to identify the need for ASCT and determine the requirements for the ASCT system.

- Western Avenue from 49th Street to 57th Street – 4 signals
- 10th Street from Franklin Ave to Sycamore Ave – 11 signals
- Benson Road from Cliff Ave to Sycamore Ave – 6 signals

See ***Appendix G3*** for potential placement of the ASCTs.

Planning Level Cost Estimate

- Western Avenue: 4 signals x $35,000/signal = $140,000
- 10th Street: 11 signals x $35,000/signal = $385,000
- Benson Road: 6 signals x $35,000/signal = $210,000

Dynamic Message Signs

There is a need to disseminate information to travelers along the corridor regarding incidents, congestion, road conditions and wide-area alerts. The primary need is to disseminate information to travelers along I-229.

Service Packages

- Primary
    - ATMS06 – Traffic Information Dissemination
    - EM06 – Wide-Area Alert
- Secondary
    - ATMS08 – Traffic Incident Management
    - MC08 – Work Zone Management

Potential Solution

The potential solution is to place a dynamic message sign (DMS) upstream of all three approaches for the systems interchanges of I-229/I-29 and I-229/I-90 and at the locations noted below. These locations allow the ability to provide information to travelers in order to make alternate route decisions or information regarding road conditions or hazards. The signs would be located in accordance with MUTCD 2L.06.

- I-229 Northbound
    - Between Western Ave and Minnesota Ave
    - Between 26th Street and 10th Street
- I-229 Southbound
    - Between Benson Road and Rice Street
    - Between 26th Street and Cliff Ave

See **APPENDIX G3** for potential placement of the DMS.

Planning Level Cost Estimate

- 10 DMS x $200,000/DMS = $2,000,000 (Amber Only), or
- 10 DMS x $250,000/DMS = $2,500,000 (Full Color)

Highway Advisory Radio

There is a need to disseminate information to travelers along the corridor regarding incidents, congestion, road conditions and wide-area alerts. The primary need is to disseminate information to travelers along I-229.

Service Packages

- Primary
    - ATMS06 – Traffic Information Dissemination
    - EM06 – Wide-Area Alert
- Secondary
    - ATMS08 – Traffic Incident Management
    - MC08 – Work Zone Management

Potential Solution

The potential solution is to place a highway advisory radio (HAR) along I-229 with flashing signs indicating when the HAR is activated. Place 2 HAR transmitters along the I-229 and with a flashing sign approximately every mile in each direction and on all approaches at the I-29/I-229 and I-90/I-229 system interchanges

Planning Level Cost Estimate

- HAR: 2 transmitters x $25,000 = $50,000
- Flashing signs: 22 signs x $10,000 = $220,000

TRAFFIC MANAGEMENT CENTER

There is a need to proactively manage the I-229 corridor and the intersecting crossroads in order to improve the safety, efficiency and reliability of travel. A traffic management center (TMC) is responsible for managing traffic by collecting and processing data along the system and then distributing information to the various stakeholders and the traveling public. The TMC is the hub for the ITS solutions which allows for the operators to control and manage the functional elements of the system.

Service Packages

- Primary
    - ATMS07 – Regional Traffic Management
    - ATMS08 – Traffic Incident Management System
    - ATIS06 – Transportation Operations Data Sharing
    - MC06 – Winter Maintenance
    - MC07 – Roadway Maintenance and Construction
- Secondary
    - ATMS01 – Network Surveillance
    - ATMS03 - Traffic Signal Control
    - ATMS06 – Traffic Information Dissemination
    - ATMS22 – Variable Speed Limits
    - ATIS02 – Interactive Traveler Information
    - EM01 – Emergency Call-Taking and Dispatch
    - EM04 – Roadway Service Patrol
    - EM06 – Wide Area Alert
    - MC01 – Maintenance and Construction Vehicle and Equipment Tracking
    - MC03 – Road Weather Data Collection
    - MC04 – Weather Information Processing and Distribution
    - MC08 – Work Zone Management

Potential Solution

The potential for a TMC in the region is currently being studied though SHRP2. There has been discussion that the TMC needs to be a partnership between the SDDOT and the City of Sioux Falls. There is also a currently on-going study considering TMCs statewide.

One of the critical issues that needs to be addressed is the staffing for the TMC. The TMC will have limited functionality without appropriate detection technology in the field. There should also be considerations for integrating the TMC with the computer aided dispatch system. SDDOT and the City of Sioux Falls should also consider integrating each others systems.

Planning Level Cost Estimate

Cost for TMC varies and there is not enough information at this time.

511/ADVANCED TRAVELER INFORMATION SYSTEM (ATIS)

There is a need to provide travelers with more information to make decisions about route choice, road conditions and avoid congestion. SDDOT currently provides ATIS/511 information in the Sioux Falls area. The information is disseminated to travelers through a website, telephone or application. The ATIS/511 system only contains the interstate system within the study area.

Service Packages

- Primary
  - ATIS02 – Interactive Traveler Information
  - EM06 – Wide Area Alert
- Secondary
  - ATMS08 – Traffic Incident Management System
  - EM04 – Roadway Service Patrol
  - MC04 – Weather Information Processing and Distribution
  - MC06 – Winter Maintenance
  - MC07 – Roadway Maintenance and Construction

Potential Solution

No additional improvements proposed

Planning Level Cost Estimate

Not Applicable

VARIABLE SPEED LIMIT SIGNS

There is a need to adjust the speed limit (either advisory or regulatory) along I-229 during adverse road conditions or congestion in order to improve safety.

Service Packages

- Primary
  - ATMS22 – Variable Speed Limits

Potential Solution

Place variable speed limit signs along I-229 at approximately 1 mile spacing in both directions. Information from the traffic detectors and road weather information systems will be used to set the speed limit. SDDOT does not currently have the legislative authority to use regulatory VSL signs.

Planning Level Cost Estimate

10 miles x $50,000/mile = $500,000

Road Weather Information Systems

There is a need to have weather and road condition data along I-229 in order to make decisions regarding winter maintenance and to provide traveler information. There is currently a roadway weather information system at Benson Road.

Service Packages

- Primary
  - MC03 – Road Weather Data Collection
  - MC04 – Weather Information Processing and Distribution
- Secondary
  - ATMS22 – Variable Speed Limits
  - ATMS24 – Dynamic Roadway Warning

Potential Solution

Place 2 road weather information systems (RWIS) with non-intrusive pavement sensors along the I-229 corridor to gather data on atmosphere, precipitation and pavement conditions. One of the systems should be placed at or near the horizontal curve between the Cliff Avenue and 26th Street interchanges. The other system should be placed near the I-29/I-229 system interchange.

Planning Level Cost Estimate

2 systems x $75,000/system = $150,000

Dynamic Road Warning Signs

There is a need to provide information to drivers along I-229 to alert them to adverse road surface conditions.

Service Packages

- Primary
  - ATMS24 – Dynamic Roadway Warning
- Secondary
  - MC03 – Roadway Weather Data Collection

Potential Solution

Place 4 (2 in each direction) warning signs with flasher on I-229 upstream of the horizontal curve between Cliff Ave and 26th Street. The signs would be connected to the RWIS pavement sensors and the flashers would be activated prior to the formation of ice on the road surface. These signs could be used as an interim solution prior to installing DMS.

Planning Level Cost Estimate

4 signs x $20,000/sign = $80,000

ROADWAY SERVICE PATROL VEHICLES

There is a need for quick clearance of incidents and debris from I-229 in order to reduce primary and secondary crashes and reduce congestion.

Service Packages

- Primary
  - EM04 – Roadway Service Patrol
- Secondary
  - ATMS24 – Traffic Incident Management System

Potential Solution

Provide a service patrol vehicle for I-229 during the morning and afternoon peak hours. The service patrol would assist in quick clearance of vehicles and debris. There is a wide range of service patrol programs from sponsored volunteer programs to fully equipped maintenance vehicles with mounted electronic message signs

Planning Level Cost Estimate

Costs vary depending on number of vehicles, structure of program and hours of operation.

AUTOMATED VEHICLE LOCATION

There is a need to be able to track maintenance vehicles in order to determine current location of vehicles and to be able to determine which roads and been plowed and when they were plowed. Some maintenance vehicles already have automated vehicle location (AVL) services. I-229 is a maintenance decision support system (MDSS) route.

Service Packages

- Primary
  - MC01 – Maintenance and Construction Vehicle and Equipment Tracking
- Secondary
  - EM04 – Roadway Service Patrols
  - MC06 – Winter Maintenance

Potential Solution

Provide automated AVL services on all SDDOT and City of Sioux Falls maintenance vehicles and the roadway service patrol vehicles. This would allow for tracking of winter weather operations and allow dispatch of vehicles to respond to incidents. The City of Sioux Falls currently contracts some of there snow removal, so it would not be possible to place AVL services on vehicles.

Planning Level Cost Estimate

$5,000 per vehicle

Automated Work Zone

There is a need to manage traffic in areas where maintenance, construction and utility activities are underway. The traffic conditions need to be monitored and information disseminated to drivers.

Service Packages

- Primary
  - MC08 – Work Zone Management

Potential Solution

Provide automated work zones to manage traffic in maintenance and construction areas. The automated work zones typically consist of traffic detectors, CCTV cameras and portable message signs. The work zone would be able to automatically deploy messages and send alerts when certain thresholds are met and the CCTV cameras are used to monitor and verify the conditions.

Planning Level Cost Estimate

Costs vary depending on size of work zone and type of procurement (lease/purchase).

Summary of Potential ITS Solutions Costs

The planning level cost estimate summary for the potential ITS solutions is shown in **TABLE 3**. The cost estimates for potential ITS solutions use general planning level unit costs. After completion of a systems engineering process to define the user needs and required functionality, a more refined cost estimate can be established.

Table 3. Planning Level Cost Estimate

Potential ITS Solutions	Quantity	Unit Cost	Total Cost
CCTV Cameras	21	$ 30,000	$ 630,000
Traffic Detectors			
I-229	13	$ 20,000	$ 260,000
Arterial Corridors	11	$ 15,000	$ 165,000
Adaptive Signal Control Technology			
Western Avenue	4	$ 35,000	$ 140,000
10th Street	11	$ 35,000	$ 385,000
Benson Road	6	$ 35,000	$ 210,000
Dynamic Message Signs			
Amber Only	10	$ 200,000	$2,000,000
or			
Full Color	10	$ 250,000	$2,500,000
Highway Advisory Radio			
Transmitters	2	$ 25,000	$ 50,000
Flashing Signs	22	$ 10,000	$ 220,000
Traffic Management Center	Varies		
511/ATIS	N/A		
Variable Speed Limit Signs	10	$ 50,000	$ 500,000
Road Weather Information Systems	2	$ 75,000	$ 150,000
Dynamic Road Warning Signs	4	$ 20,000	$ 80,000
Roadway Service Patrol	Varies		
Automated Vehicle Location	Quantity Unknown		
Automated Work Zones	Varies		

APPENDIX G2 –

SUMMARY OF THE CURRENT ITS OPERATIONS QUESTIONNAIRE

GENERAL:

Number of Responses:

13

Represented Agencies/Companies

- SDDOT
- City of Sioux Falls
- South Dakota Highway Patrol
- Lincoln County Sheriff's Office
- Minnehaha County Sheriff's Office
- Metro Communications Agency
- Jim and Ron's Services Inc.
- All American Towing

QUESTIONNAIRE:

Incident and Emergency Response

1. Are wide-area alerts currently used or being explored for in the Sioux Falls region (amber, severe weather, etc.)?
    a. ***Yes, amber and weather alerts***
2. Does the Sioux Falls region utilize service patrols to assist stalled or stranded motorist?
    a. ***There are not designated motorist assist vehicles. Highway troopers provide assistance.***
3. How does your agency currently receive information from 911 incidents?
    a. ***Typically through state radio dispatch***
4. Is there currently any inter-agency computer-aided dispatch system in use in the Sioux Falls region?
    a. ***Yes.***
5. Are there any resources you feel would improve incident or emergency response in your area?
    a. ***Towing industry: more detailed information to determine proper equipment. Need more message boards along I-229, everyone needs to use inter-agency channel during incidents, need prompt notifications to update message boards and 511, need inter-agency computer-aided maps and need public safety software interoperability.***

Freeway and Roadway Management

1. Do you actively monitor the roadway infrastructure and if so how (detectors, cameras, etc.)?
    a. ***Yes, through pavement management system data, cameras and direct inspections.***

2. Do you use or plan to use any of the following resources to manage traffic?
    a. Dynamic message boards (portable or permanent) - ***Yes***
    b. Variable speed limit systems – ***No, potential to use in future***
    c. Traffic signal control systems - ***Yes***
    d. Ramp or mainline gate systems (automated or manual) - ***Yes***
    e. Ramp metering system - ***No***
    f. Traffic probe data system - ***No***
    g. Other systems not listed above – ***No other items listed***
3. Do you talk with other centers that manage freeway or roadway systems (statewide or regional)?
    a. Yes.
4. Do you share any equipment resources (view only or control) with other centers?
    a. Yes, currently sharing camera images.
5. What resources do you currently feel are needed to help you provide better service to the public?
    a. More alerts regarding incident/road conditions and more cameras/message board.

Traveler Information

1. Do you plan to or currently provide any interactive traveler information (website or 511)?
    a. Yes, the SDDOT manages the 511 system and updates it about every 2 hours during weather events. The City of Sioux Falls places images of their traffic cameras on the website. Would like to add real-time travel time information in the future.
2. Do you provide travel data, incident data, or event data to any third parties (public or private)?
    a. Provide data through 511 and when asked for information.
3. Do you receive any event data from third parties (public or private)?
    a. Receive data from Weather Service and Public Safety.
4. If you generate traveler data, how do you envision that information being used in the future?
    a. Envision it being used for construction, incident management and congestion. Information to be automated to provide for timely updates.
5. What resources do you currently feel are needed to help provide better information to the public?
    a. Better connection with 511 system, more cameras/message boards, automated roadway treatment systems and traffic management center.

Maintenance and Construction

1. Currently, how is weather information collected and used by your agency?
    a. Through visual observations, weather service and MDSS.
2. How do you distribute weather data to other parties?
    a. Through 511 and voice/data communications.
3. Do you currently use any automated roadway treatment systems for severe weather (bridge anti-icing systems)?
    a. No.
4. How do you share maintenance and construction activities with third parties?
    a. Through newsletters, press releases, listserv updates, public meetings, 511 and message boards.

5. Are there any on-vehicle systems used to support winter weather response (monitors, probes, GPS)?
    a. ***Some snow plow trucks are equipped with MDC units.***
6. Are there any resources that would improve and support the region's maintenance and construction activities?
    a. ***SDDOT is getting tablets in order to update IRIS system.***

Scenarios:

Weather Related Event:

A winter weather event occurs with heavier than predicted amounts of snowfall. By 7:00 AM, four inches of snow has fallen and it is supposed to continue throughout the morning.

1. How do you find out about the event?
    a. ***Through reports from field, weather service (national and local) and MDSS***
2. What is the step-by-step process involved with managing the event?
    a. ***Identify materials/equipment/staff, then prioritize needs, notify department superiors, issue updates and continue to monitor and manage. City of Sioux Falls sends out crews to remove snow from LEDs during certain snow events.***
3. What major obstacles might you face when managing an event like this?
    a. ***Distribution of information to public and inter-agency, lack of materials/equipment/staff, number of crashes and unsafe driving speeds.***

Crash Related Event:

There is a two vehicle crash on a I-229 northbound south of 10th Street, involving an SUV and commercial truck at 9:00 AM. The crash is blocking one of the northbound lanes.

1. How do you find out about the event?
    a. ***Metro communications/state radio and phone.***
2. What is the step-by-step process involved with managing the event?
    a. ***Contact first responders, issue press release, identify immediate needs (equipment and labor), determine detour route, implement quick clearance and coordinate with local entities for increase traffic on local roads. City of Sioux Falls will adjust signal timings as needed.***
3. How does this event change if both lanes are blocked?
    a. ***Reroute traffic and work to get at least one lane reopened.***
4. What major obstacles might you face when managing an event like this?
    a. ***Notifying the public, mobilizing staff and materials, managing the traffic, secondary crashes and communications.***

Planned Event:

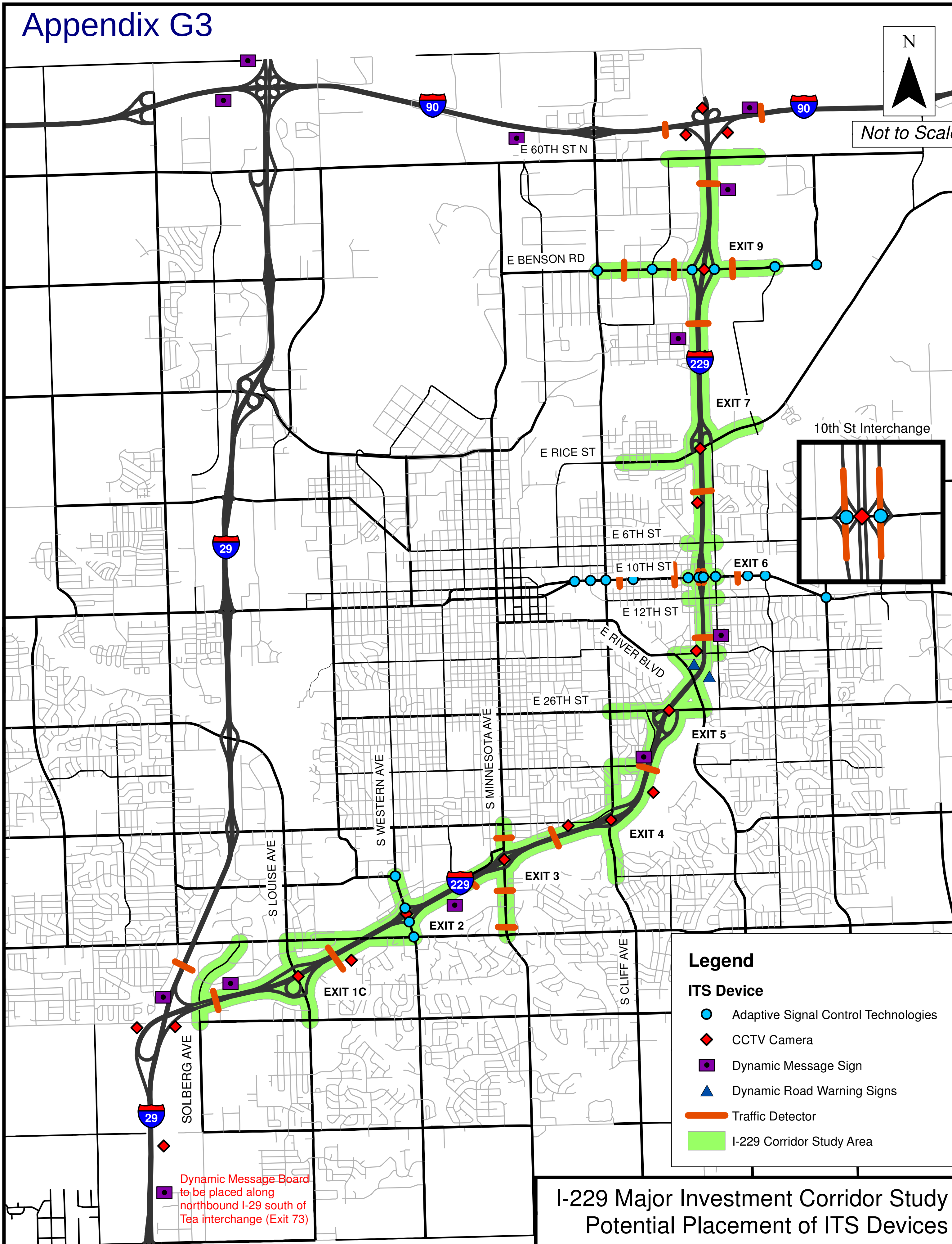
The state is planning on minor maintenance along I-229 for a two-week period. The maintenance will require the closure of a single lane in one-mile segments along I-229.

1. When and how do you find out about the project?
    a. ***Typically through written communication (email).***
2. What steps/elements are incorporated to assist in managing the traffic?

   a. ***Thorough review of sequence and traffic control plans prior to work beginning, press releases, notification to project stakeholders, advance notice to motorists, use of message boards, attempt to minimize disruptions with no lane closures during peak hours if possible. State patrol assists with traffic and City adjusts signal timings.***

3. What on-going monitoring occurs during the construction of the project?
   a. ***Visual inspections from field, speed enforcement, monitor with camera if one in the area and adjust traffic signal timings as needed.***
4. The northbound traffic starts to backup during the AM peak hour.
   a. How do you find out?
      i. ***Typically, through the state radio, field personnel, news or the public.***
   b. What steps are taken to alleviate the traffic back-ups?
      i. ***Re-evaluate and consider providing advance notice to reroute traffic, deploy a flagger or adjust signal timings.***

Appendix G3



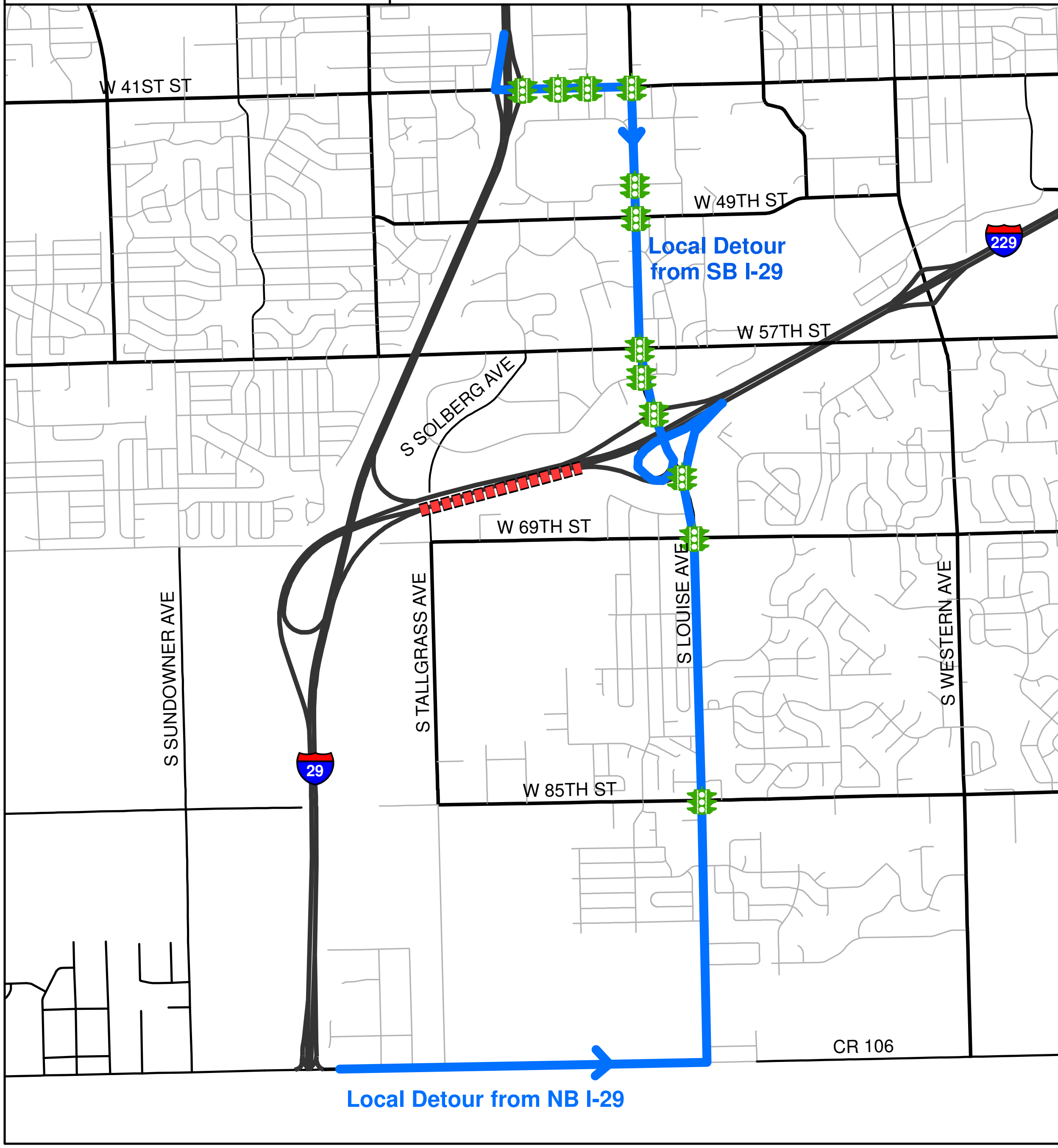
I-229 Major Investment Corridor Study
Potential Placement of ITS Devices

APPENDIX H -

INCIDENT MANAGEMENT ACTIONS AND DETOUR ROUTES

Closure: I-229 Northbound | **From:** I-29 | **To:** Louise Ave

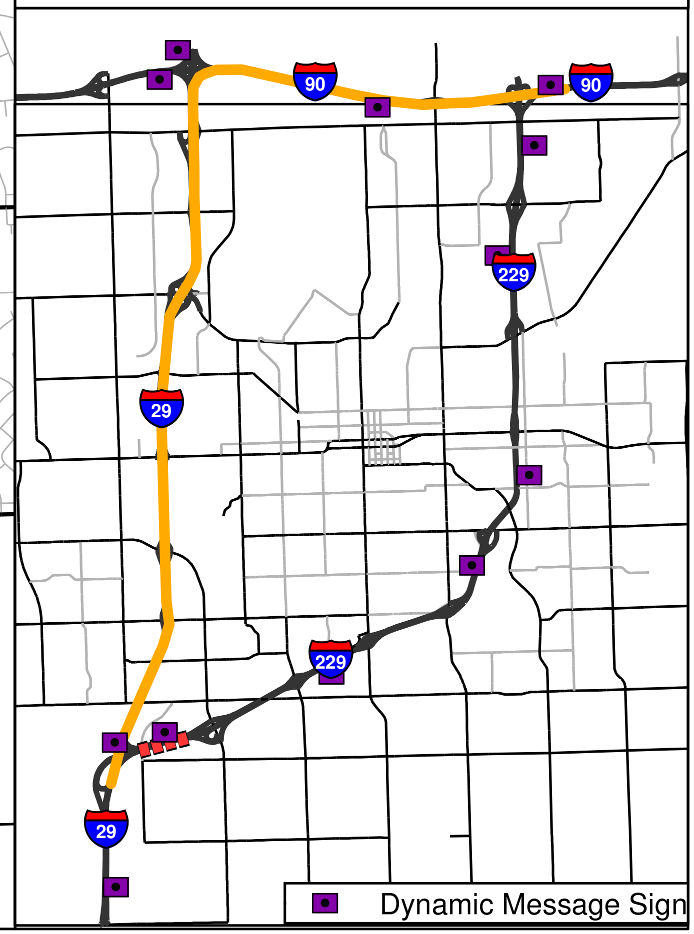
I-229 Major Investment Corridor Study
I-229 Corridor Study Area



Incident Management Action

Closure and Response Routes

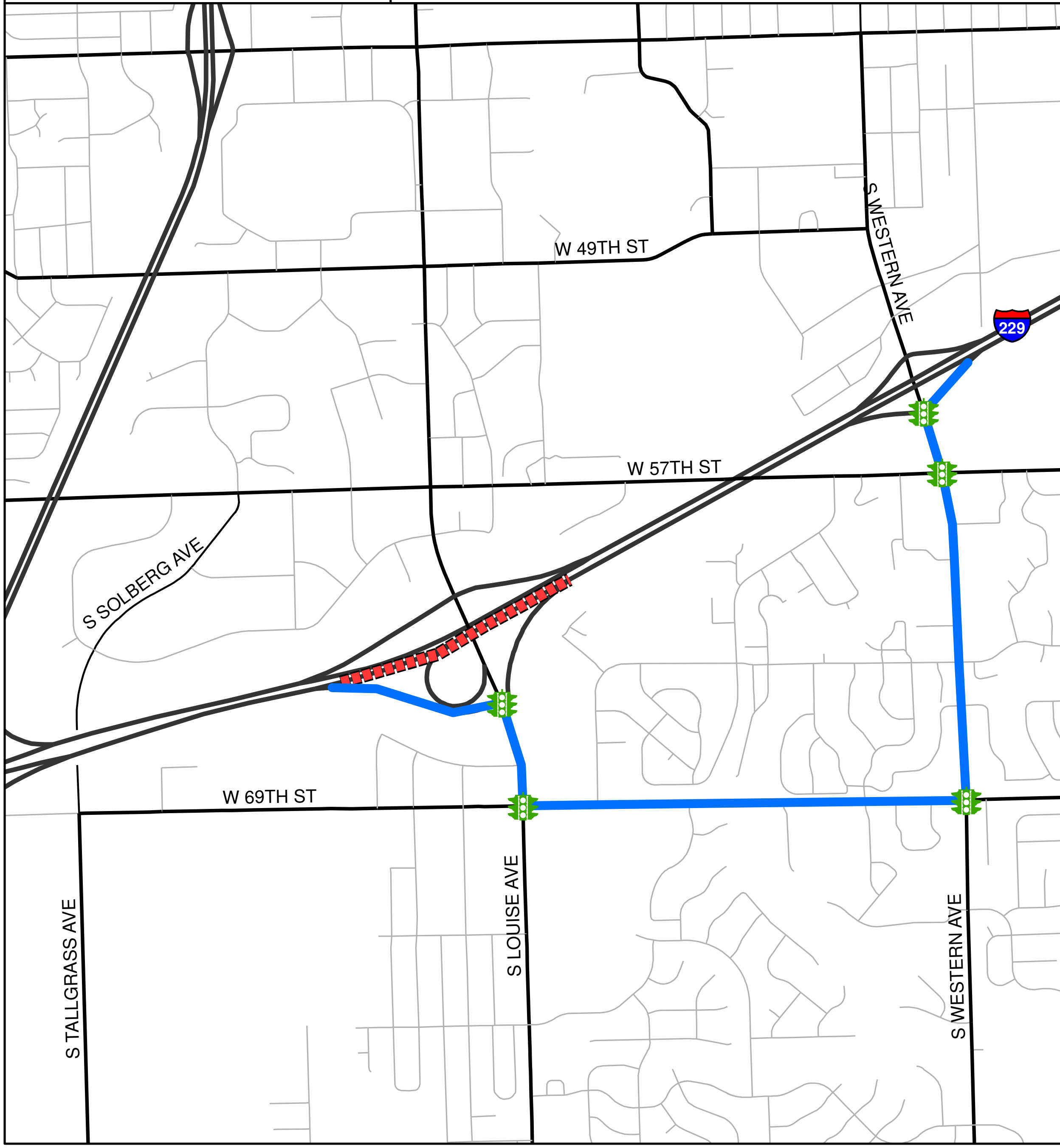
- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Northbound

From: Louise Ave. Off-Ramp **To:** Louise Ave. On-Ramp

I-229 Major Investment Corridor Study
I-229 Corridor Study Area



Incident Management Action

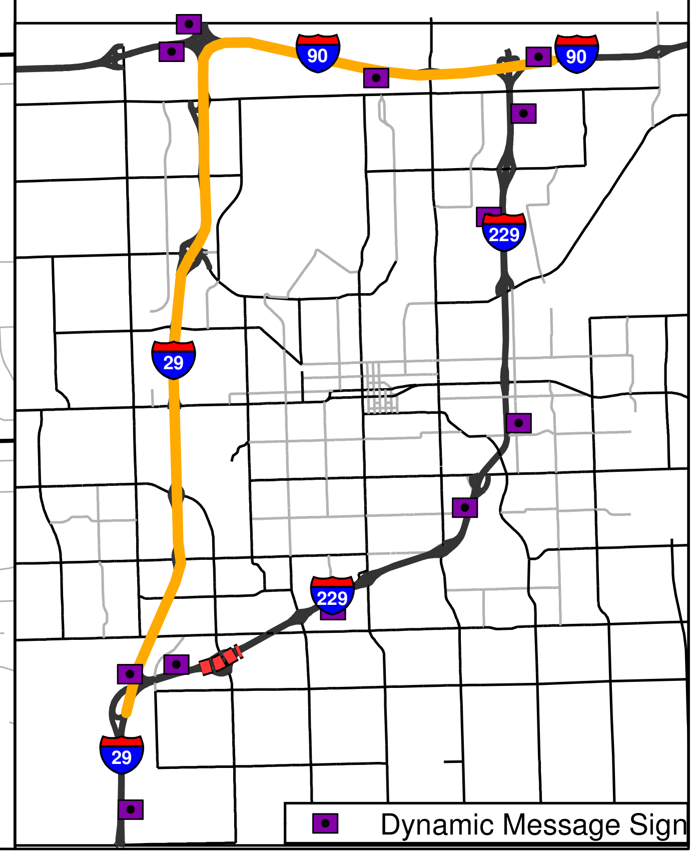
Closure and Response Routes

Closure

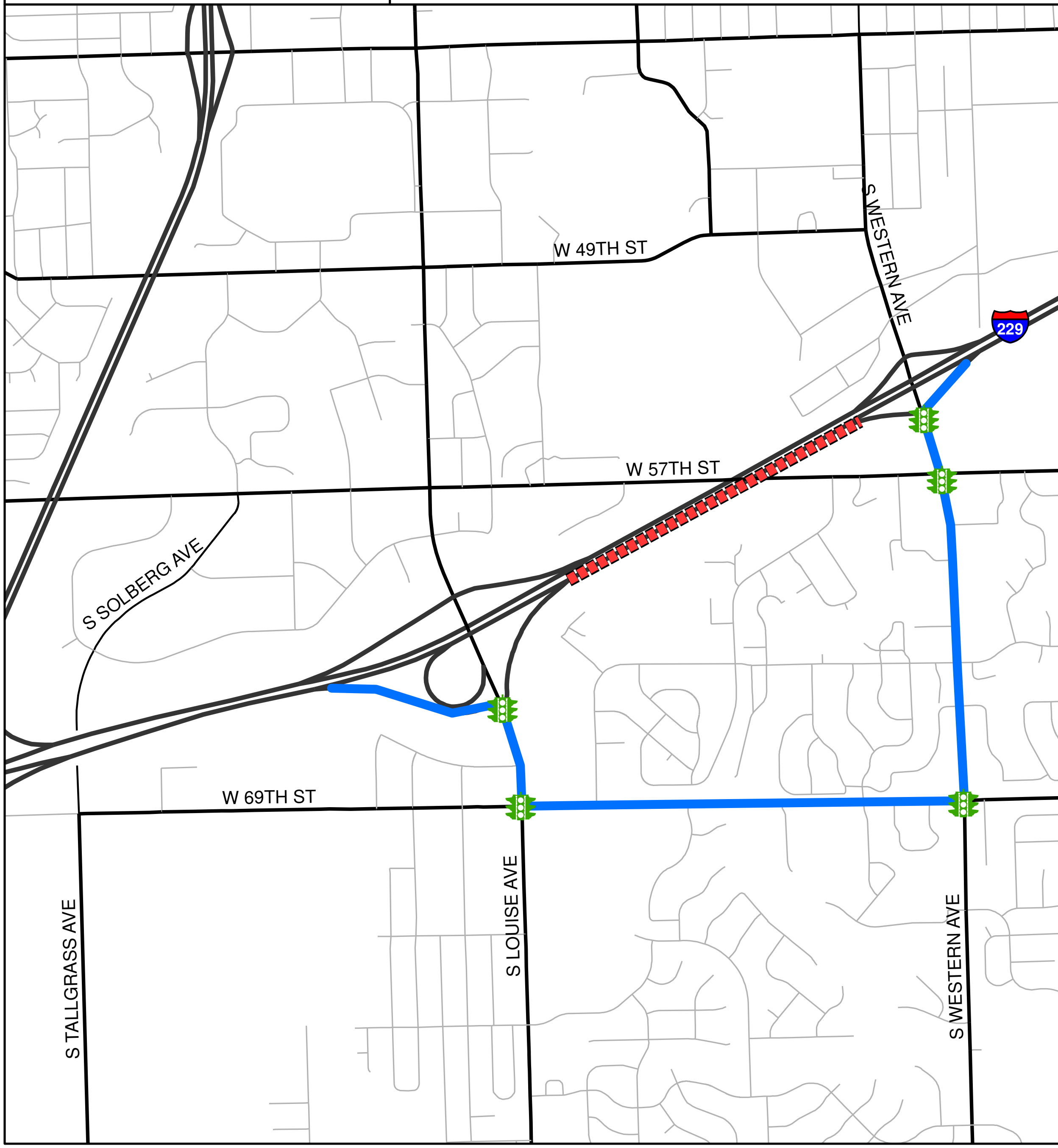
Local Detour

Regional Detour

Signals



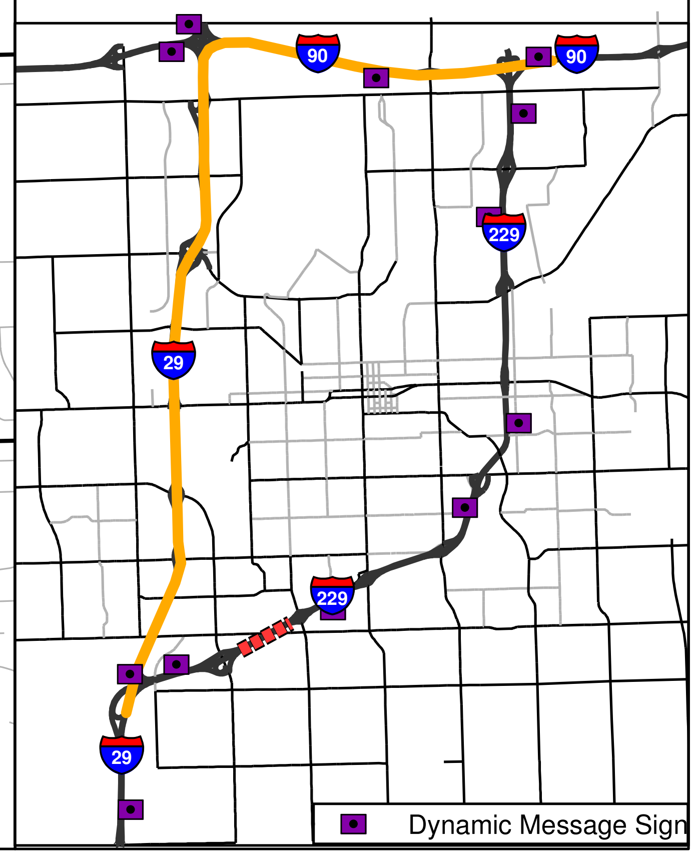
Closure: I-229 Northbound	From: Louise Ave. To: Western Ave.	I-229 Major Investment Corridor Study I-229 Corridor Study Area



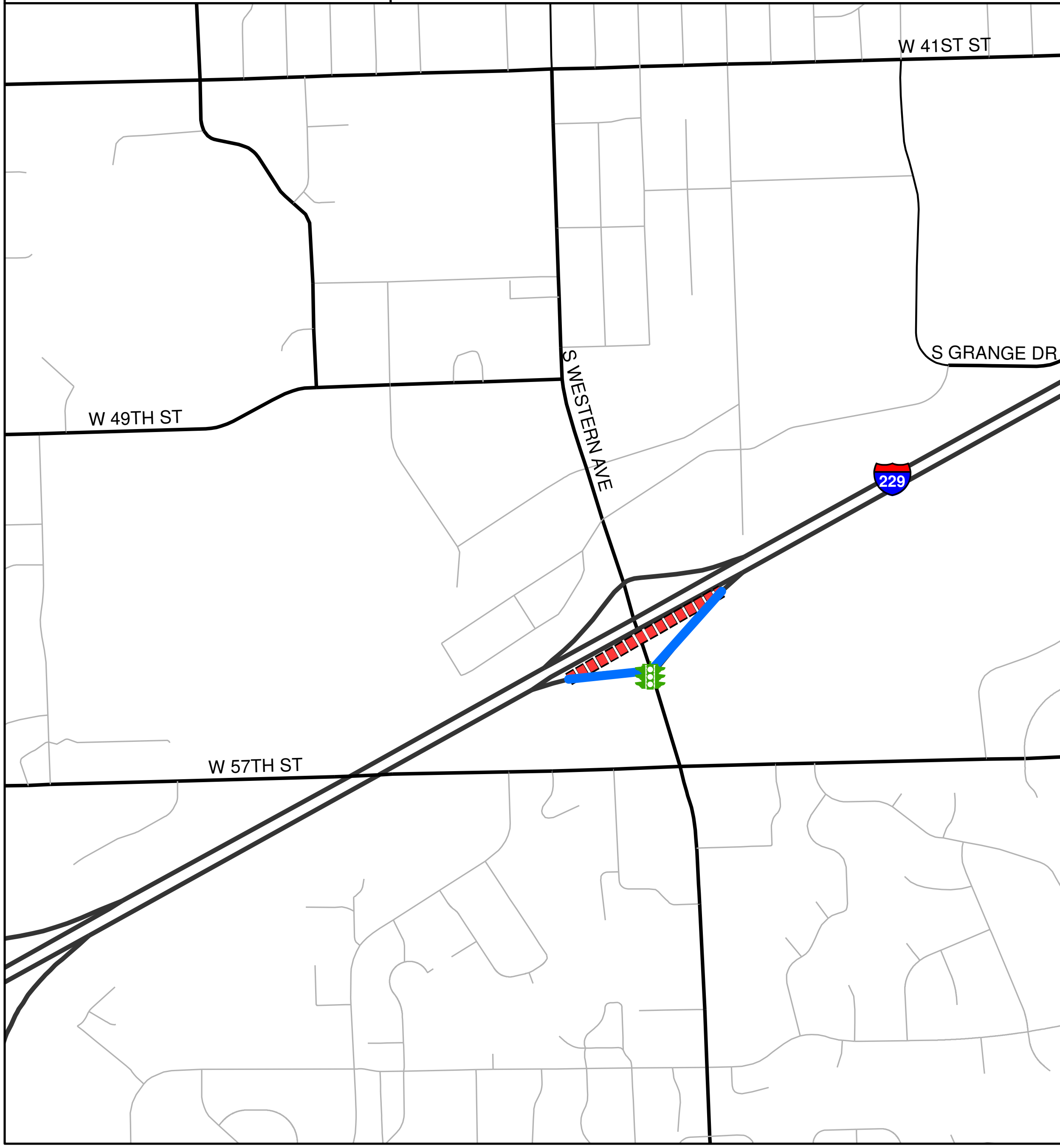
Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



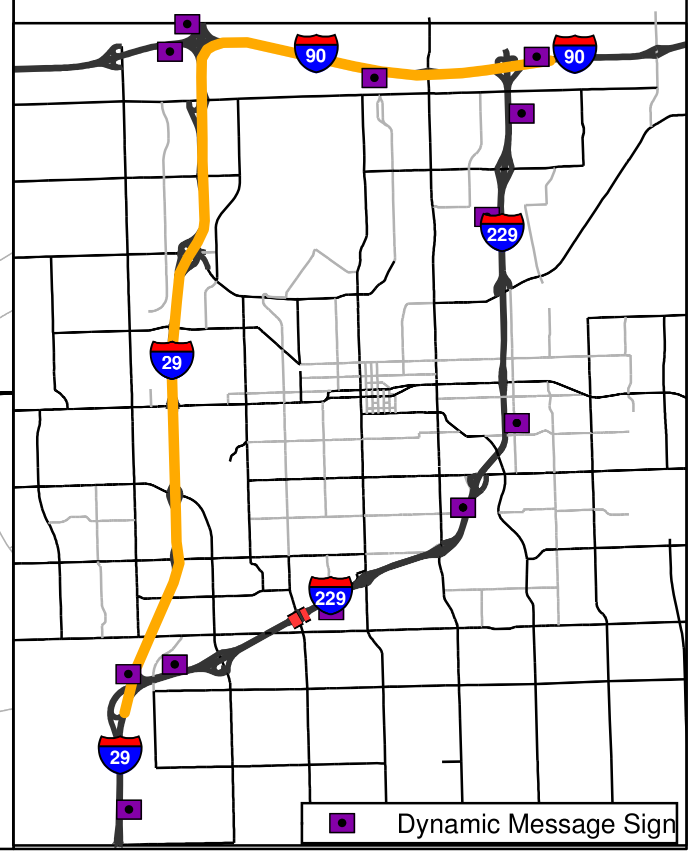
Closure: I-229 Northbound	From: Western Ave. Off-Ramp	To: Western Ave. On-Ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Northbound

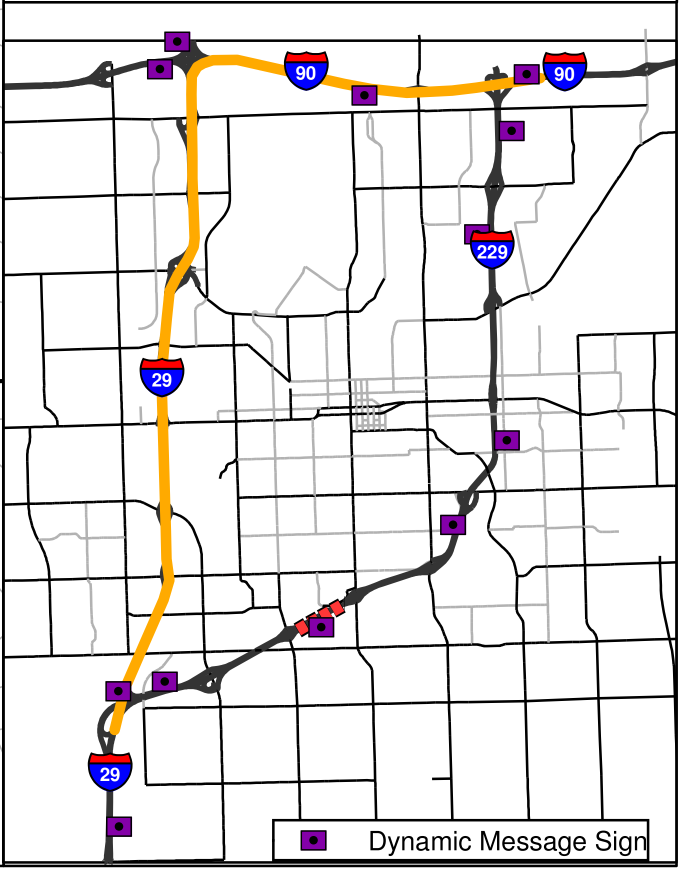
From: Western Ave. **To:** Minnesota Ave.

I-229 Major Investment Corridor Study
I-229 Corridor Study Area

Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals

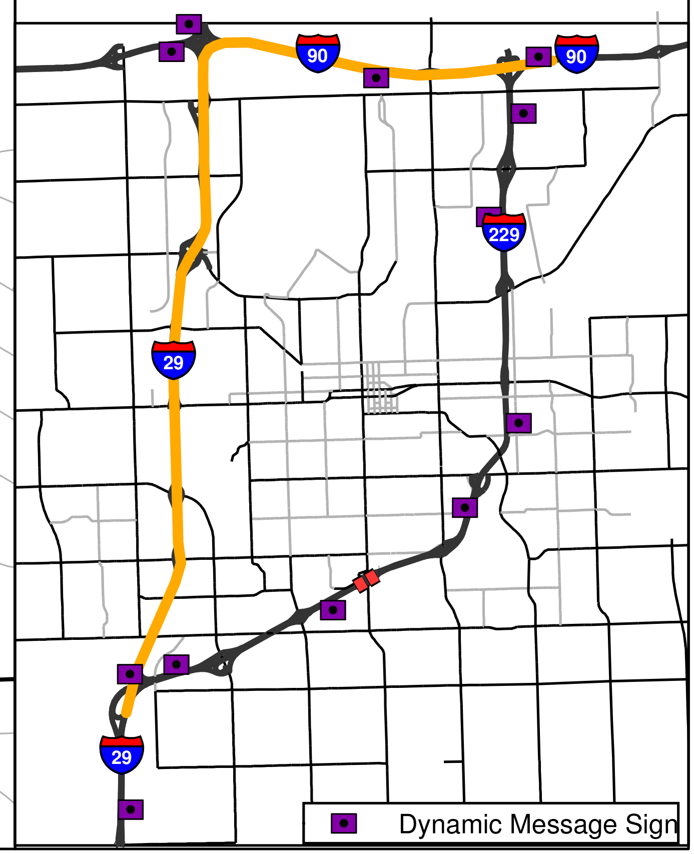


Closure: I-229 Northbound	**From:** Minnesota Ave. Off-Ramp **To:** Minnesota Ave On-Ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area

Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals

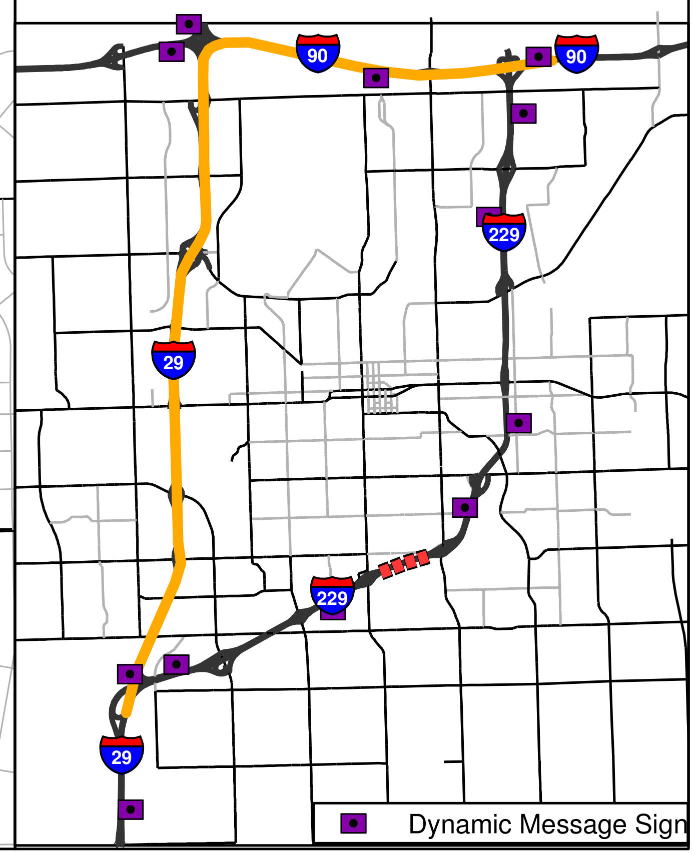


Closure: I-229 Northbound	**From:** Minnesota Ave. **To:** Cliff Ave.	I-229 Major Investment Corridor Study I-229 Corridor Study Area

Incident Management Action

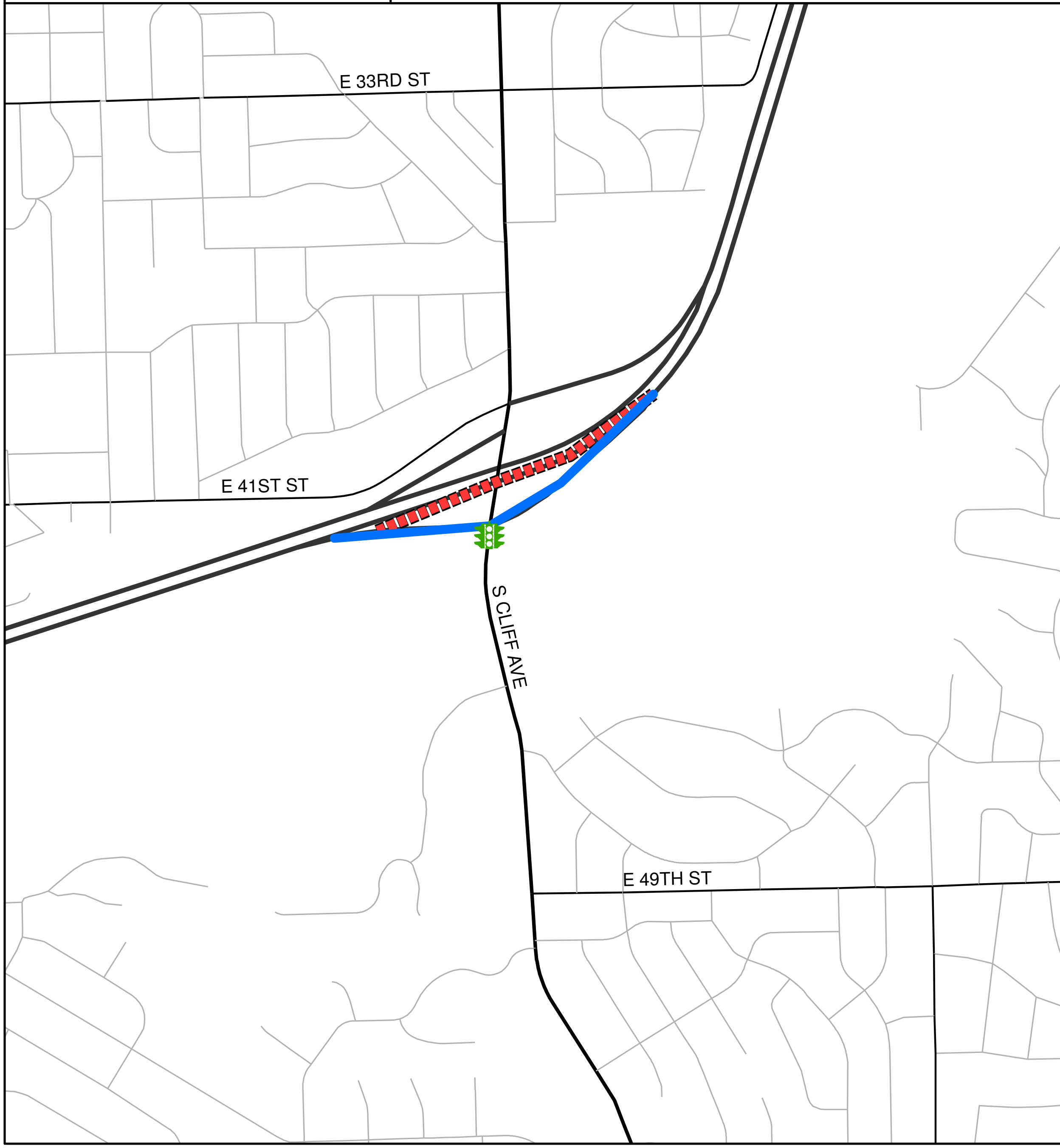
Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Northbound | **From:** Cliff Ave. Off-Ramp | **To:** Cliff Ave. On-Ramp

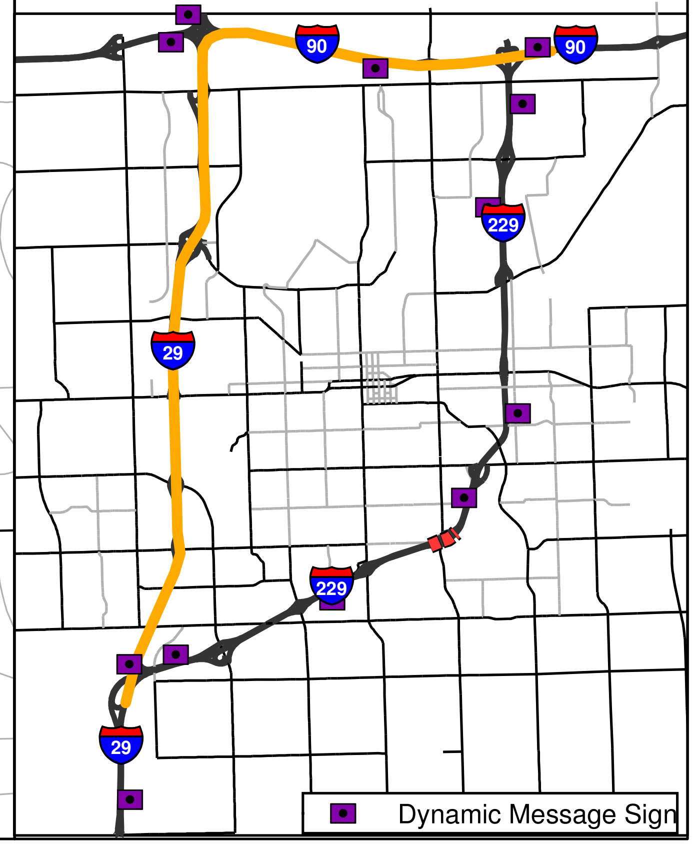
I-229 Major Investment Corridor Study
I-229 Corridor Study Area



Incident Management Action

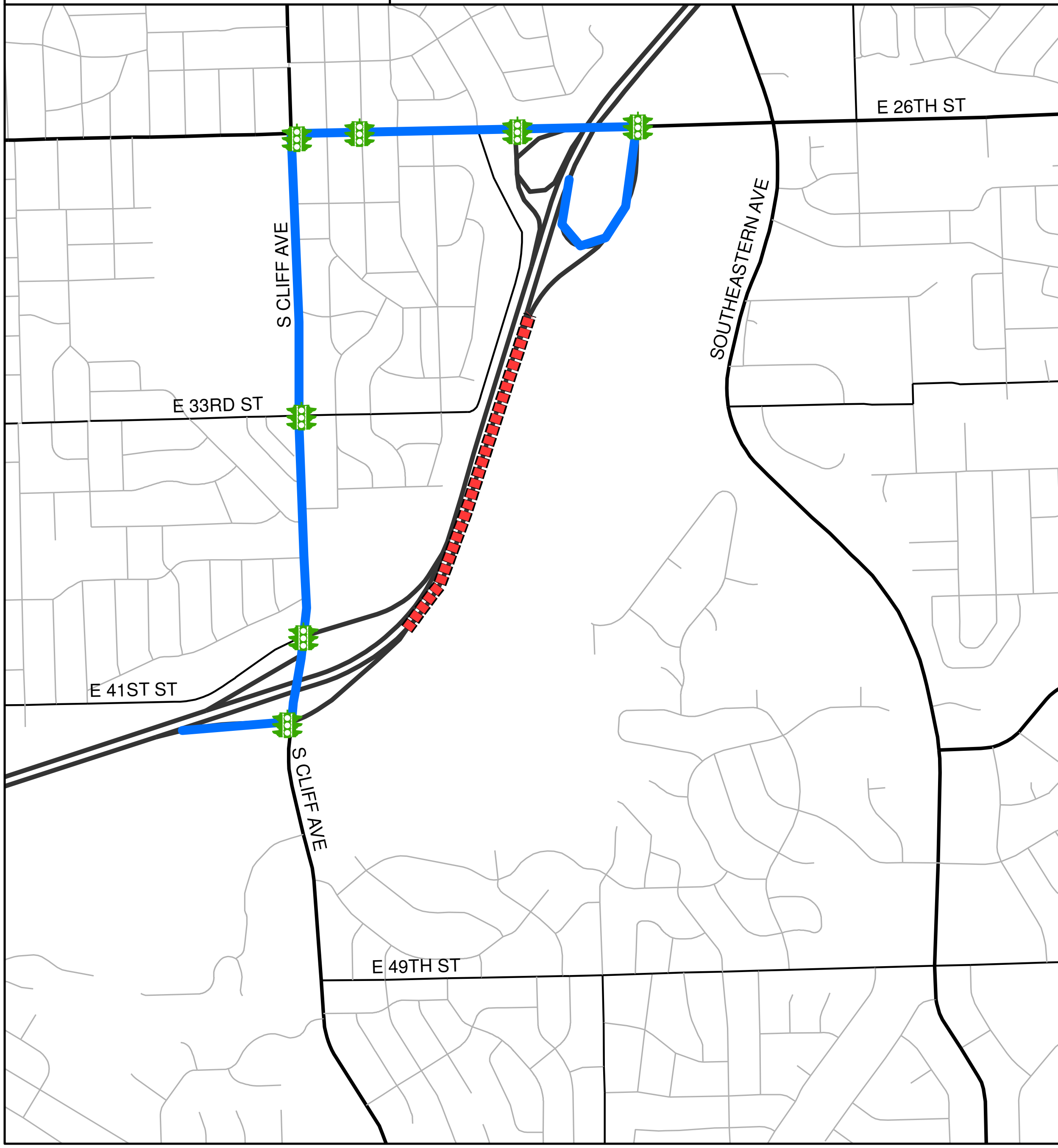
Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Northbound **From:** Cliff Ave. **To:** 26th St.

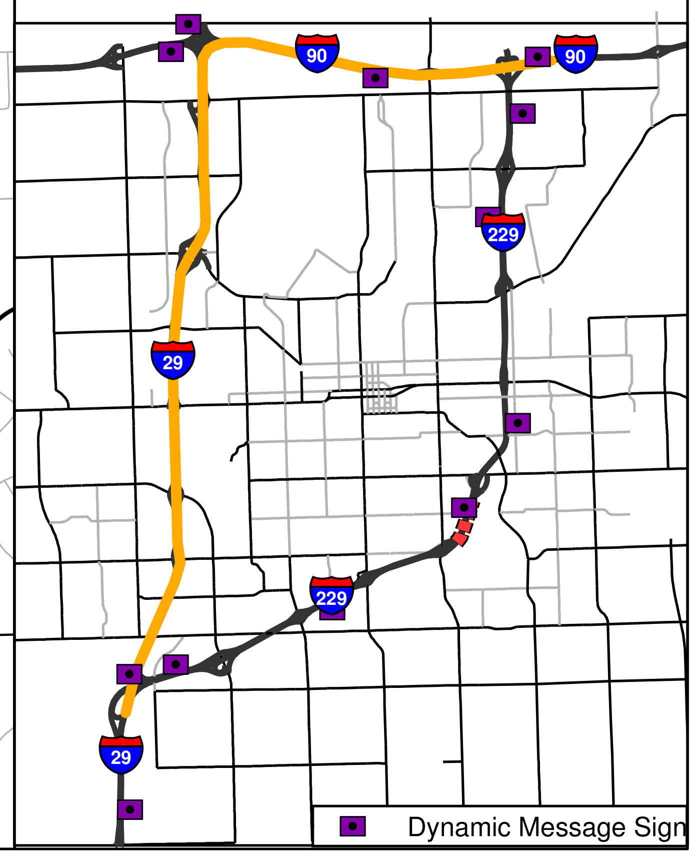
I-229 Major Investment Corridor Study
I-229 Corridor Study Area



Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



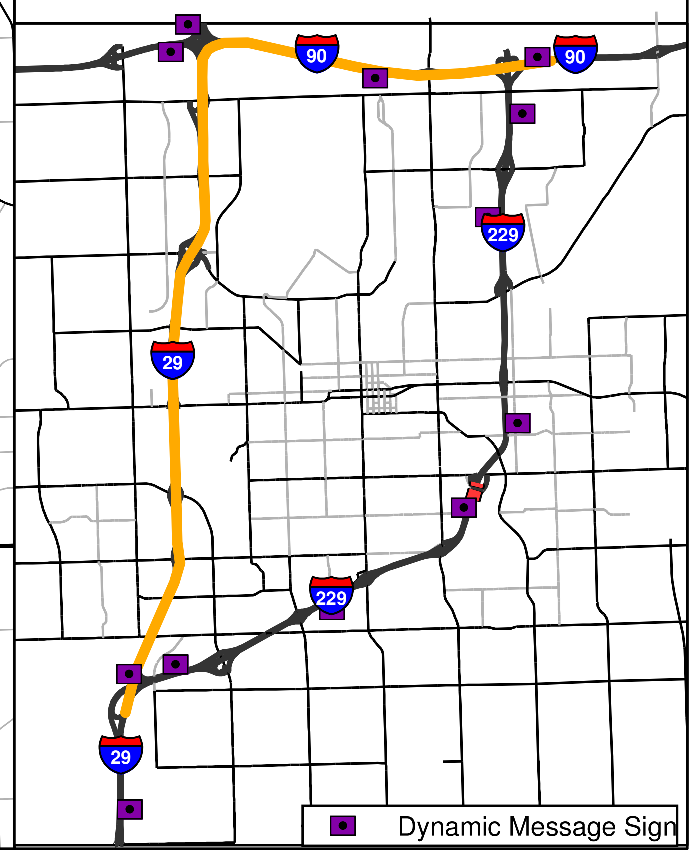
Closure: I-229 Northbound | **From:** 26th St. Off-Ramp | **To:** 26th St. On-Ramp

I-229 Major Investment Corridor Study
I-229 Corridor Study Area

Incident Management Action

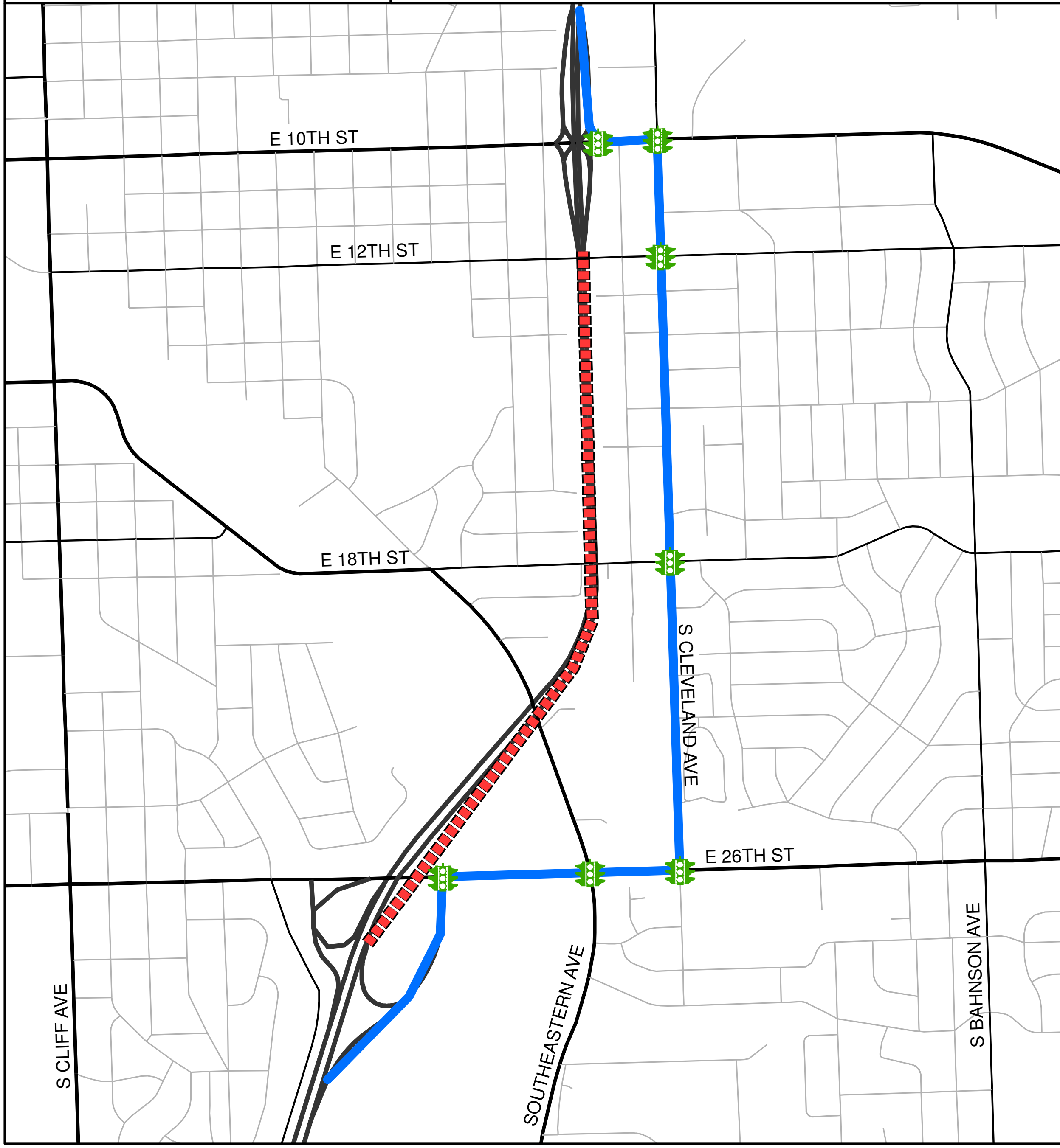
Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Northbound **From:** 26th St. **To:** 10th St.

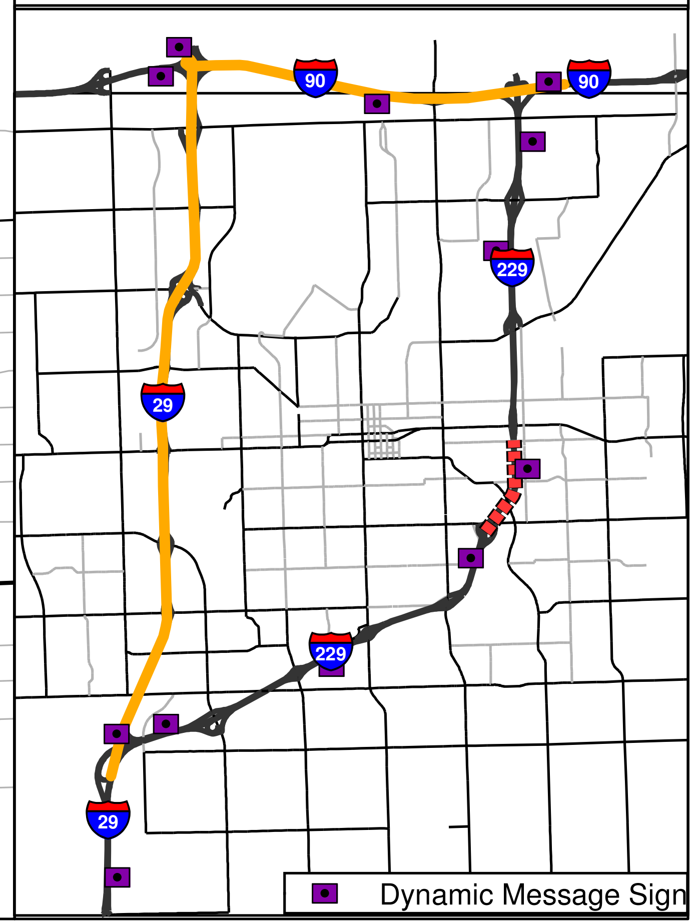
I-229 Major Investment Corridor Study
I-229 Corridor Study Area



Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Northbound	From: 10th St Off-Ramp	To: 10th St On-Ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area

Incident Management Action

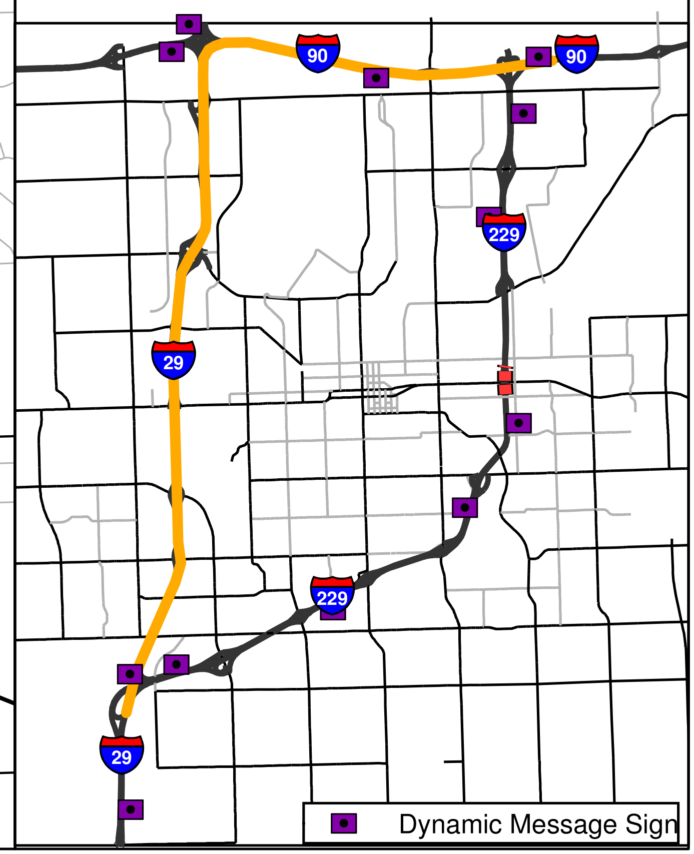
Closure and Response Routes

Closure

Local Detour

Regional Detour

Signals



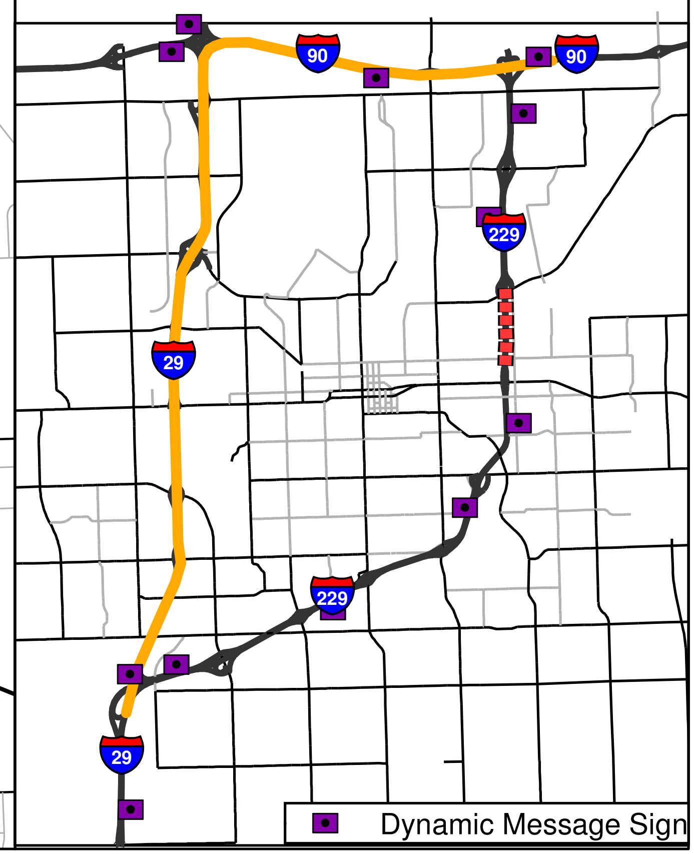
Closure: I-229 Northbound | **From:** 10th St. | **To:** Rice St.

I-229 Major Investment Corridor Study
I-229 Corridor Study Area

Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals

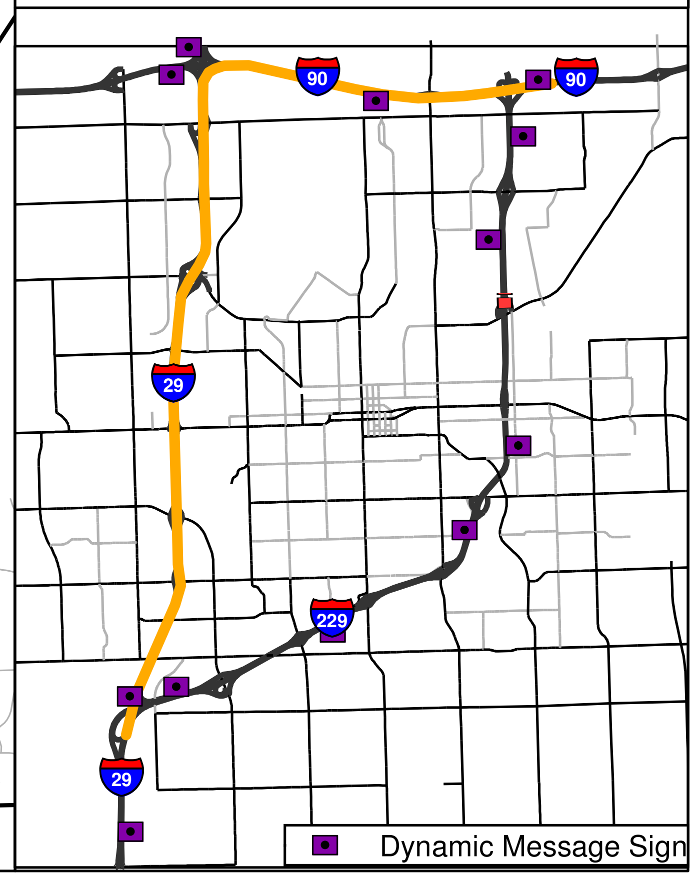


Closure: I-229 Northbound	From: Rice St. Off-Ramp	To: Rice St. On-Ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area

Incident Management Action

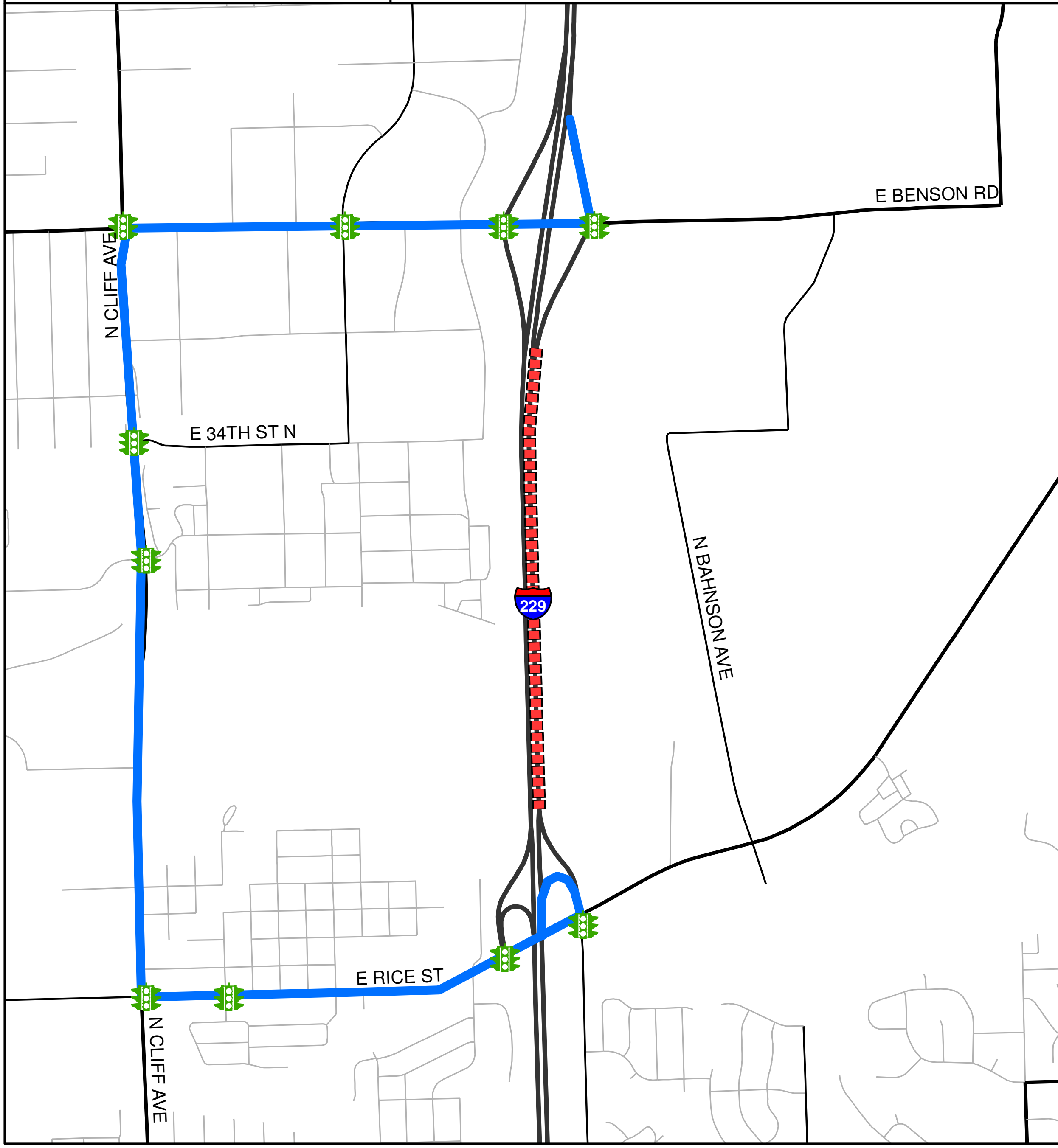
Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Northbound **From:** Rice St. **To:** Benson Rd.

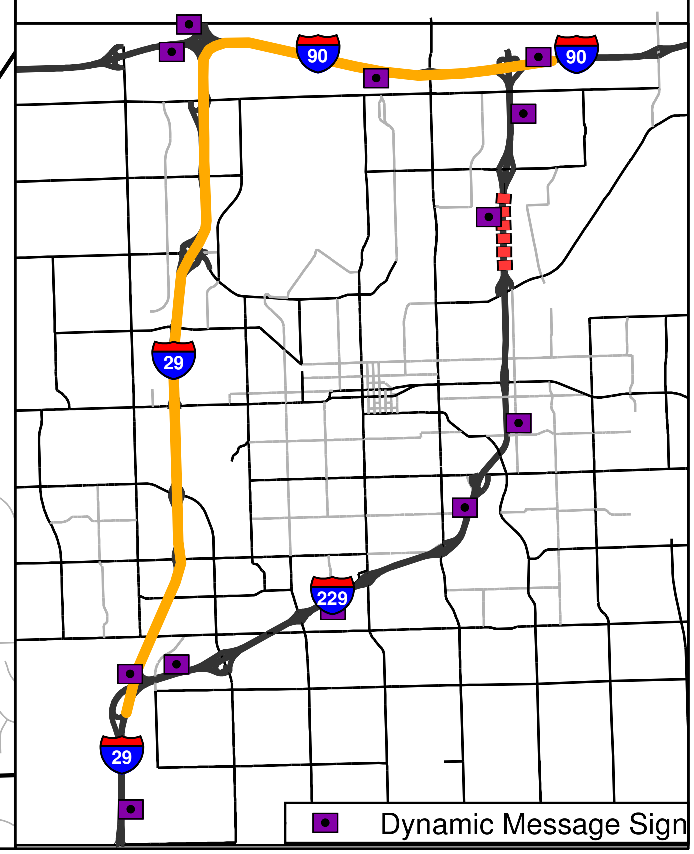
I-229 Major Investment Corridor Study
I-229 Corridor Study Area



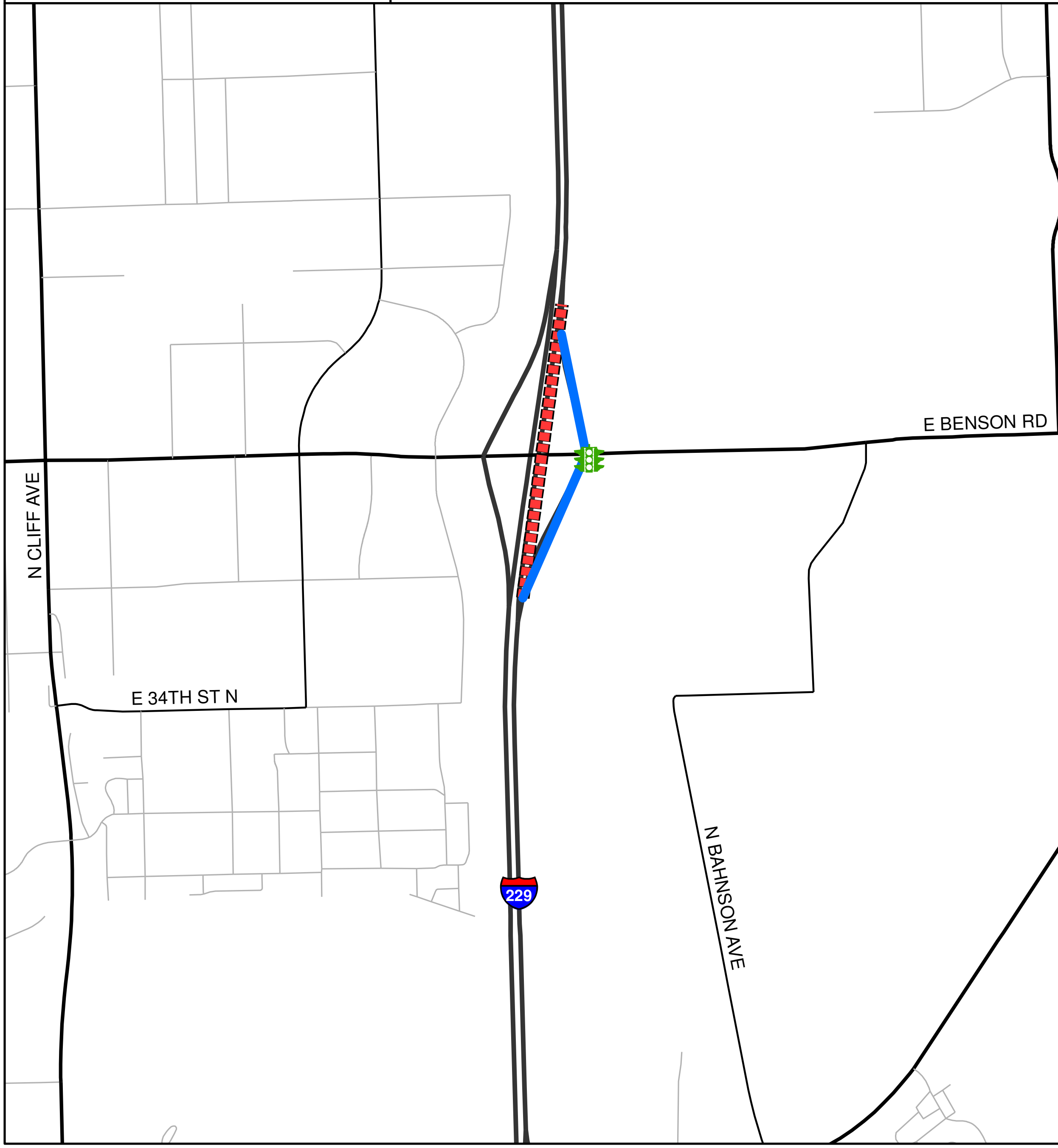
Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



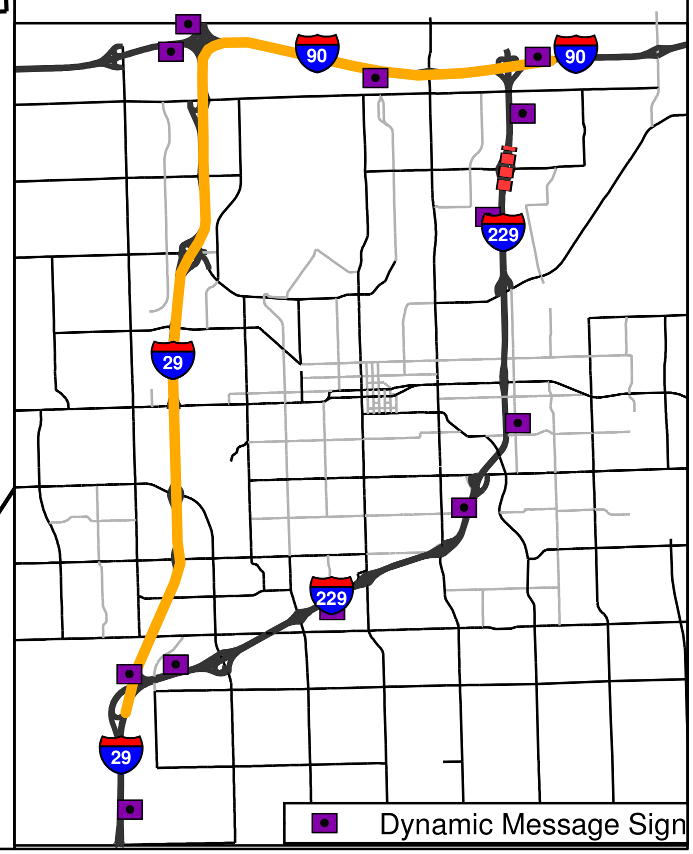
Closure: I-229 Northbound	**From:** Benson St. Off-Ramp	**To:** Benson St. On-Ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Northbound	**From:** Benson Rd. **To:** I-90	I-229 Major Investment Corridor Study I-229 Corridor Study Area

Incident Management Action

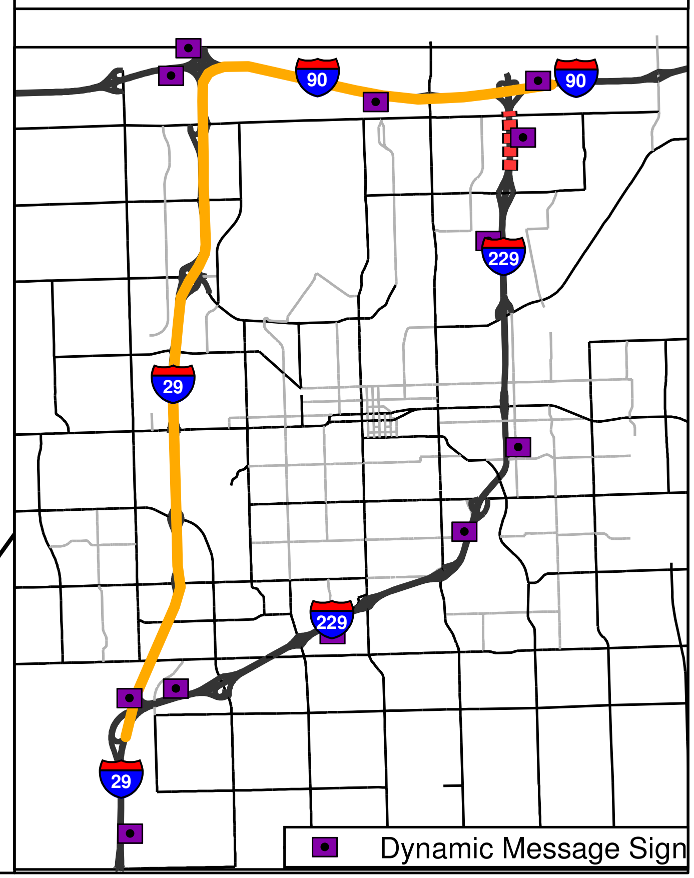
Closure and Response Routes

Closure

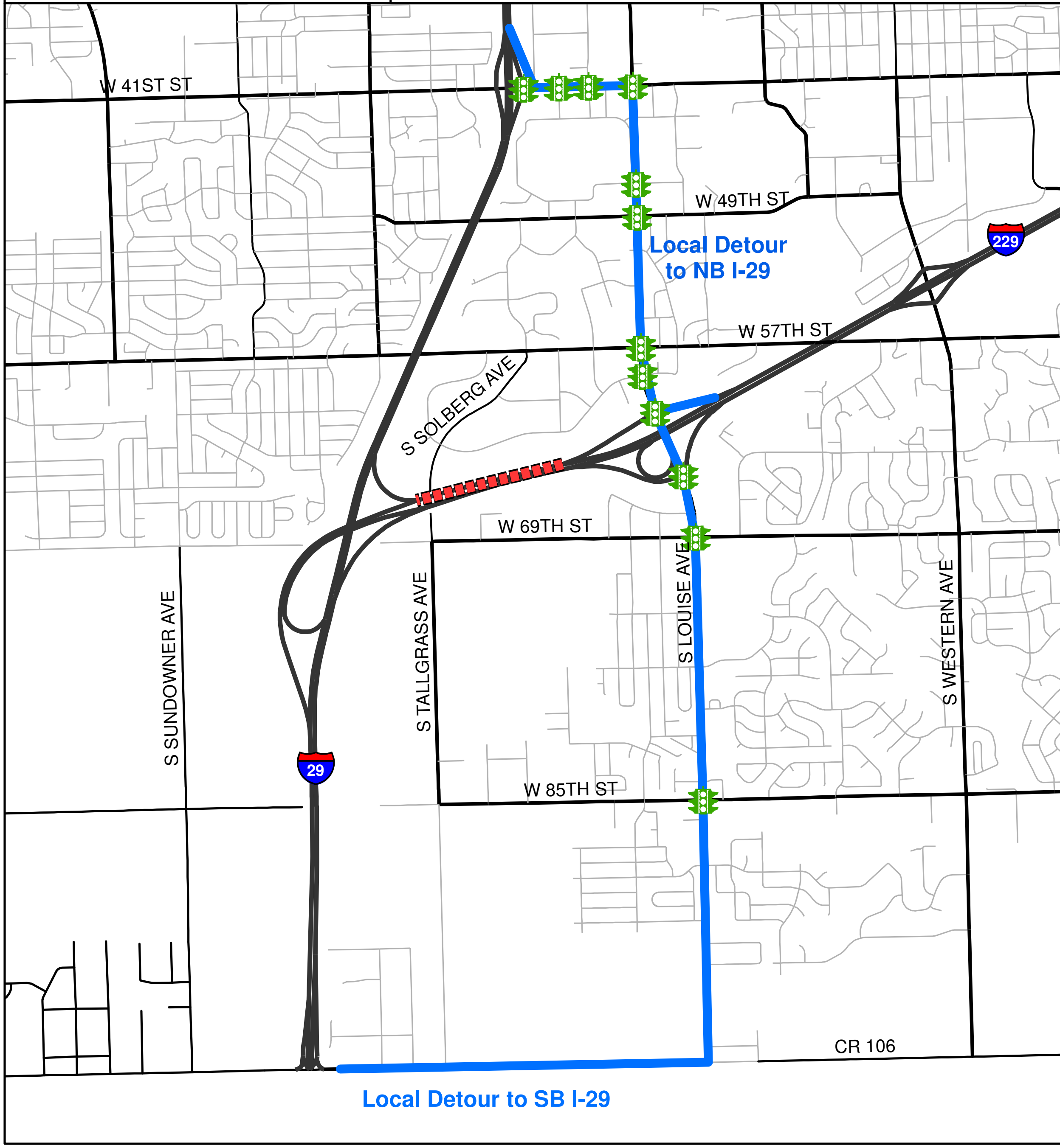
Local Detour

Regional Detour

Signals



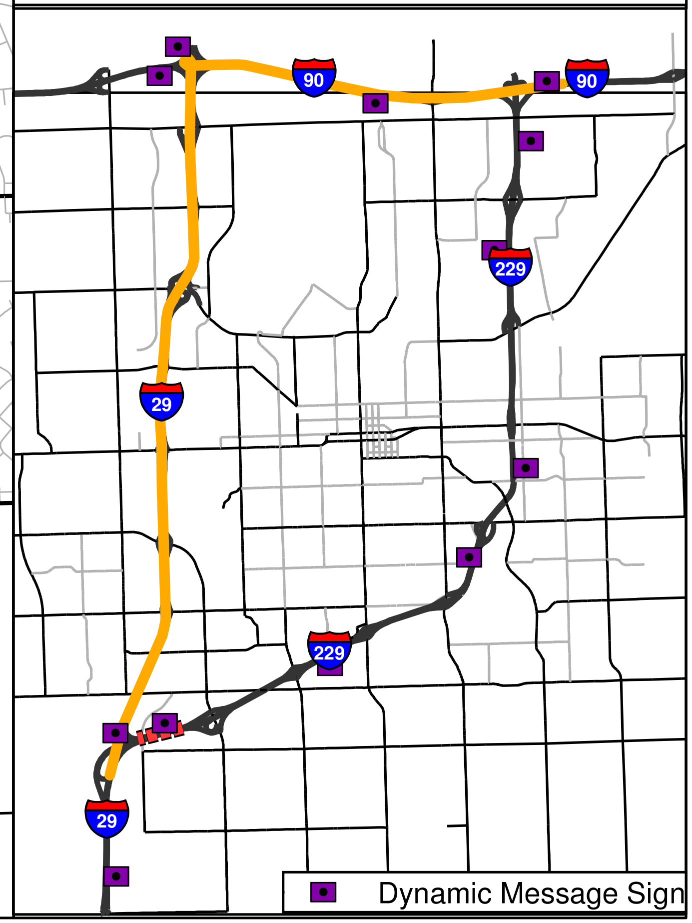
Closure: I-229 Southbound	From: I-29	To: Louise Ave.	I-229 Major Investment Corridor Study I-229 Corridor Study Area



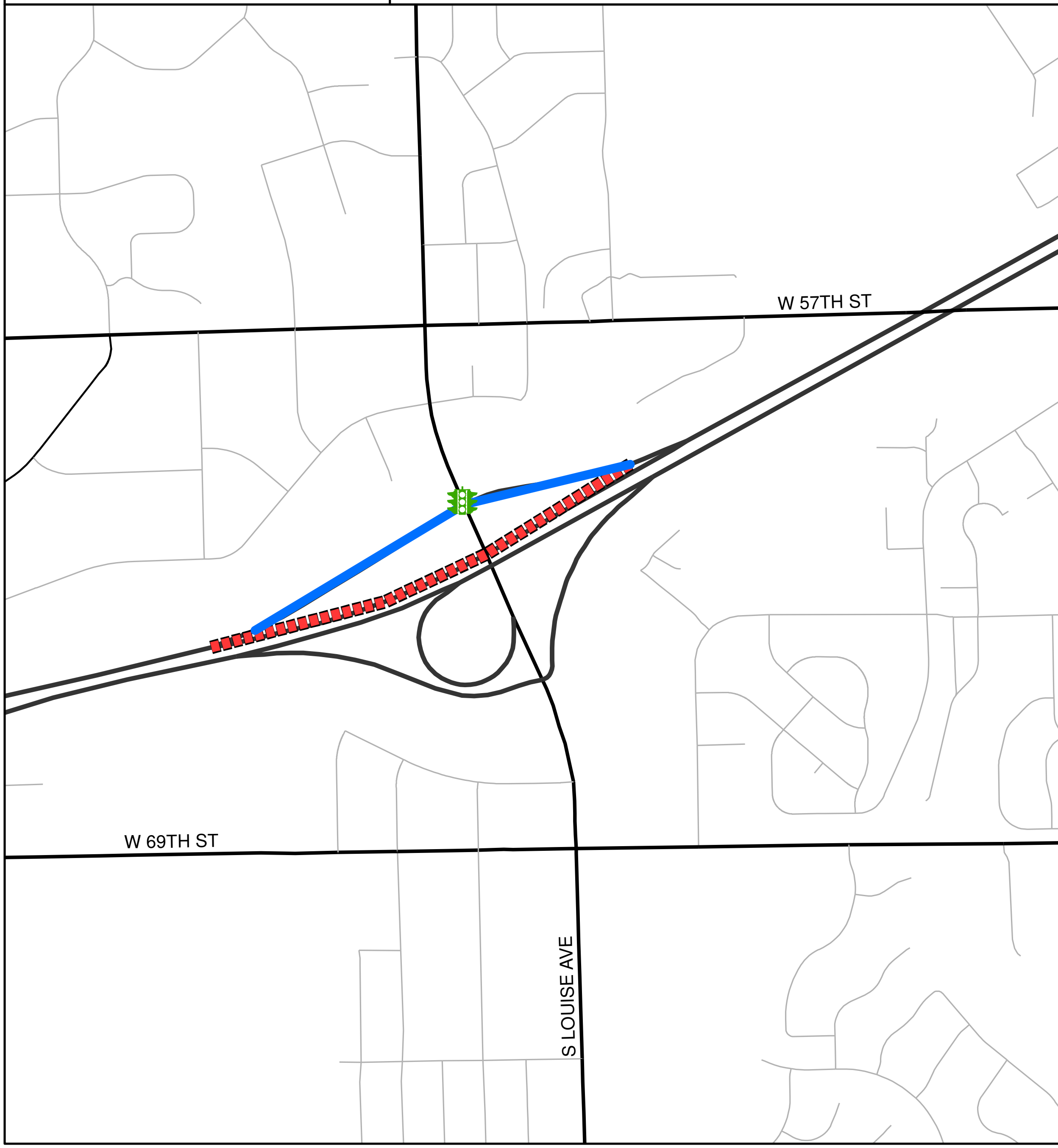
Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



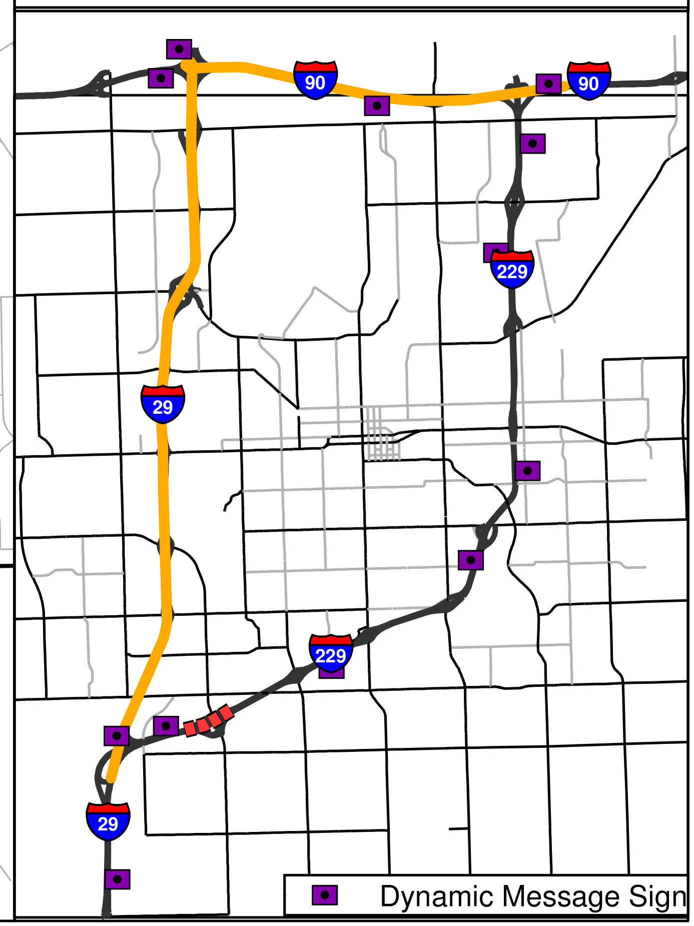
Closure: I-229 Southbound	**From:** Louise Ave. Off-ramp	**To:** Louise Ave. On-ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Southbound	From: Louise Ave. To: Western Ave.	I-229 Major Investment Corridor Study I-229 Corridor Study Area

Incident Management Action

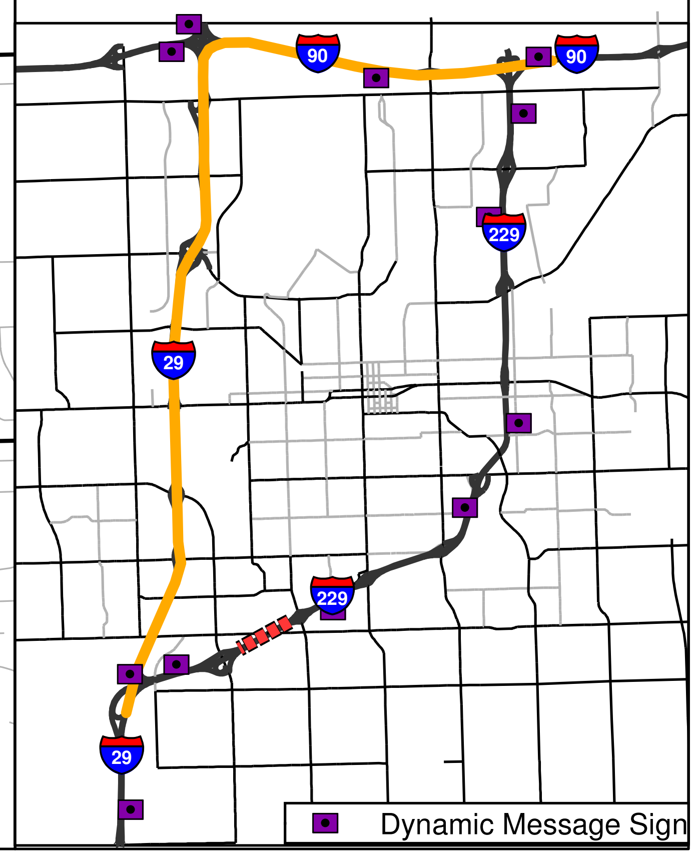
Closure and Response Routes

Closure

Local Detour

Regional Detour

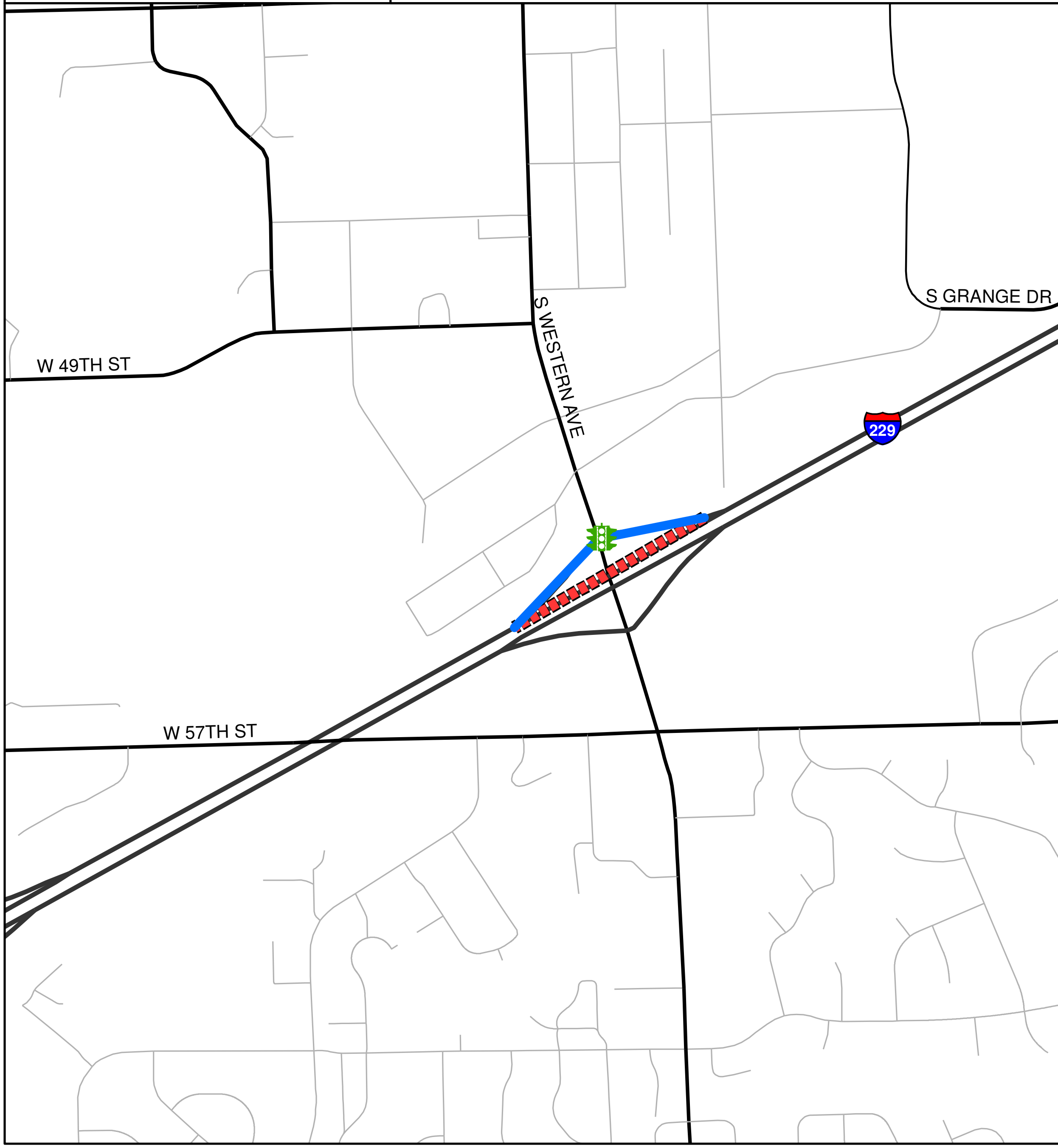
Signals



Closure: I-229 Southbound

From: Western Ave. Off- Ramp **To:** Western Ave. On- Ramp

I-229 Major Investment Corridor Study
I-229 Corridor Study Area



Incident Management Action

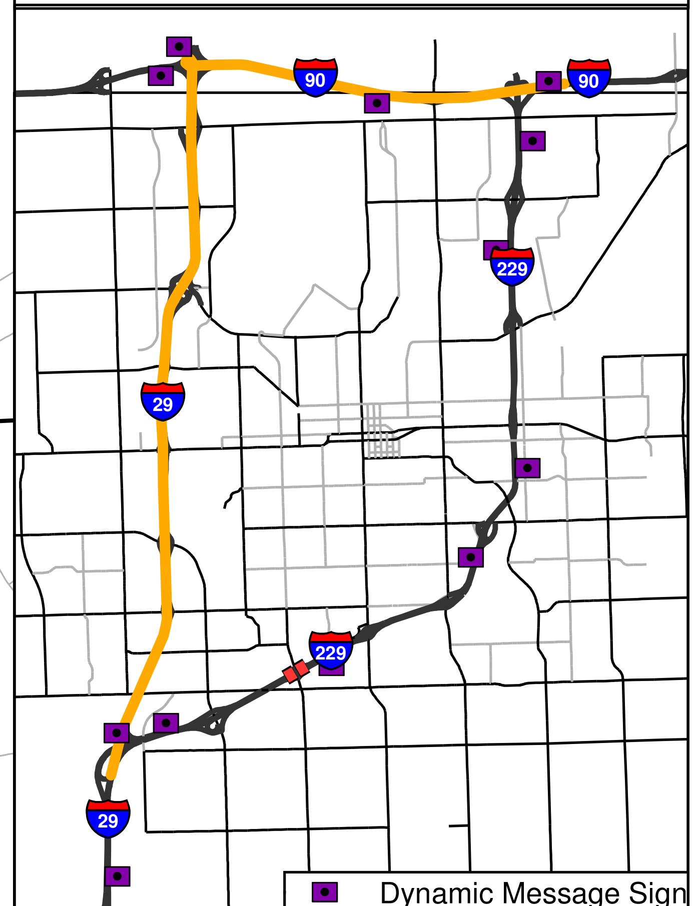
Closure and Response Routes

Closure

Local Detour

Regional Detour

Signals



Closure: I-229 Southbound | **From:** Minnesota Ave. **To:** Western Ave.

I-229 Major Investment Corridor Study
I-229 Corridor Study Area

Incident Management Action

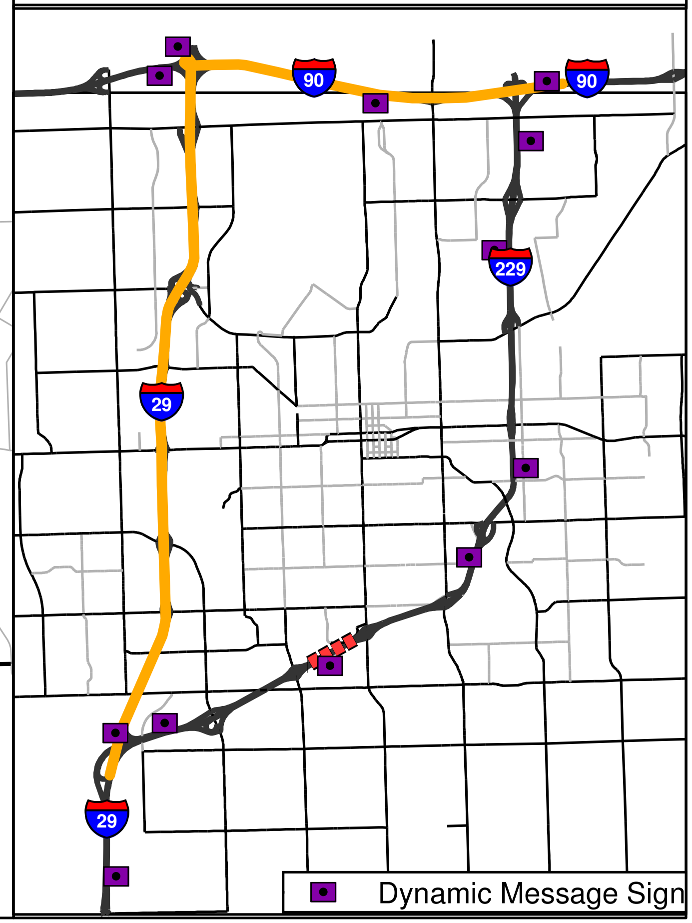
Closure and Response Routes

Closure

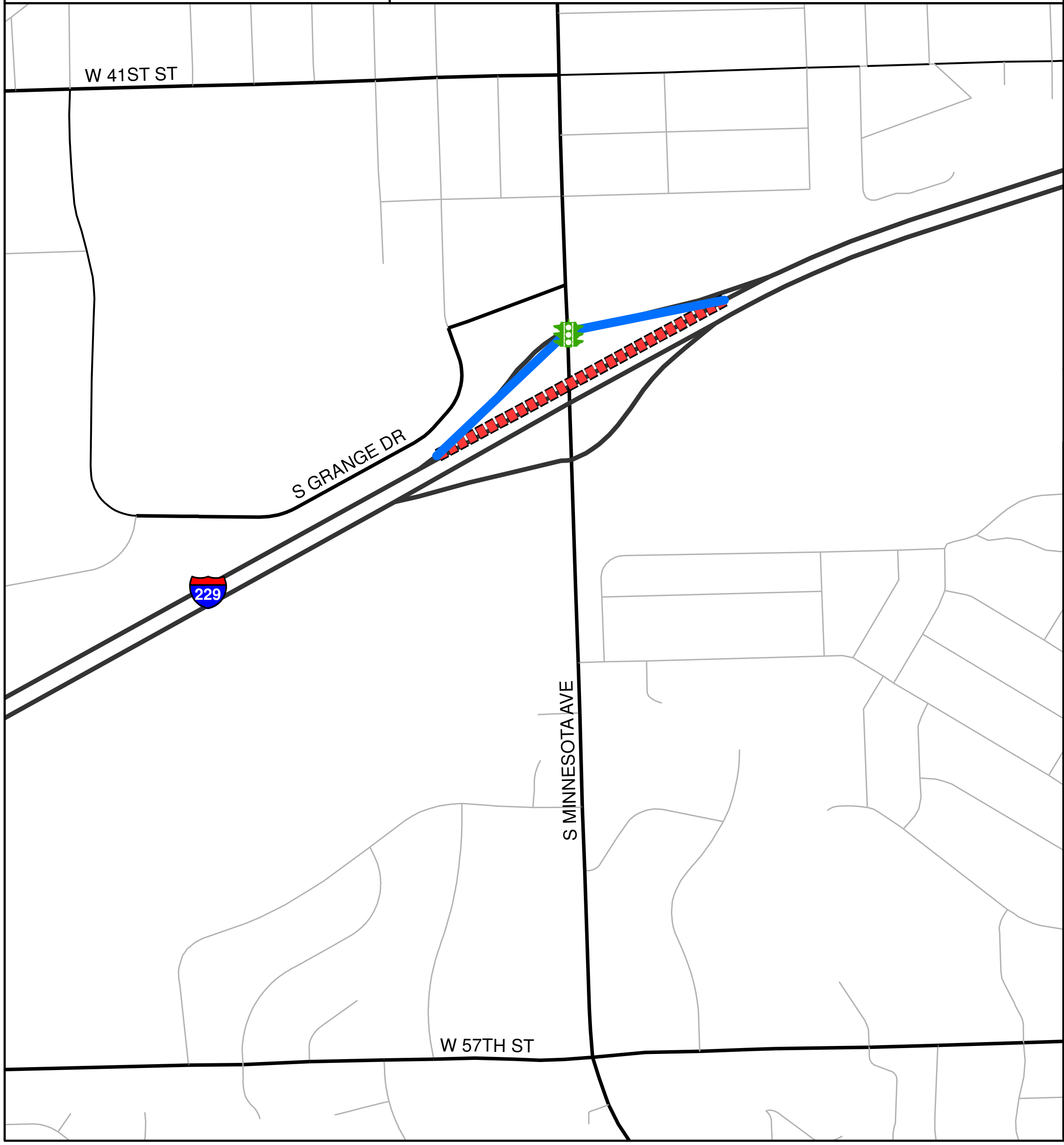
Local Detour

Regional Detour

Signals



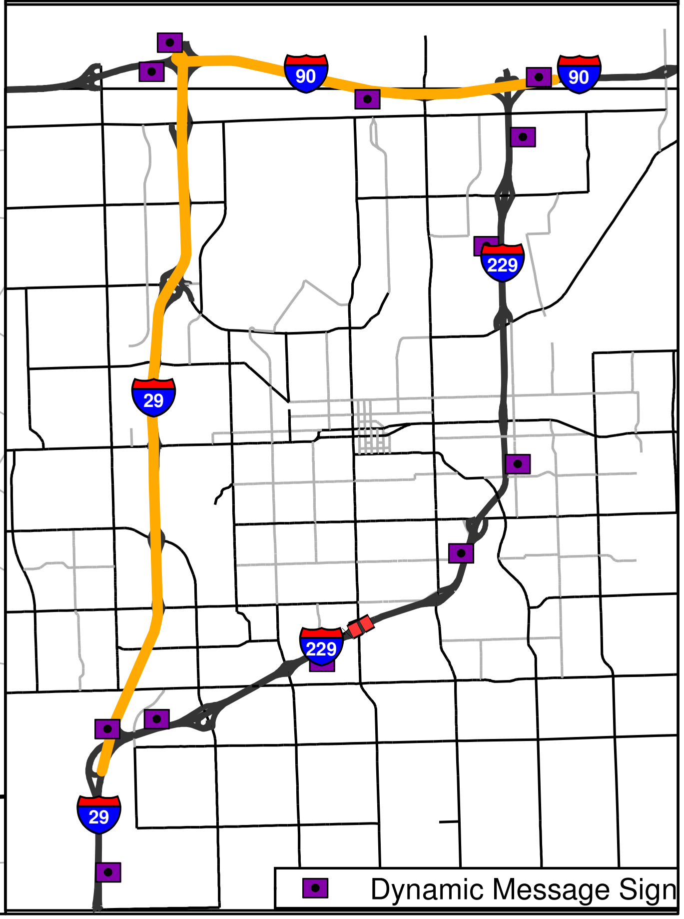
Closure: I-229 Southbound	**From:** Minnesota Ave. Off-Ramp **To:** Minnesota Ave. On-Ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



Incident Management Action

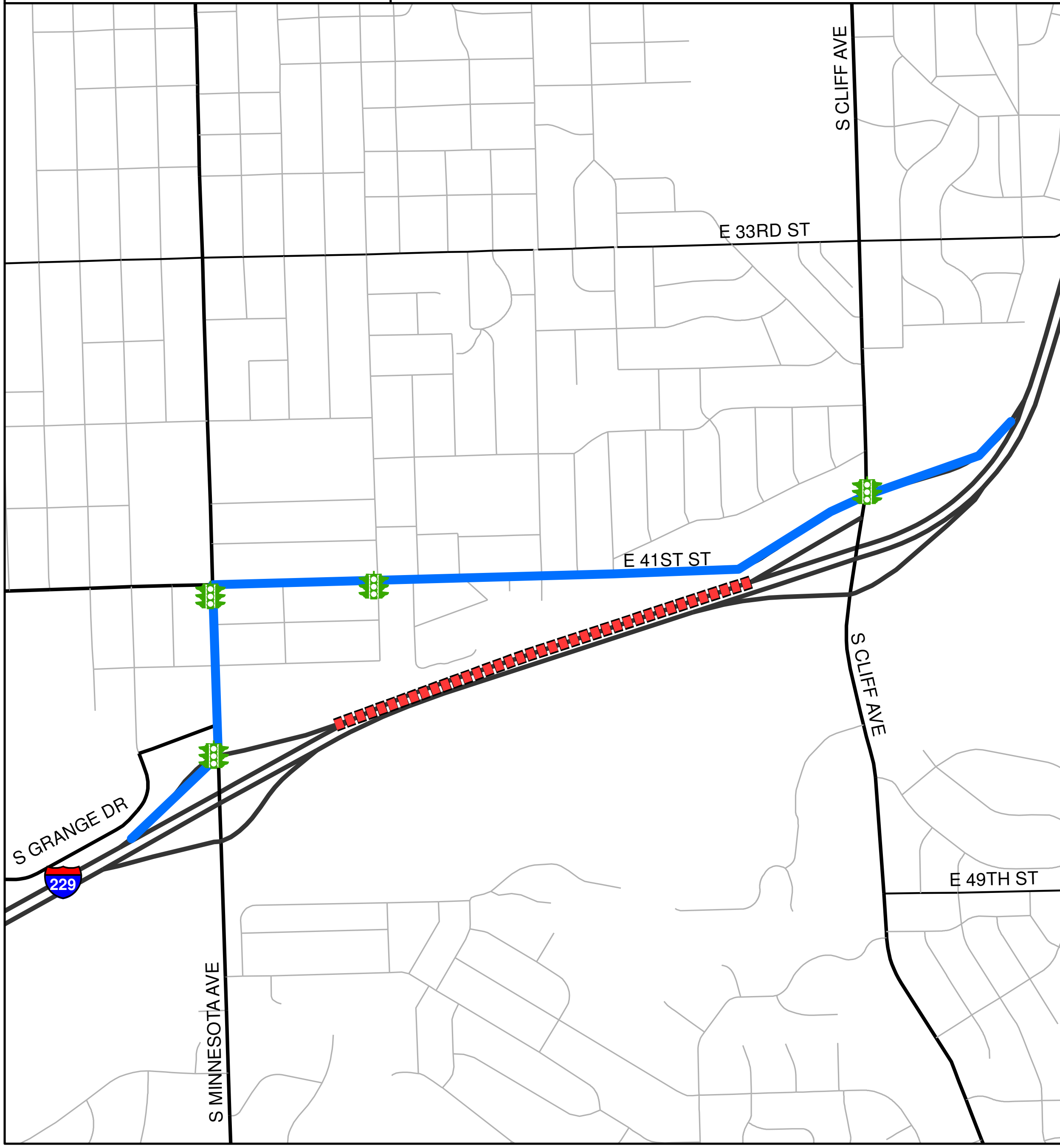
Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Southbound | **From:** Cliff Ave. | **To:** Minnesota Ave.

I-229 Major Investment Corridor Study
I-229 Corridor Study Area



Incident Management Action

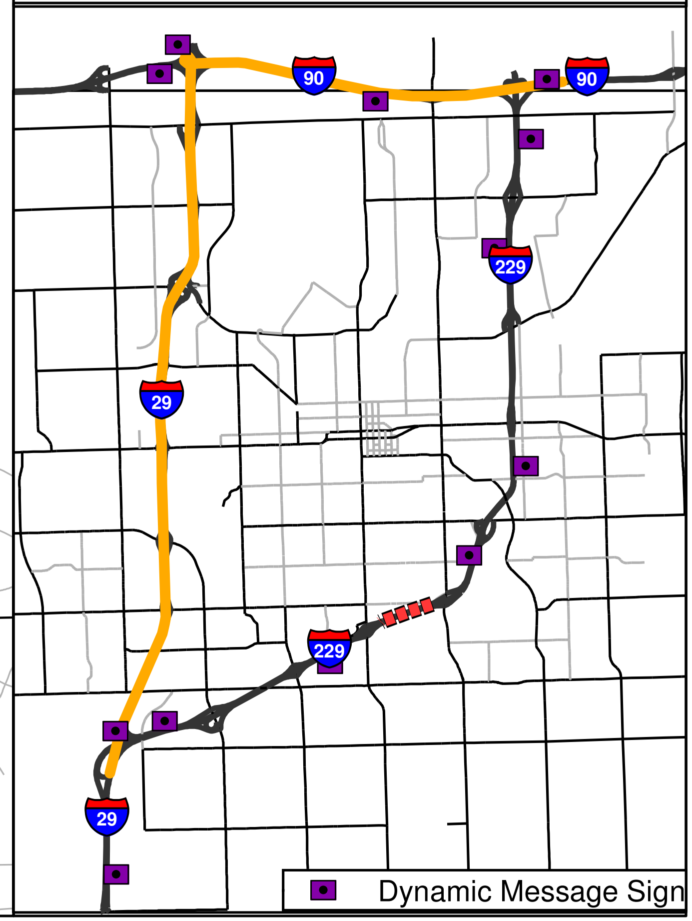
Closure and Response Routes

Closure

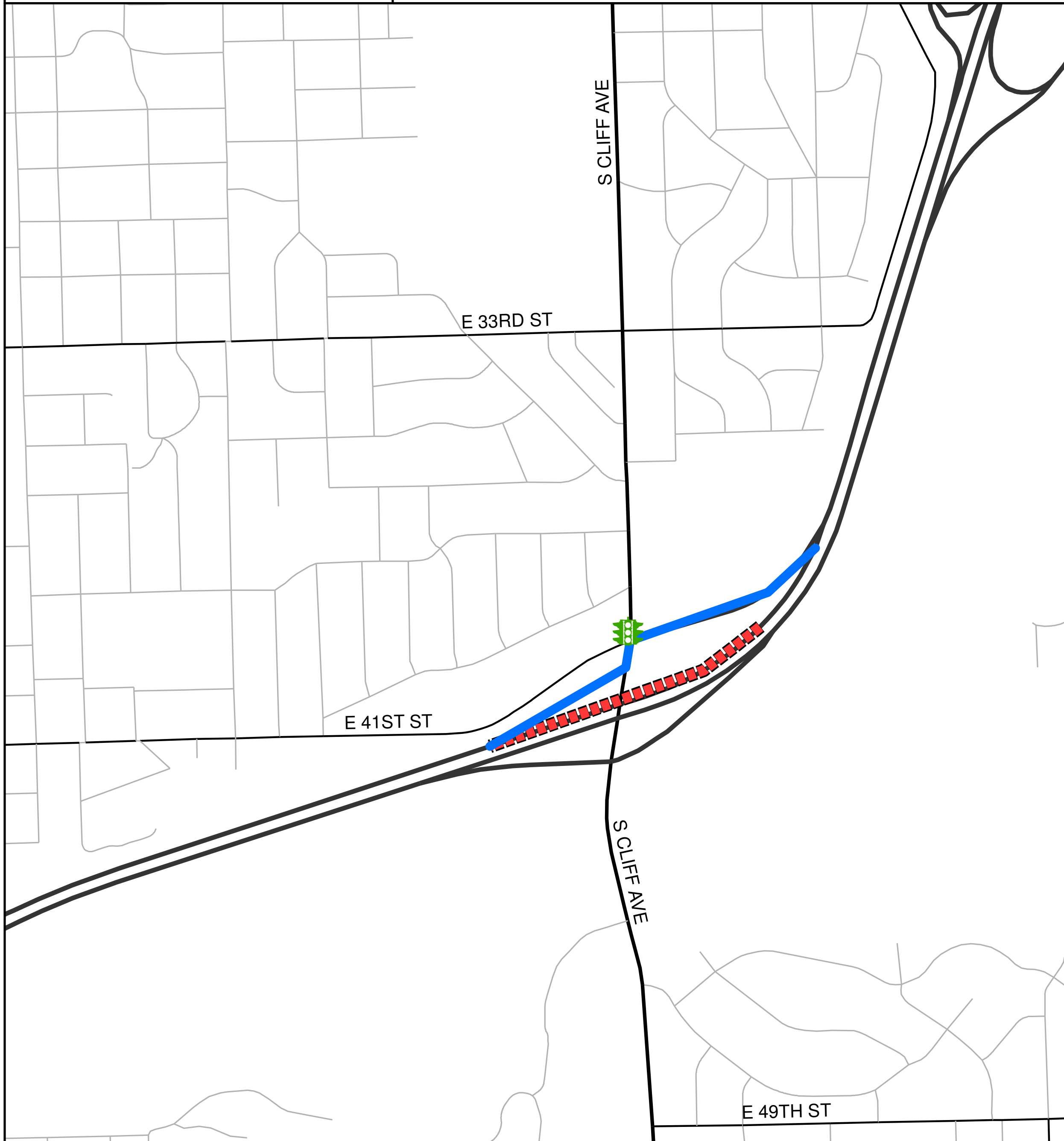
Local Detour

Regional Detour

Signals



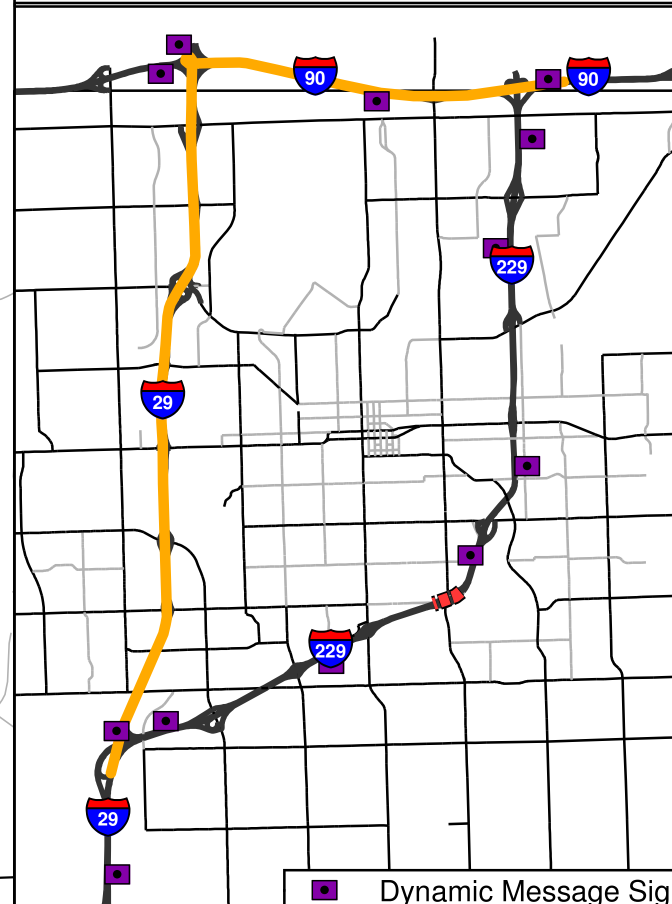
Closure: I-229 Southbound	**From:** Cliff Ave. Off-Ramp	**To:** Cliff Ave. On-Ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



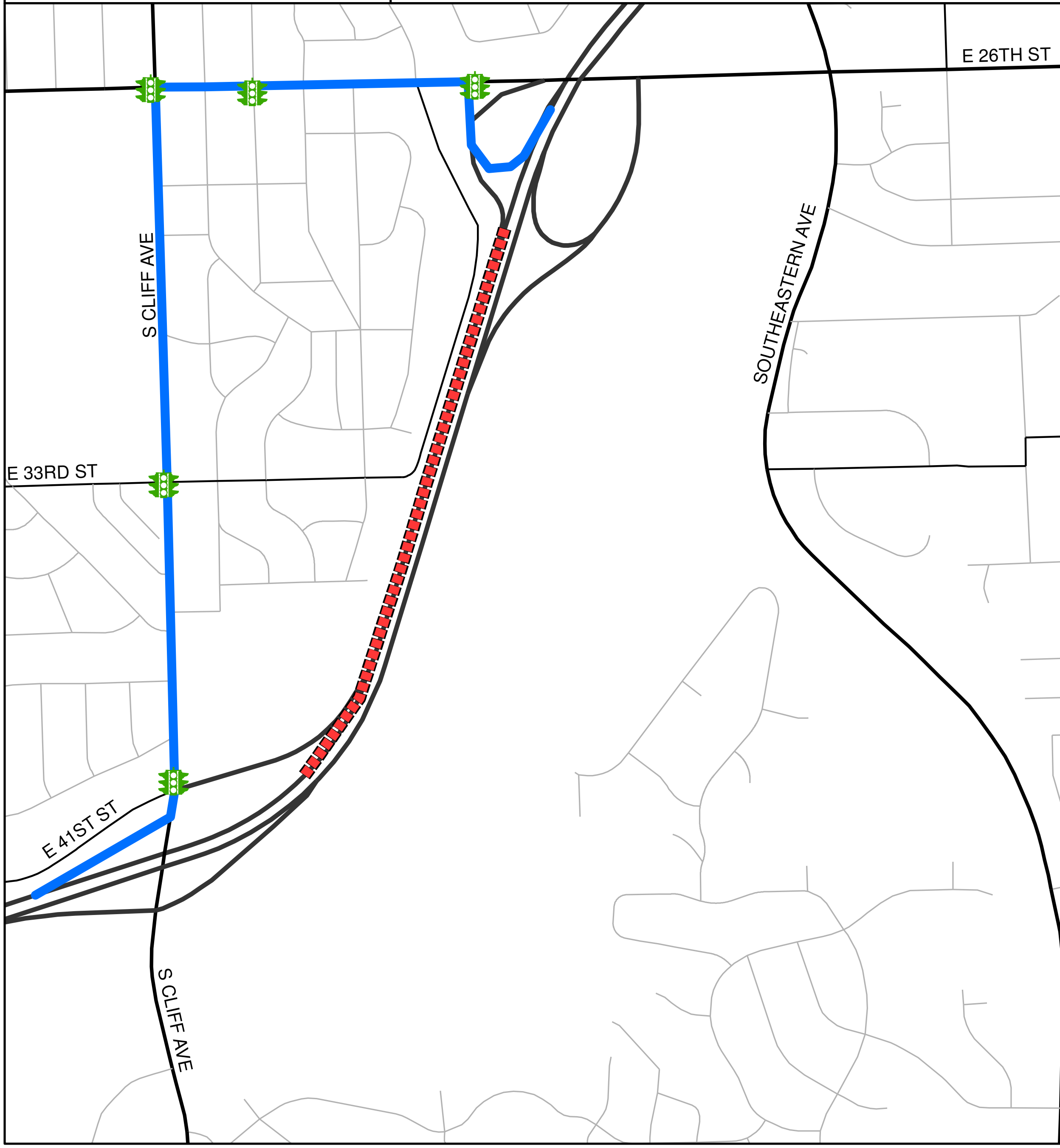
Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



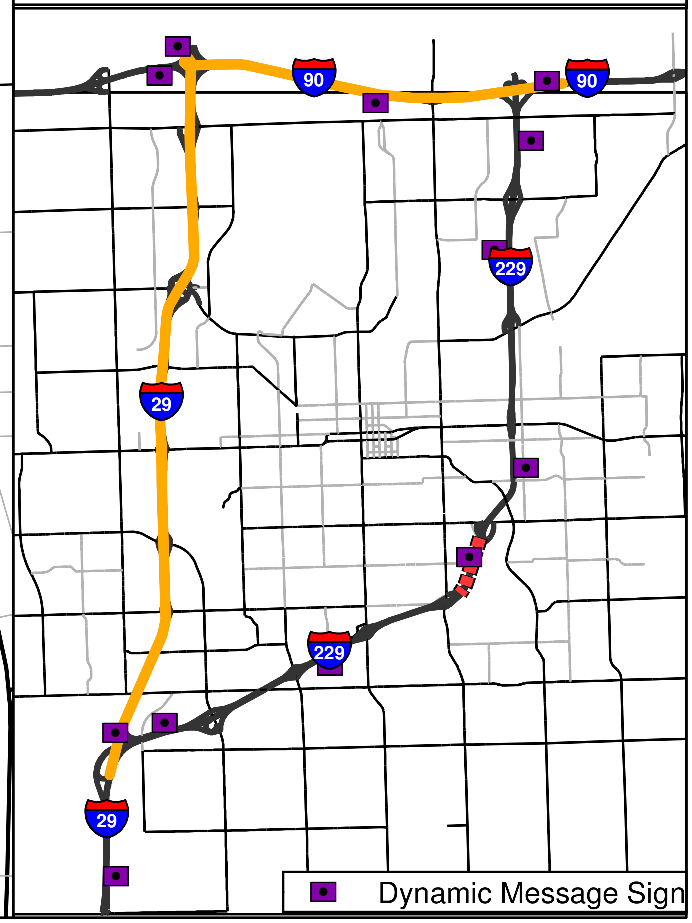
Closure: I-229 Southbound	From: 26th St. To: Cliff Ave.	I-229 Major Investment Corridor Study I-229 Corridor Study Area



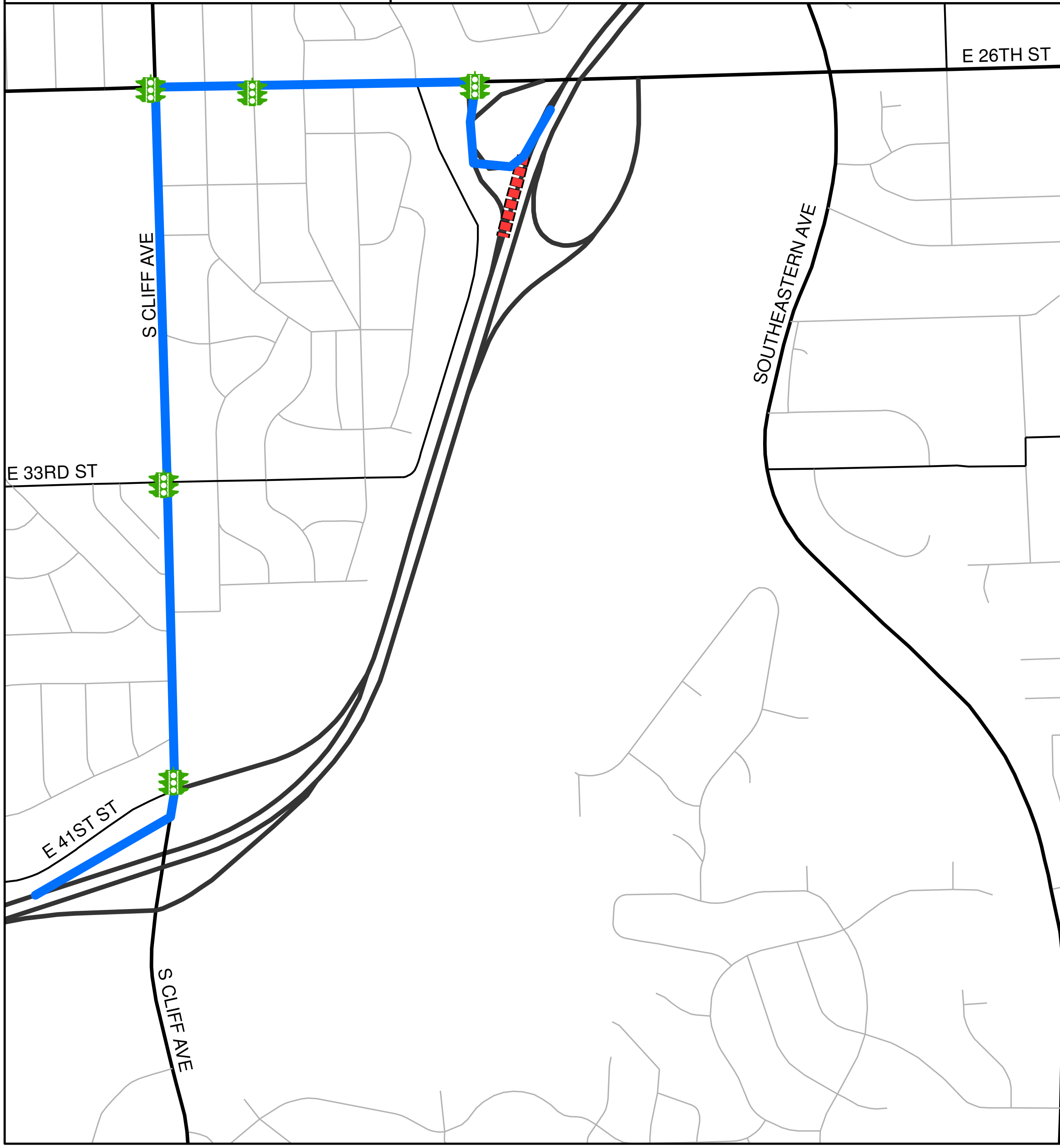
Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



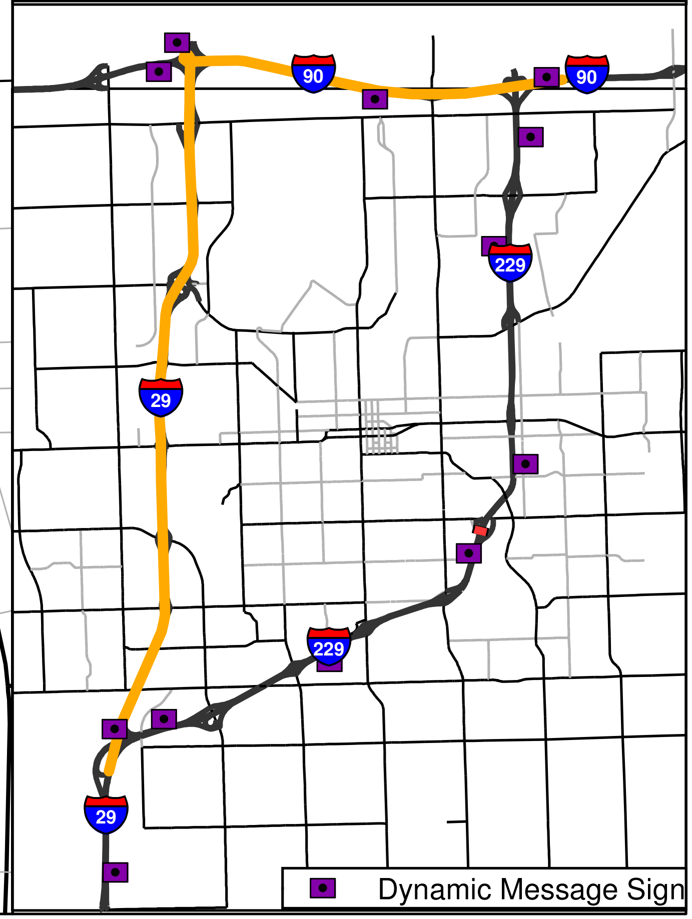
Closure: I-229 Southbound	From: 26th St. Off-ramp	To: 26th St. On-ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



Incident Management Action

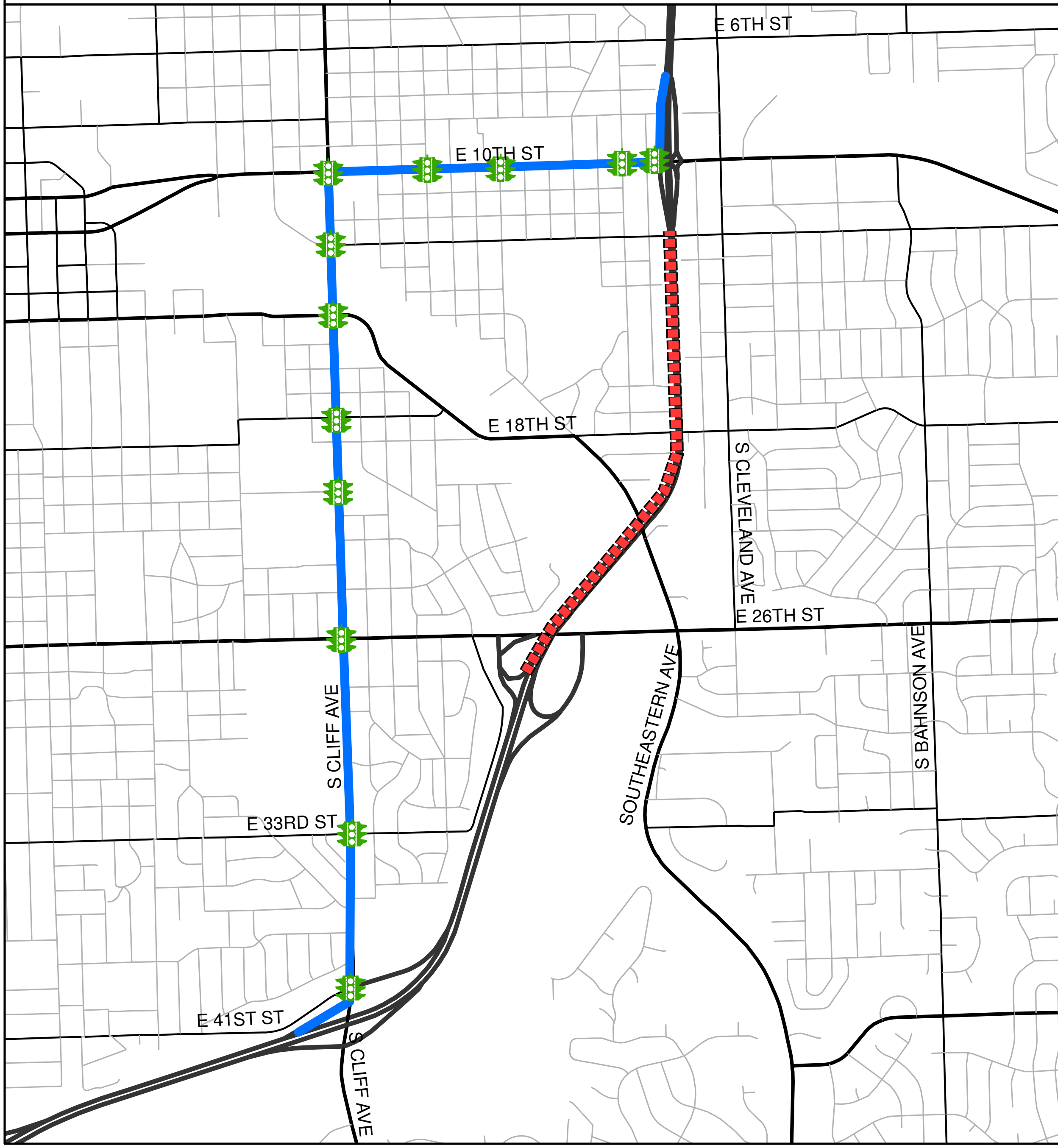
Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Southbound | **From:** 10th St. | **To:** 26th St.

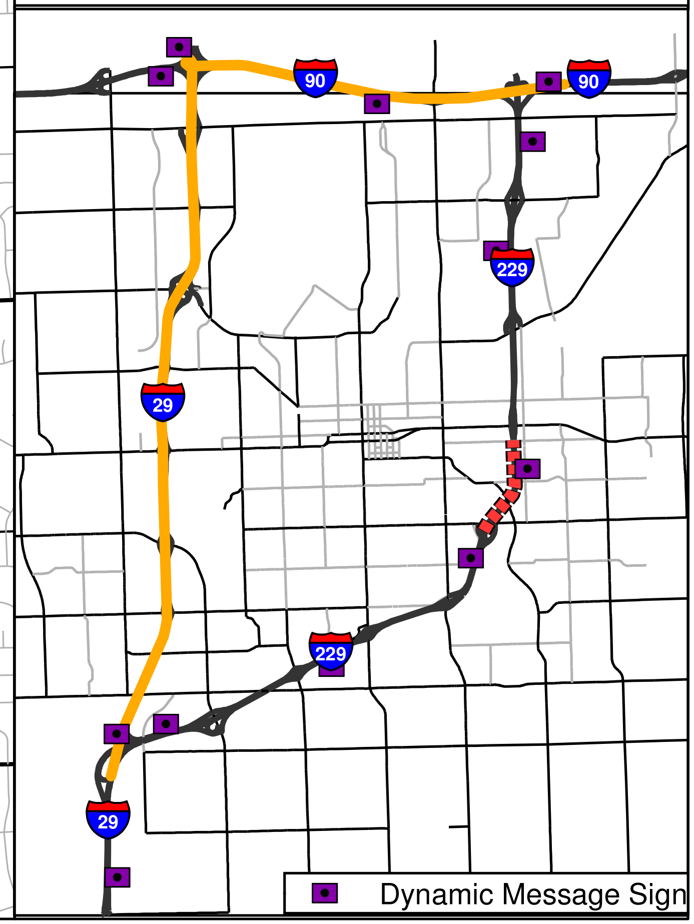
I-229 Major Investment Corridor Study
I-229 Corridor Study Area



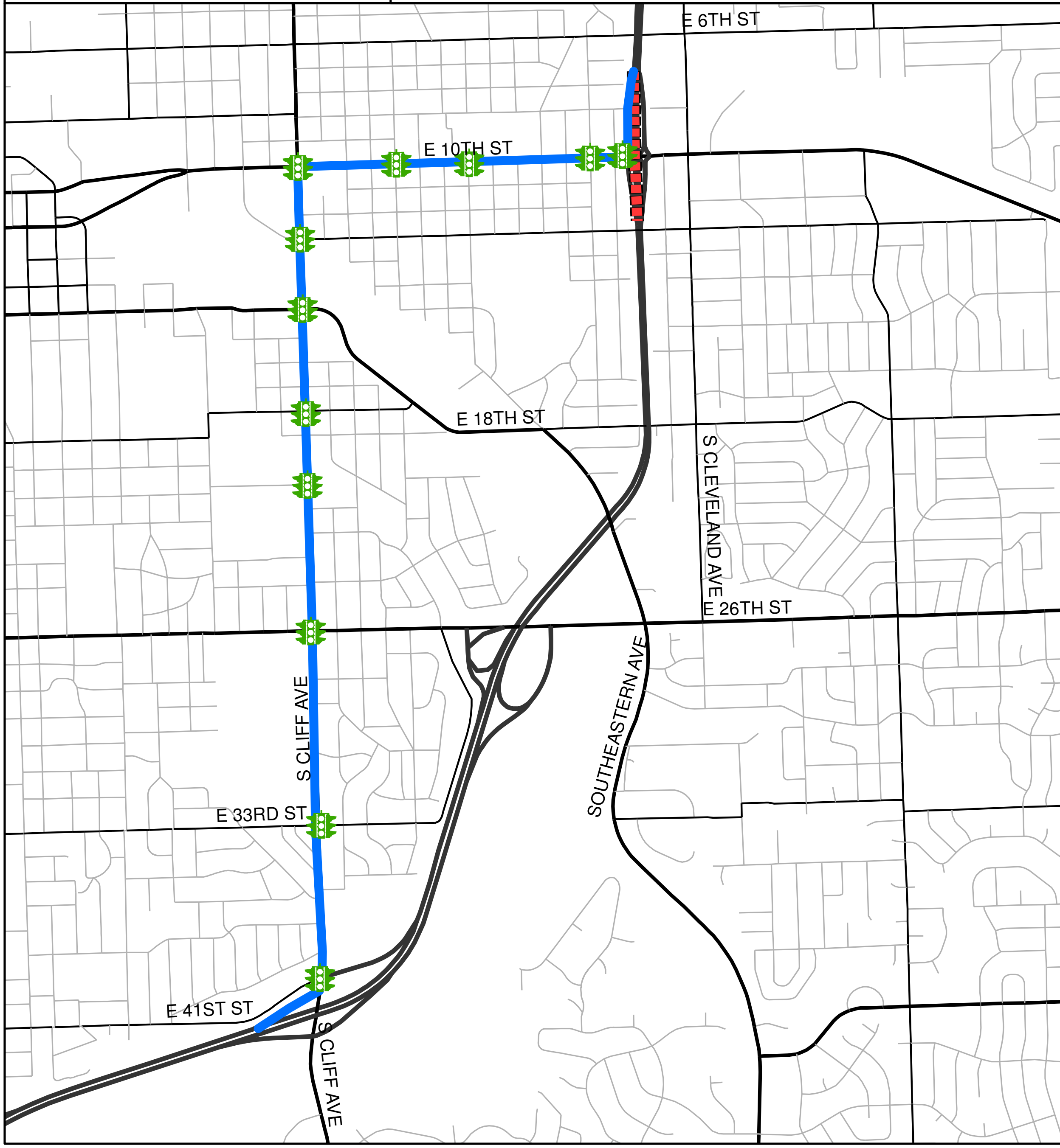
Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



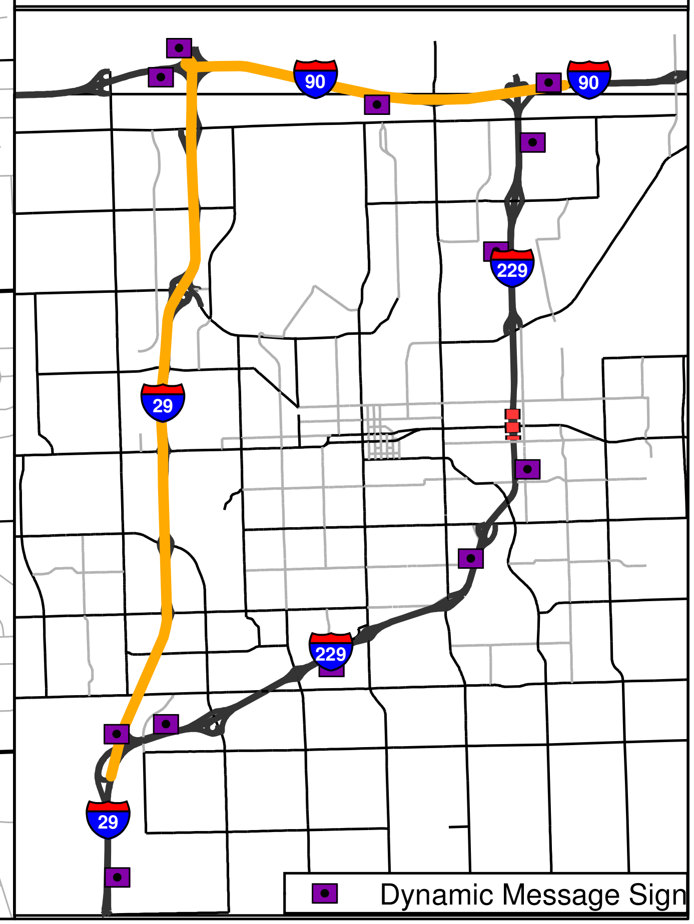
Closure: I-229 Southbound	From: 10th St. Off-ramp	To: 10th St. On-ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



Incident Management Action

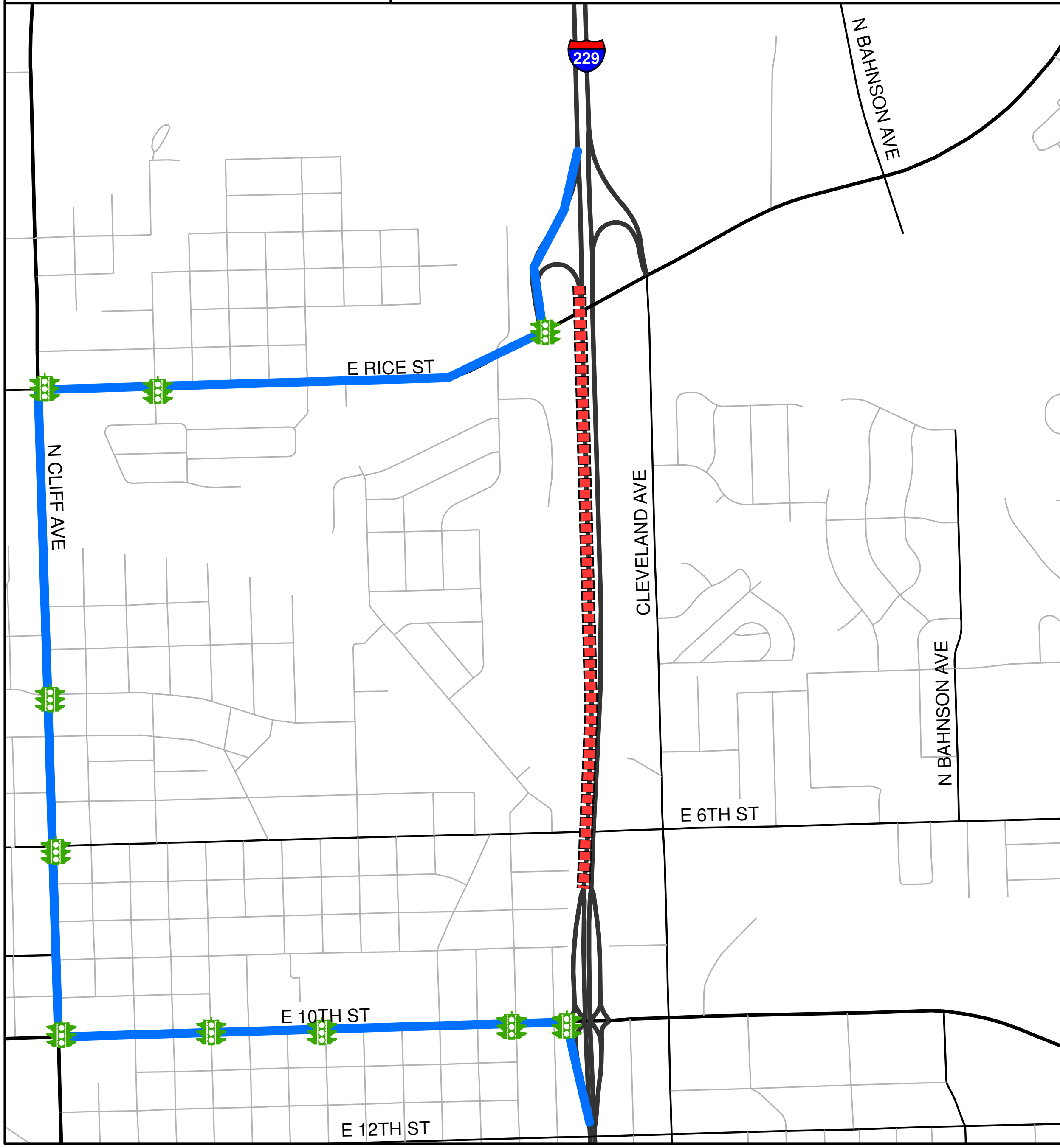
Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Southbound | **From:** Rice St. | **To:** 10th St.

I-229 Major Investment Corridor Study
I-229 Corridor Study Area



Incident Management Action

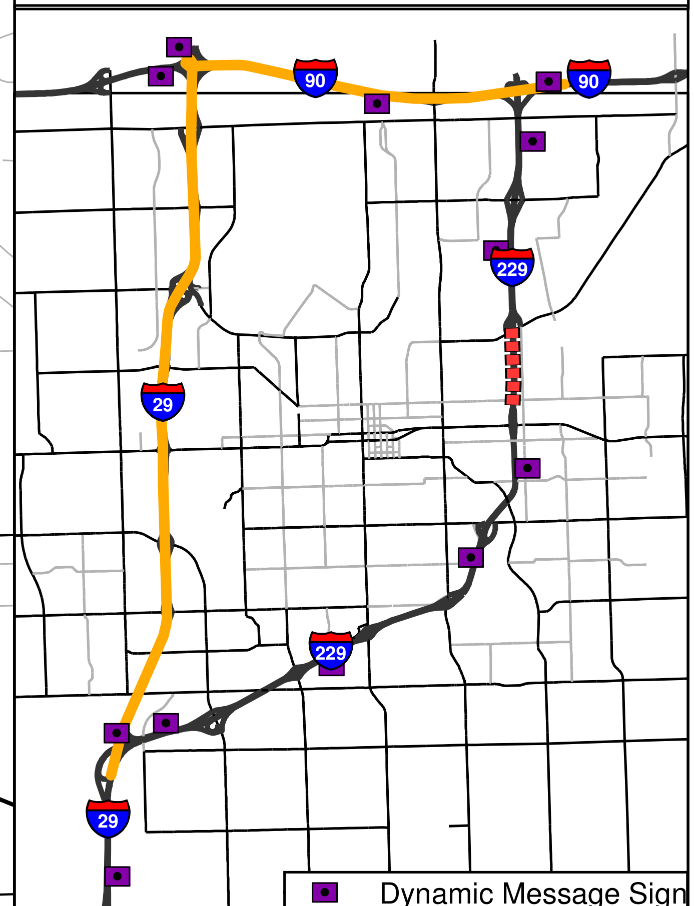
Closure and Response Routes

Closure

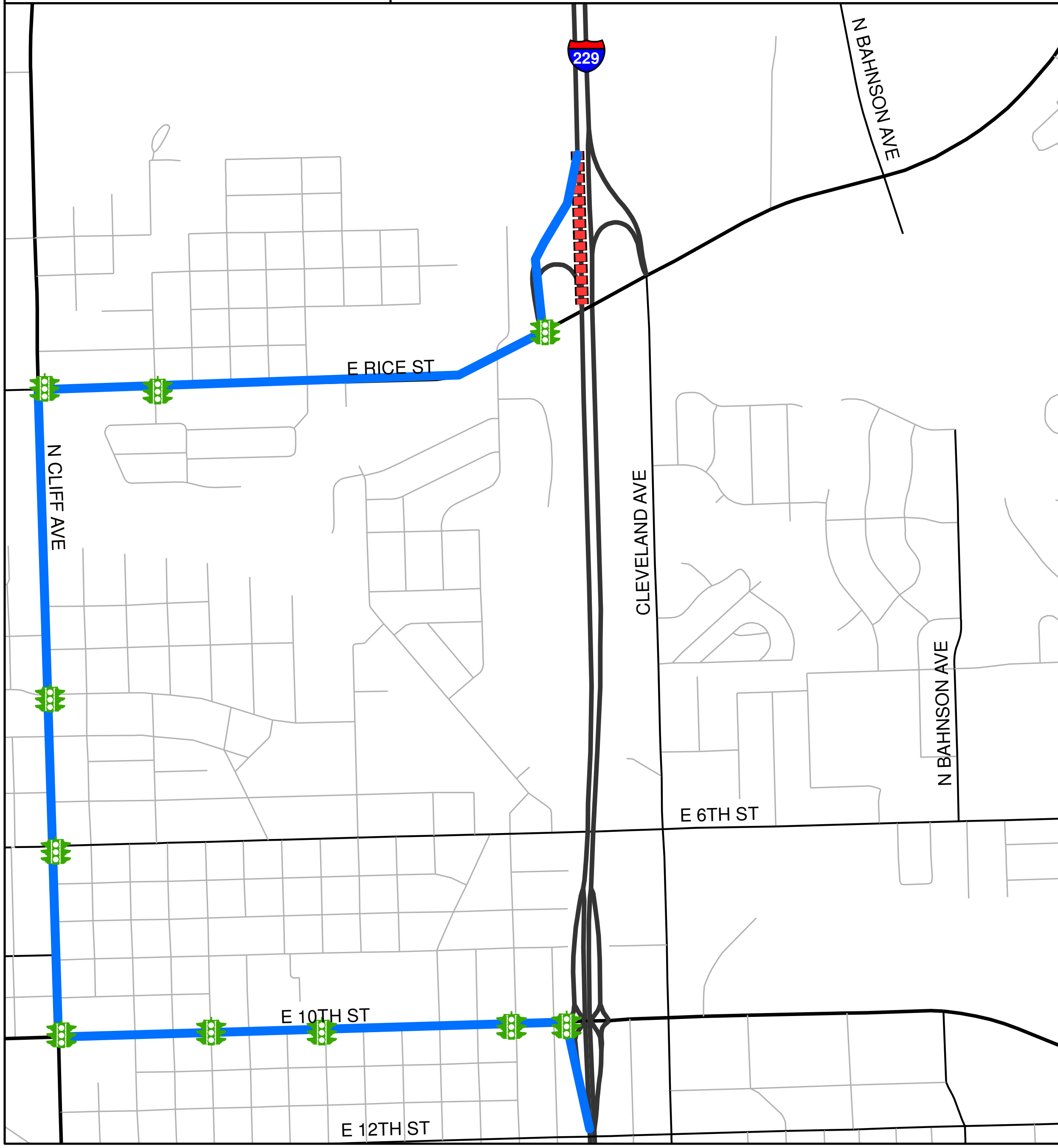
Local Detour

Regional Detour

Signals



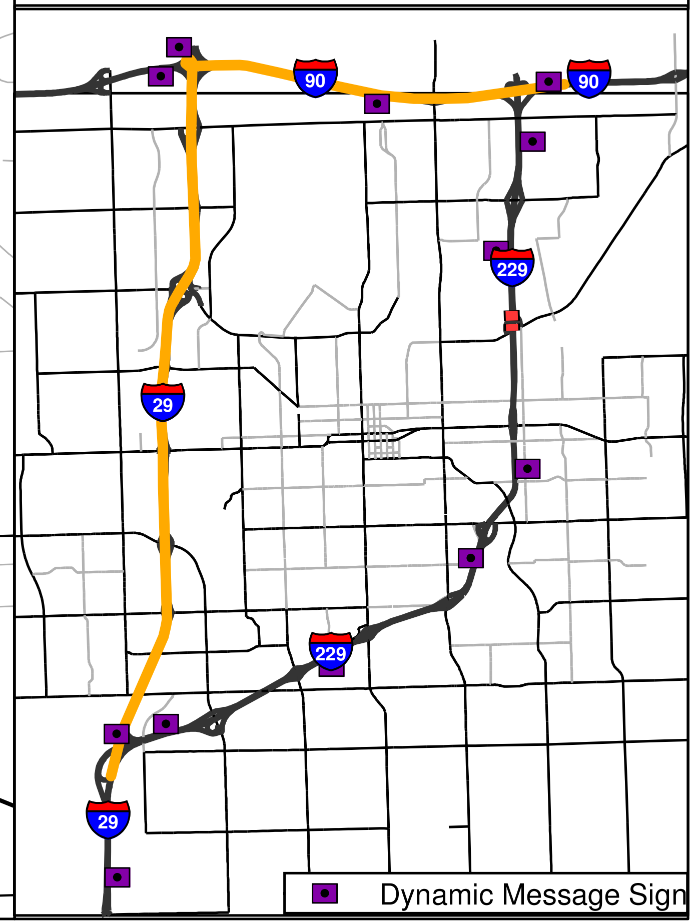
Closure: I-229 Southbound	From: Rice St. Off-ramp	To: Rice St. On-ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



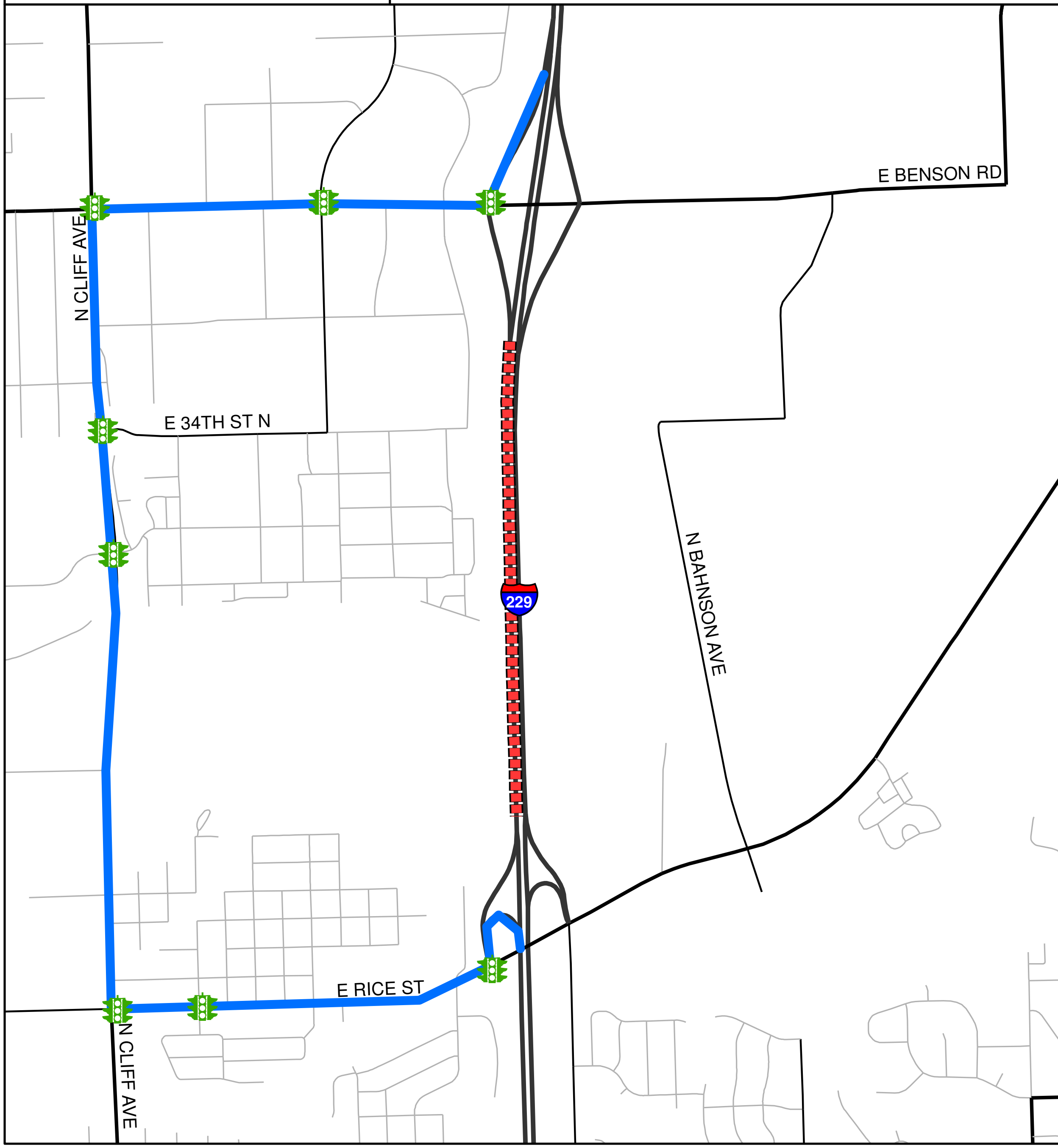
Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Southbound	**From:** Benson Rd. **To:** Rice St.	I-229 Major Investment Corridor Study I-229 Corridor Study Area



Incident Management Action

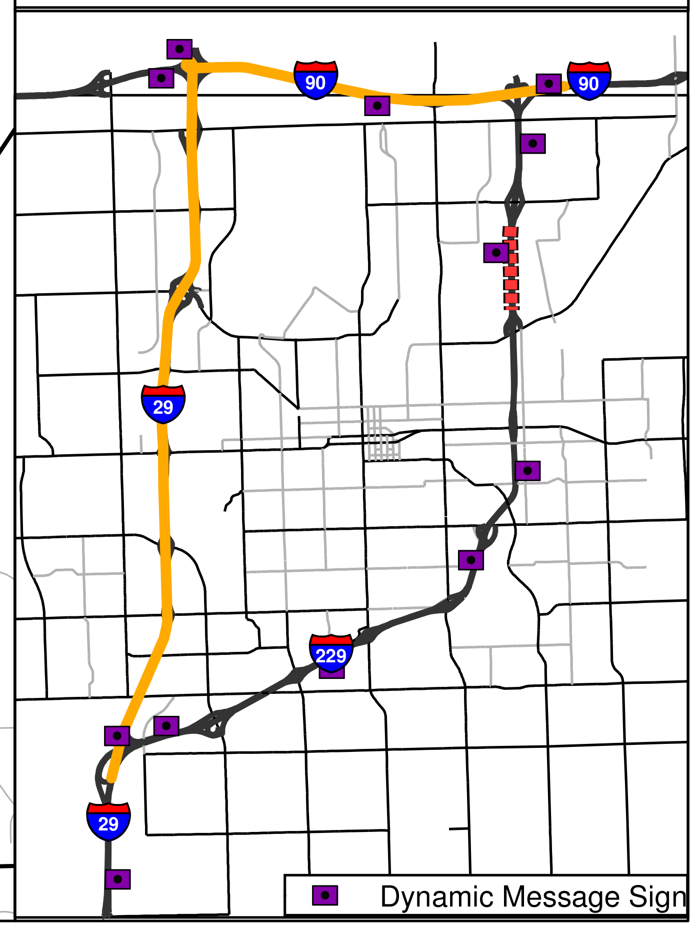
Closure and Response Routes

Closure

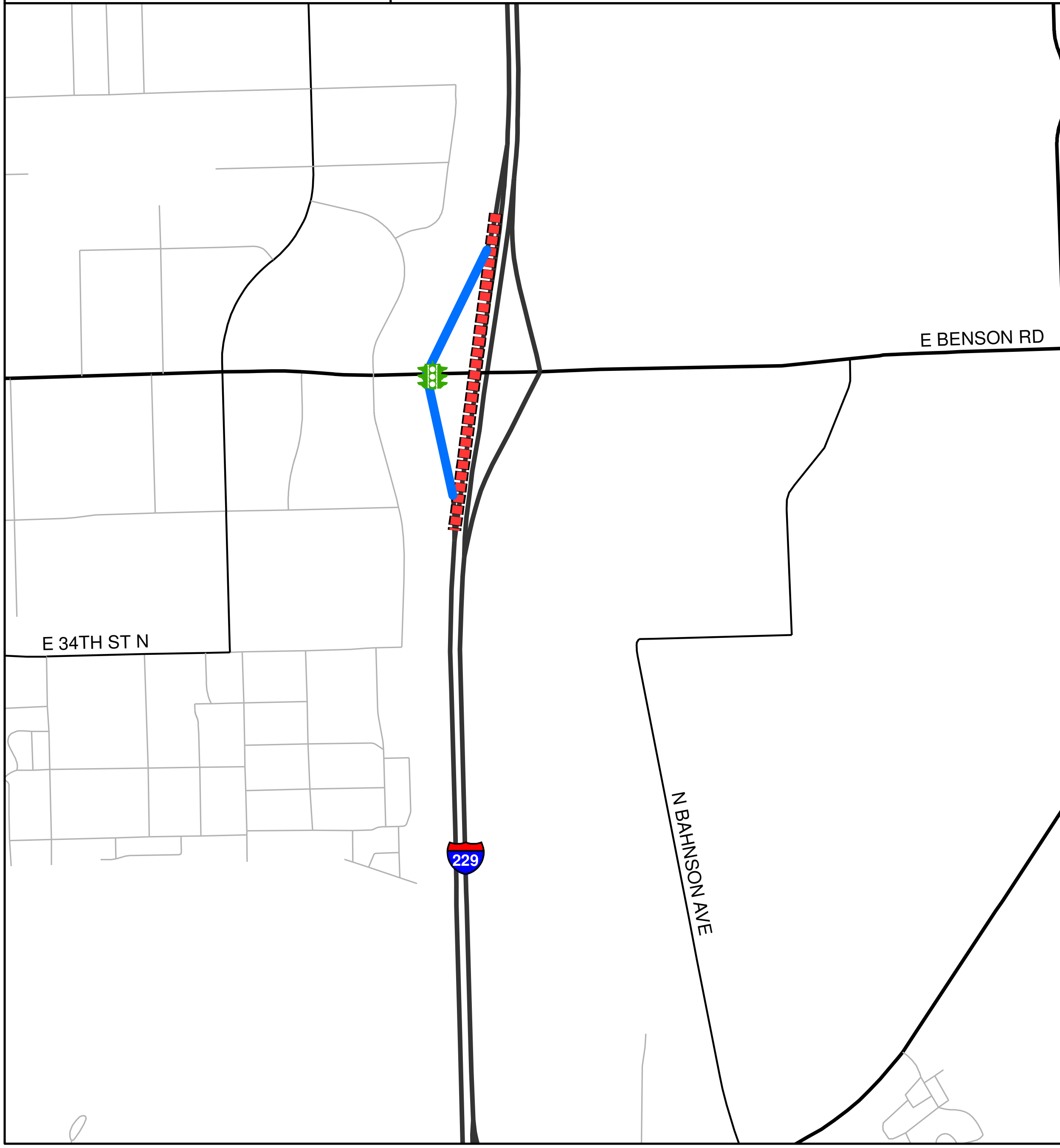
Local Detour

Regional Detour

Signals



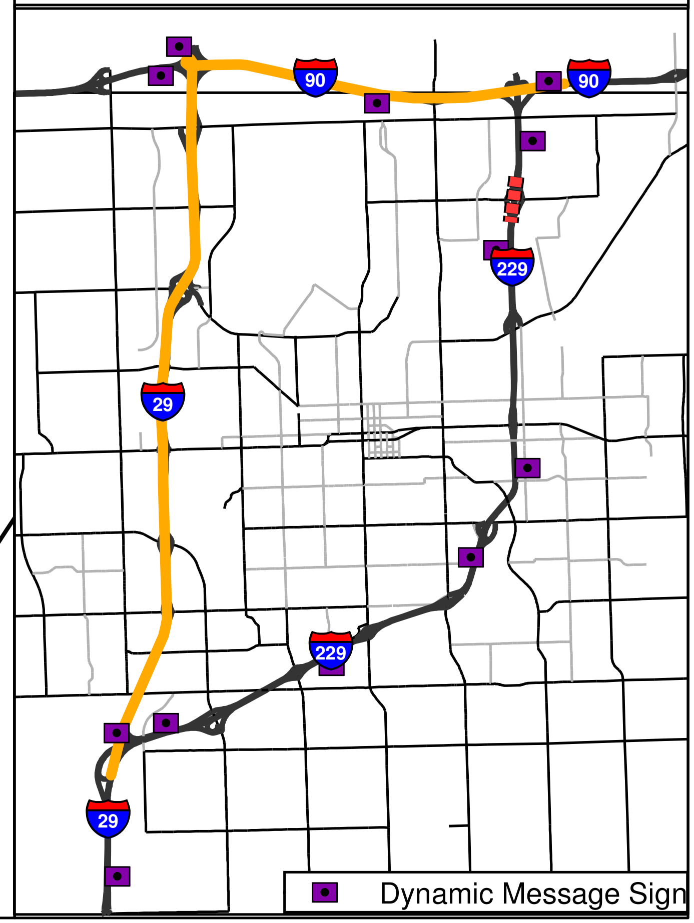
Closure: I-229 Southbound	From: Benson Rd. Off-ramp	To: Benson Rd. On-ramp	I-229 Major Investment Corridor Study I-229 Corridor Study Area



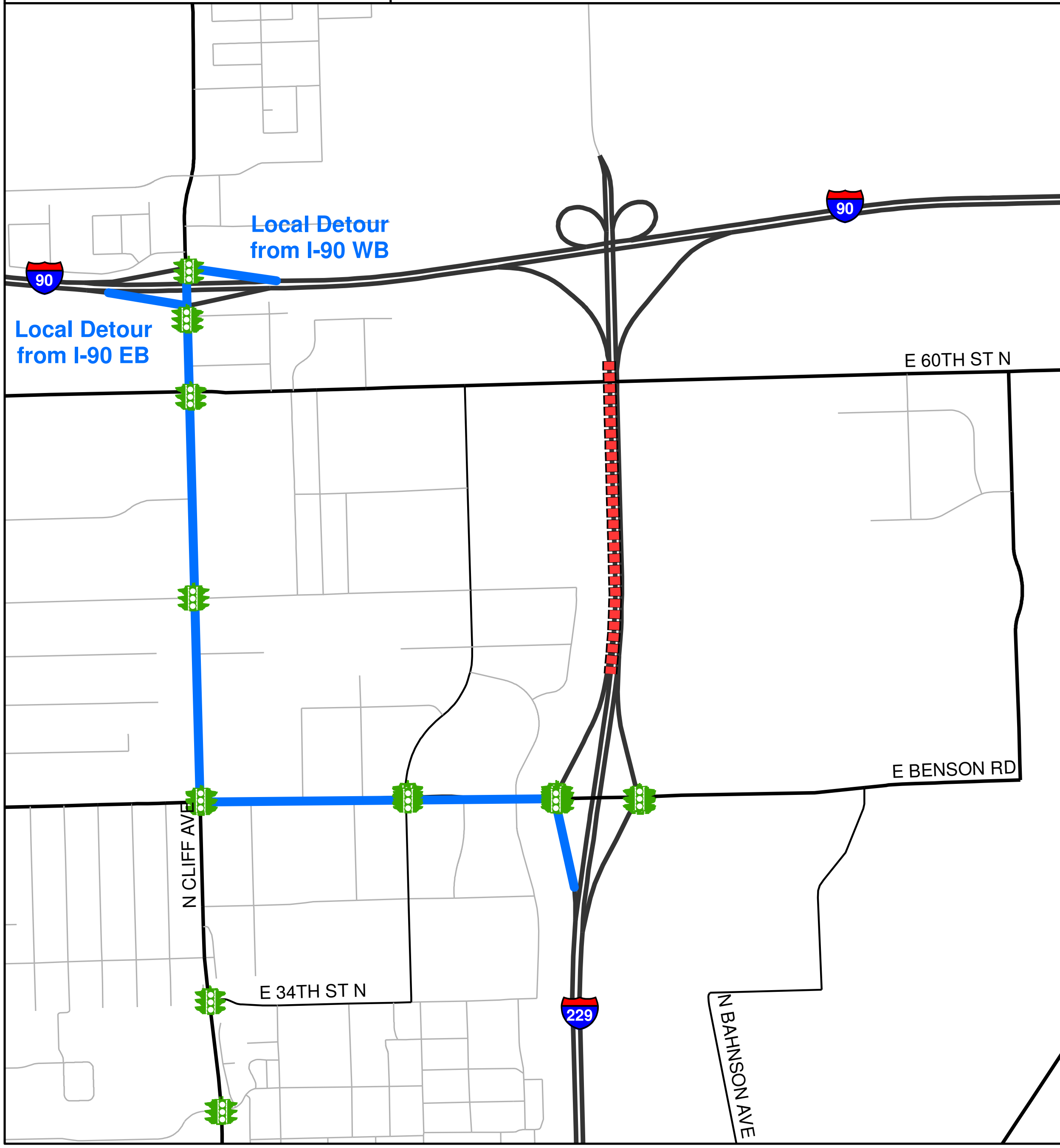
Incident Management Action

Closure and Response Routes

- Closure
- Local Detour
- Regional Detour
- Signals



Closure: I-229 Southbound	From: I-90	To: Benson Rd.	I-229 Major Investment Corridor Study I-229 Corridor Study Area



Incident Management Action

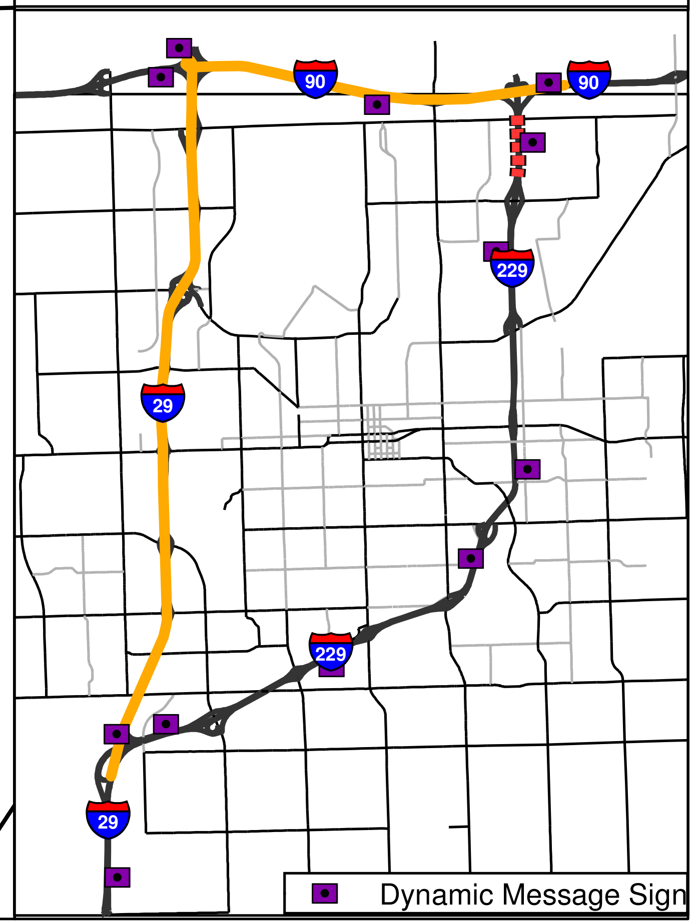
Closure and Response Routes

Closure

Local Detour

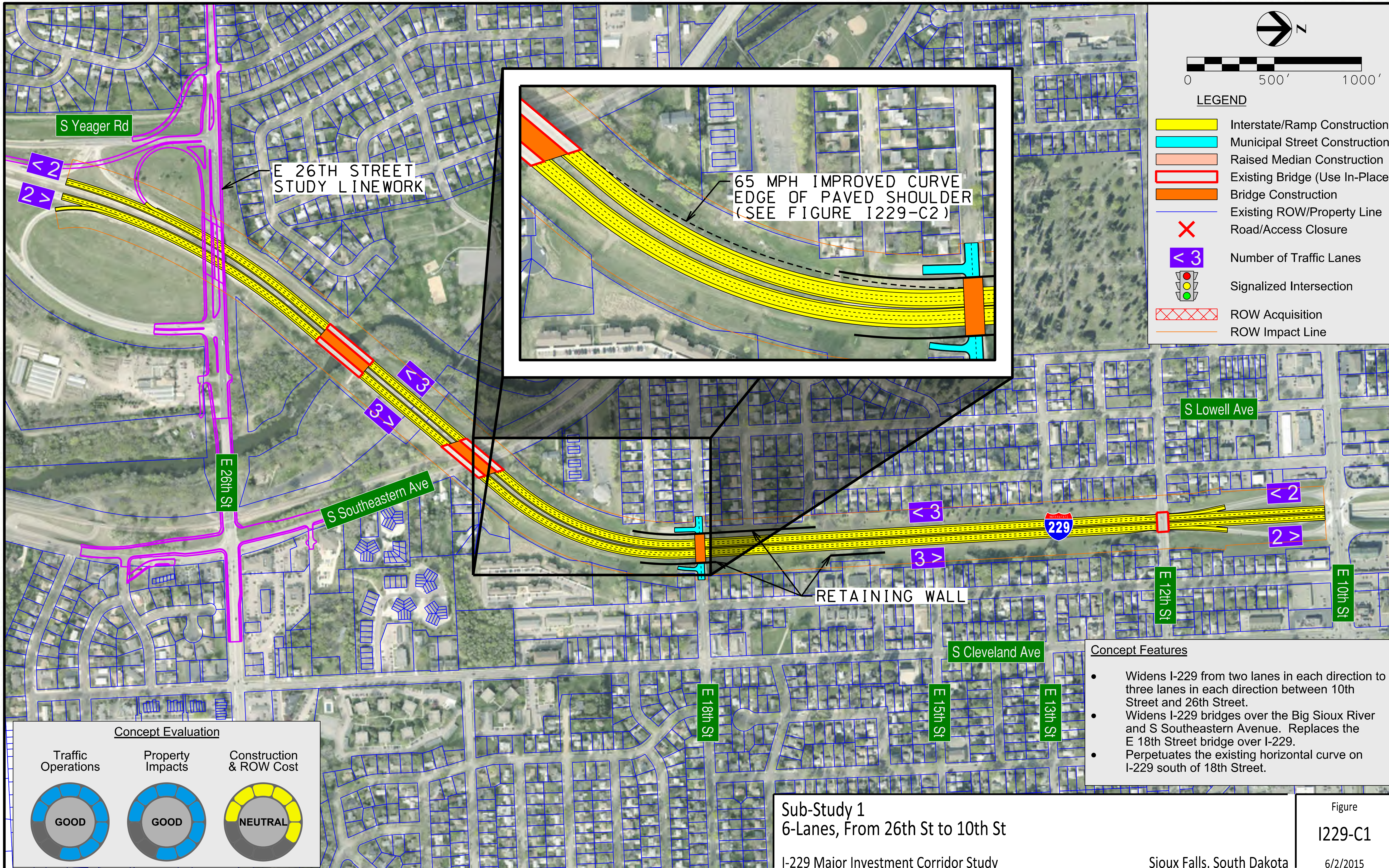
Regional Detour

Signals



APPENDIX I1 -

PRELIMINARY CONCEPT FIGURES



Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
GOOD	GOOD	NEUTRAL

Concept Features

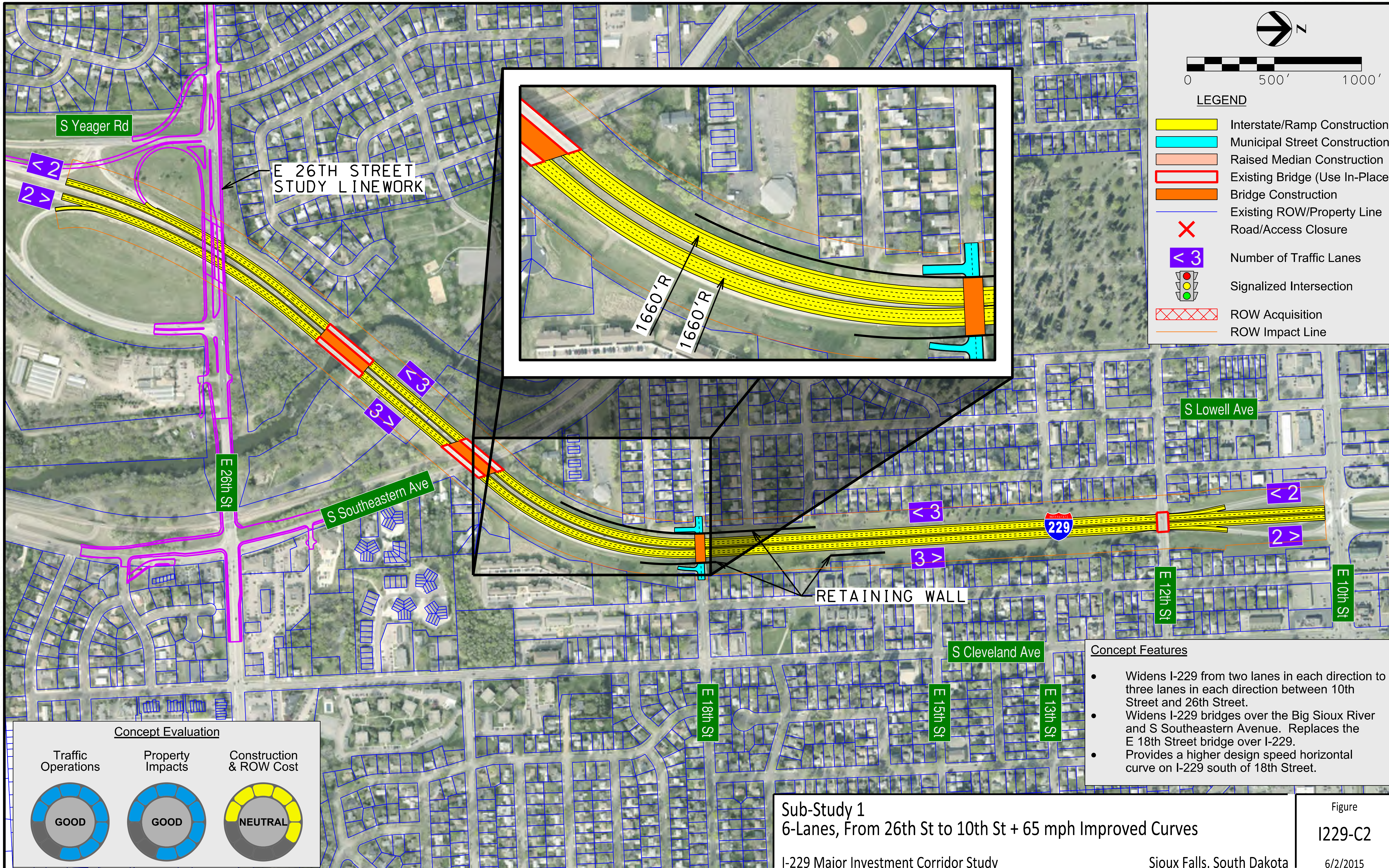
- Widens I-229 from two lanes in each direction to three lanes in each direction between 10th Street and 26th Street.
- Widens I-229 bridges over the Big Sioux River and S Southeastern Avenue. Replaces the E 18th Street bridge over I-229.
- Perpetuates the existing horizontal curve on I-229 south of 18th Street.

Sub-Study 1
6-Lanes, From 26th St to 10th St

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
I229-C1
6/2/2015



Concept Features

- Widens I-229 from two lanes in each direction to three lanes in each direction between 10th Street and 26th Street.
- Widens I-229 bridges over the Big Sioux River and S Southeastern Avenue. Replaces the E 18th Street bridge over I-229.
- Provides a higher design speed horizontal curve on I-229 south of 18th Street.

Sub-Study 1
6-Lanes, From 26th St to 10th St + 65 mph Improved Curves

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure

I229-C2

6/2/2015

APPENDIX I2. PRELIMINARY CONCEPTS TECH MEMO

Preliminary Concepts – I-229 Corridor and Interchanges

The I-229 Corridor portion of the Preliminary Concept Matrix was completed following the document Study Advisory Team (SAT) decisions and serves as a road map for the development of concepts identified during the workshop. A comments column has been added to allow notes regarding evolution of the concepts from the workshop to be explained. The Preliminary Concept Matrix is shown in *TABLE 1*.

The concepts depicted in ***APPENDIX I1- PRELIMINARY CONCEPT FIGURES*** have had one or the other of the following actions determined by the SAT, as documented in the Concept Matrix:

- Develop comparative data for preliminary concept screening
- Eliminate from further development due to anticipated impacts, but will be shown at the second public meeting to note that the concept was identified and received initial consideration.

Table 1. Preliminary Concept Matrix

I-229 Major Investment Study - Preliminary Concept Matrix

Type
SPUI = Single Point
TD = Tight Diamond
DDI = Diverging Diamond
Par = Parclo
TSD = Tight Split Diamond
CFI = Continuous Flow Intersection

Concept Workshop Decision
Develop = Develop for public meeting
Show = Show public / No further development
Eliminate = Do not show public / No further development

Concept ID	Type / Details Description	Workshop Decision	Development Items: Traffic Assessment	Development Items: ROW/Environ/Cost	Comments
I-229 Corridor					
I229-C1	6-Lanes, From 26th St to 10th St	Develop	X	X	- Added approximate retaining wall locations - Created blow up of curve between Southeastern and 18th St. - Identified approximate reconstruction on 18th St.
I229-C2	6-Lanes, From 26th St to 10th St + 65 mph improved horizontal curves, 18th St to SE Ave	Develop		X	- New Concept - Variation of I229-C1 - I-229 Mainline curve between Southeastern and 18th St. designed to 65 mph
I229-SAT	6-Lanes + auxiliary lanes, Cliff Ave to Rice St	(1)	X		
Cliff Ave Interchange					
	41st St on ramp bypass lane	Eliminate			
Cliff-1	NB Cliff to SB I229 Loop ramp auxiliary lane add	Develop	X	X	- No changes from workshop
Cliff-2	NB/SB Cliff to SB I229 Loop ramp, eliminate SB diagonal ramp	Develop		X	- New Concept - Variation of Cliff-1 - Full intersection with 41st St. and SB I-229
Cliff-3	SB Cliff Ave auxiliary lane from 41st St to SB I229 ramp	Develop		X	- New Concept - Variation of Cliff-1 - Added aux. lane between 41st St. and SB I-229 on ramp
Rice St Ave Interchange					
Rice-1	NB Rice exit ramp terminal lane additions	Develop	X	X	- Developed layout not previously shown at the workshop

Footnotes
(1) No layout of this concept required. Provide DTA traffic analysis comparison of this concept to 4-lane divided with auxiliary lanes.

Preliminary Concepts Comparative Data

The I-229 Major Investment Study scope identified the following four types of data to be developed for each preliminary concept identified for further consideration:

- Property Impacts
- Traffic Operations
- Environmental Review
- Construction and Property Impact Costs

This comparative data will be used in combination with public input to screen the concepts and identify "Build Scenarios" for further refinement. The remainder of this technical memorandum will describe the approach applied to preparing the comparative data and will document the comparative data for each concept.

Property Impacts

An approximate footprint for each preliminary concept was developed by setting impact limits based on the following criteria:

- 15 feet behind the back of curb
- 25-foot offset from ramp pavement (from back of curb or edge of shoulder)
- 100 feet from edge of I-229 shoulder pavement
- 5 feet behind retaining walls

The criteria that resulted in the greatest offset from a given roadway set the impact limit for that roadway.

The portion of each property parcel intersected by the impact limits that was inside of the impact limit was assumed to be an acquisition. If an acquisition impacted a structure, or rendered a parcel unusable in the opinion of the consultant (i.e. a large part of a parking lot was acquired), the entire structure or parcel was assumed to be an acquisition.

A unit price of $5 per square foot of acquisition area was applied to estimate the cost of property impacts. The total estimated cost of property impacts for a concept is the total impacted area times $5 per square foot plus the assessed value of structures impacted (from the Minnehaha County Assessor's website) times 1.5 (to estimate the fair market value of impacts).
The estimated property impact areas (in acres) and costs are included in the tabulation of estimated construction costs later in this memorandum.

Traffic Operations Assessment

The traffic operations assessment for each preliminary concept was developed using output from model runs of the Dynamic Traffic Assignment (DTA) model. The 2012 Existing Conditions calibrated DTA model was updated to reflect 2035 No-Build conditions and used as a baseline model to which output from each preliminary concept run was compared.

A concept DTA model run was performed for each “unique” concept, in other words, for concepts that appear to the model to be virtually identical, no independent run was made.

The following Measures of Effectiveness (MOEs) were extracted from the model runs:

- Total queues in the interchange area
- Delay in the interchange area
- Delay in the subarea
- Travel times for select Origin-Destination (O-D) pairs
- Travel time on I-229 (used in lieu of Queue-to-ramp-length ratio)
- Throughput (Sub-Study 1 only)

The MOE’s from each concept run were compared to the No-Build MOE’s and a percent change calculated between each concept and No-Build.

MOE’s that compare concepts within an “interchange area” are based on a selection of model links within a consistent boundary. Illustrations of the interchange area are shown in ***APPENDIX I3- DTA MODEL INTERCHANGE AND MODEL AREAS***.

Concepts that were not explicitly modeled were classified based on the DTA model output of similar concepts.

Next, the MOE’s were grouped into the following categories:

- Queues
- Delay
- Travel Time
- Throughput

Both AM and PM comparison percentages and a composite qualitative rating are shown for each of the concepts in ***TABLE 2***. Composite ratings are based on consideration of both AM and PM comparison percentages. The subjective classifications are:

- Very Good
- Good
- Neutral
- Poor

Context of DTA Traffic Assessment Results

The MOE's from the DTA model output are indicators of how effective a particular concept may be at improving traffic conditions, but may need further explanation of what may appear to be a worsening of traffic conditions compared to the No-Build.

- In some of the modeled interchange concepts, the impact of increased demand levels between Build and No-Build concepts yielded worse traffic operations for the Build than the No-Build in the interchange area. In the DTA model, an improved interchange may provide needed capacity which triggers vehicles to shift from a congested parallel corridor to a route through the improved interchange.
  In this example, the No-Build provides no additional capacity at the interchange, and vehicles will avoid it, whereas in the Build model, traffic is now shifted to the interchange. Though the Build condition may provide a level of congestion relief compared to the No-Build model (in terms of control delay in seconds per vehicle) that congestion relief may not be reflected in the traffic-volume related MOEs provided by the DTA model (such as overall vehicle minutes of delay).
  Upcoming phases of this study will further examine the Build concepts to verify that each Build concept advanced to the alternatives analysis stage provides adequate LOS using Highway Capacity Manual 2010 procedures, which are more suited to assessing the level of congestion in the interchange area.
- In some of the modeled corridor concepts, because model runs were conducted for each concept in isolation, some capacity constraints did result in comparisons to No-Build traffic conditions that appear worse than would be the case if the concept were implemented in logical combination with associated improvements. These instances will be noted in the results.
- The DTA model structure first includes the generation of traffic demand by the Sioux Falls regional (macro) travel demand model, and assigns traffic through the subarea using a dynamic procedure. The DTA model subarea is shown in ***Appendix I3- DTA Model Interchange and Model Areas***. The level of traffic demand from the macro model does not consider intersection-level sensitivity to congestion.
  By contrast, the DTA model does consider intersection-level congestion. If the DTA model sees capacity constraints, then that traffic accumulates extreme levels of delay and cannot get to the downstream links (vehicles are stuck in the network at the end of simulation period).
  The DTA model is also extremely sensitive to peaking characteristics, whereas the regional macro model is blind to peaking within the 2-hour peak period. Therefore, the macro model results are representative of average conditions within the 2-hour period, but the DTA model results capture impacts of the worst part of the peak that influences the rest of the 2-hour period.
  In certain Build scenarios the macro model may have generated more traffic volume due to the proposed improvement with a preferred route through the interchange improvements. This additional volume is more than the DTA model can serve through the intersections along that route due to the combination of intersection-level congestion and peaking. The DTA model attempts to optimize vehicle routing to minimize individual vehicle delay, but the optimal routing may still lead to more network-wide delay than the

No-Build model because of the different distributions of traffic demand between the two scenarios.

For the reasons outlined above, less than favorable results in the traffic assessment comparative data in ***TABLE 2*** should not be treated as fatal flaws.

The following additional notes are referenced from the MOE's shown in ***TABLE 2***:

1. MOE's show degraded performance compared to No-Build; see first explanation item above.
2. Corridor improvement effectiveness limited by lack of available upstream capacity; see second explanation item above.
3. MOE's show degraded performance compared to No-Build, see third explanation item above.

Table 2. Preliminary Concept DTA Traffic Assessment Comparative Data

Queues

Interchange Area Total Queue Length		Queues		Subjective
Concept ID	Description	AM	PM	Classification
Cliff-1	NB Cliff to SB I229 Loop ramp auxiliary lane add	-52%	1%	Good
Rice-1	NB Rice exit ramp terminal lane additions	28% [1]	-40%	Good

Delay

Interchange Area Delay (veh-min)		Delay, veh-min		Subjective
Concept ID	Description	AM	PM	Classification
Cliff-1	NB Cliff to SB I229 Loop ramp auxiliary lane add	-49%	-16%	Good
Rice-1	NB Rice exit ramp terminal lane additions	24% [1]	-44%	Good
Overall Subarea Delay (min)		**Delay, min**		**Subjective**
Concept ID	Description	AM	PM	Classification
I229- C1	6-Lanes, From 26th St to 10th St	10% [2]	7% [2]	Poor
I-229 SAT	6-Lanes + auxiliary lanes, Cliff Ave to Rice St	-2%	13% [2]	Poor
Cliff-1	NB Cliff to SB I229 Loop ramp auxiliary lane add	0%	-5%	Neutral
Rice-1	NB Rice exit ramp terminal lane additions	6%	11% [3]	Poor

Travel Time

Travel Time- Interstate Through Trips		Travel Time		Subjective
Concept ID	Description	AM	PM	Classification
I229- C1	6-Lanes, From 26th St to 10th St	1%	0%	Neutral
I-229 SAT	6-Lanes + auxiliary lanes, Cliff Ave to Rice St	2%	-2%	Neutral
Cliff-1	NB Cliff to SB I229 Loop ramp auxiliary lane add	1%	0%	Neutral
Rice-1	NB Rice exit ramp terminal lane additions	6% [1]	2%	Poor
Travel Time- Cliff Avenue				
Concept ID	Description	AM	PM	Classification
Cliff-1	NB Cliff to SB I229 Loop ramp auxiliary lane add	-6%	-2%	Neutral
Concept ID	Description	AM	PM	
Travel Time- Rice Avenue				Classification
Rice-1	NB Rice exit ramp terminal lane additions	11% [1]	43% [1]	Poor

Throughput

Volume- Average Interstate Vehicular Volume between Cliff Ave & Rice Street				
Concept ID	Description	AM	PM	Classification
I229- C1	6-Lanes, From 26th St to 10th St	-3%	-1%	Neutral
I-229 SAT	6-Lanes + auxiliary lanes, Cliff Ave to Rice St	0%	-3%	Neutral

Environmental Review

To analyze potential resources within the Study Area, a desktop review of available data was analyzed against the project concepts, in addition to review of aerial imagery of the I-229 corridor. Items that could require further analysis at the time of future project initiation were identified for issues which separate project concepts. Later phases in potential project corridor planning will require environmental documentation if federal funds are used, and would require analysis of additional resources such as environmental justice, noise, etc.

Archaeological and Historical Resources

Approach

A record search was completed by the SD Archaeological Research Center. The area which encompasses a particular preliminary roadway concept was reviewed for potential historic and cultural resources. Historic and cultural resources are regulated under Section 106 of the National Historic Preservation Act, and may require consultation with the South Dakota Department of Transportation (SDDOT) and the South Dakota State Historic Preservation Office (SHPO).

The record search identified record sites and cultural surveys that were completed within the study area. Known sites that were listed as eligible for the National Register of Historic Places (NRHP) include three bridges and two railroad beds. Additionally, one unevaluated Native American stone circle is located within the study area. Shapefiles of these sites were imported into ArcGIS and compared against preliminary concepts to determine the potential for impacts to cultural resources.

Limitations

Early in project planning, the City of Sioux Falls (City) should work with SDDOT to coordinate its intent to proceed with a particular roadway improvement project, and request that the SDDOT advise the City on the applicability of Section 106, the need to identify consulting parties, and for a Class I cultural resource literature search. When appropriate, the City should anticipate that a Class III identification effort will be conducted, including identification of archaeological, architectural, and traditional cultural properties subject to the effects of the project. When historic properties are identified, the City should anticipate that avoidance or mitigation of adverse effects to such properties may be required.

Wetlands and Waters of the U.S.

Approach

The National Wetlands Inventory (NWI) and aerial imagery were reviewed within the study area to determine potential project impacts. The Big Sioux River and its tributaries are located within the study area and cross the I-229 corridor three times. There are also several wetlands located adjacent to the I-229 corridor. Because the NWI provides an estimate of wetlands based on soil type and aerial photography, these boundaries are utilized as guidance for identifying wetland areas and delineation would be required for each project.

Limitations

Wetlands and other waters of the US will need to be considered for each project as the State and City want to move the project from planning stages to construction. Early in project planning, an onsite wetland delineation of the study area is recommended to confirm the boundaries of wetlands and other waters of the U.S. within the study area and to coordinate with USACE to determine jurisdiction.

Threatened and Endangered Species

Approach

Fish and wildlife species listed under the Federal Endangered Species Act (ESA) would need to be considered for each project. The list of species identified for Minnehaha and Lincoln County were identified from US Fish and Wildlife Service (USFWS) information. Four threatened, endangered, or proposed species exist in Minnehaha County. These include the rufa red knot (threatened); Topeka shiner (endangered); western prairie fringed orchid (threatened); and northern long-eared bat (proposed endangered). Lincoln County has the same species, with the addition of pallid sturgeon (endangered), which is known to occupy portions of the Big Sioux River in the County.

To identify the potential for threatened and endangered species to be present in an area, aerial imagery was used to identify potential habitat located within the project corridor. The study area is highly developed with commercial, industrial, and residential activities. Undeveloped areas are generally limited to areas associated with the Big Sioux River. Additionally, there is some cropland in the northern portion of the corridor. Habitat for the western prairie fringed orchid is not believed to occur within most of the study area due to lack of native habitat. Habitat for the Topeka shiner and the pallid sturgeon is found within certain areas of the Big Sioux River and its tributaries, and the I-229 corridor crosses the river in multiple places. Typically within the City, the USFWS has noted for previous projects that the Topeka shiner is not anticipated to occur within these stretches of the Big Sioux River. Additionally, the Big Sioux River crossings occur within Minnehaha County, and the pallid sturgeon is only listed for Lincoln County. Habitat for the rufa red knot is limited to sandy or gravel shorelines associated with the Big Sioux River. Potential habitat associated with the northern long-eared bat in the Study Area includes riparian areas and bridges along the Big Sioux River.

Limitations

Consultation with USFWS would be required to determine which ESA-listed species have the potential to occur within each Study Area. Coordination with SD Game, Fish, and Parks would be recommended regarding impacts to state-listed sensitive species.

SECTION 4(F) AND SECTION 6(F) PROPERTIES

Approach

The Department of Transportation Act (DOT Act) of 1966 included a special provision – Section 4(f) – which is intended to protect publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites. Similarly, Section 6(f) protects state and locally sponsored projects that were funded as part of the Land and Water Conservation Fund (LWCF).

The LWCF website was reviewed to identify the use of Section 6(f) grants in the Study Area. Publicly owned parks and recreation areas are present within the Study Area. Public spaces within the City of Sioux Falls that have received LWCF grant money are subject to Section 6(f) regulations. The Big Sioux Trail, a recreational trail, also received LWCF grant money for portions of the trail. Additionally, if the projects proposed in these alternatives receive Federal Highway Administration (FHWA) funds, the projects will be subject to Section 4(f) consultation.

Limitations

There have been several grants received at a variety of the City parks. Areas within the Project corridor that could impact City parks or recreational trails would need to be further reviewed to determine potential for a Section 6(f) impact. Due to the use of LWCF grants, it is recommended that consultation occur early with each project to determine the location of improvements to determine whether the park area impacted will be subject to Section 6(f) regulations.

FLOODPLAIN

Approach

The City has been a participating member of the Federal Emergency Management Agency (FEMA) Flood Insurance Program since 1979. The current Minnehaha County Flood Insurance Study (FIS) that includes the City and incorporated areas is dated September 2, 2009. The project area contains FEMA-designated zones for the Big Sioux River.

Limitations

If any projects would involve areas associated with the Big Sioux River, a floodplain permit may be required if the floodplain would be encroached upon. A Floodplain Development Application would be completed for the project and the City would obtain a Floodplain Development Permit.

REGULATED MATERIALS

Approach

The SD Department of National Resources (SDDENR) Environmental Events Database website was reviewed for the Project Area to identify any areas that could be of concern for project concepts.

Limitations

Information for hazardous material should be reviewed at the time of a proposed project to identify any potential new hazards that may have occurred from the time of the study to a project.

The environmental review findings for the I-229 corridor and interchange concepts are summarized in ***TABLE 3***.

Environmental constraints for the I-229 corridor are shown in ***APPENDIX I4- ENVIRONMENTAL CONSTRAINTS MAPS***. Note, a noise assessment will be included at later stage of the study.

Table 3. Preliminary Concepts Environmental Review

Concept ID	Description	Environmental Comparative Data					Environmental Summary	
		Wetlands	T&E	4(f) and 6(f) Properties	Cultural	Other	Anticipated Impact Level	Comments
I229-C1	6-Lanes, From 26th St to 10th St	Crosses Big Sioux River. Expansion of bridge could impact river/wetland areas.	Potential impacts to northern long-eared bat if trees are removed during summer maternity season. Bridges could be potential bat habitat and should be reviewed.	Bike path and park areas present (Riverdale Park, Rotary Park); historic railroad. Should have no impacts if construction remains in ROW. Bridge work could have temporary impacts to bike path during construction.	Area has been previously inventoried. Historic sites: BNSF railroad corridor (Eligible for NRHP)	Floodplain present. Potential increases for receptors.	Medium/ potential 4(f)	Potential impacts to Big Sioux River; potential T&E issues (northern long-eared bat), floodplain and 4(f)/6(f) and cultural resources present, may have impacts if work goes outside existing ROW in those areas. Most issues occur near E 26th Street.
I229-C2	6-Lanes, From 26th St to 10th St + 65 mph improved horizontal curves, 18th St to SE Ave	Crosses Big Sioux River. Expansion of bridge could impact river/wetland areas.	Potential impacts to northern long-eared bat if trees are removed during summer maternity season. Bridges could be potential bat habitat and should be reviewed.	Bike path and park areas present (Riverdale Park, Rotary Park); historic railroad. Should have no impacts if construction remains in ROW. Bridge work could have temporary impacts to bike path during construction.	Area has been previously inventoried. Historic sites: BNSF railroad corridor (Eligible for NRHP)	Floodplain present. Potential increases for receptors. Alignment shift moves road closer	Medium/ potential 4(f)	Same impacts as C-1, with the additional shift closer to residences near interchange
Cliff-1	NB Cliff to SB I-229 Loop ramp auxiliary lane add	Potential, but minimal	Bridge work could require analysis to determine if bridge is considered potential northern long-eared bat habitat				Low	Potential wetland impacts. Potential northern long-eared bat impacts if trees are impacted.
Cliff-2	NB/SB Cliff to SB I-229 Loop ramp, eliminate SB diagonal ramp	Potential, but minimal	Bridge work could require analysis to determine if bridge is considered potential northern long-eared bat habitat				Low	Potential wetland impacts. Potential northern long-eared bat impacts if trees are impacted.
Cliff-3	SB Cliff Ave auxiliary lane from 41st St to SB I-229 ramp	Potential, but minimal	Bridge work could require analysis to determine if bridge is considered potential northern long-eared bat habitat				Low	Potential wetland impacts. Potential northern long-eared bat impacts if trees are impacted.
Rice-1	NB Rice exit ramp terminal lane additions	Potential wetlands in area adjacent to roadway; likely avoided	Potential tree removal could impact northern long-eared bat if trees are removed during summer maternity season.				Low	Potential wetland impacts. Potential northern long-eared bat impacts if trees are impacted.

Construction Costs

In preparing estimates of construction costs for the preliminary concepts, quantities were developed for the following items and the unit costs shown in parenthesis were applied to the quantities:

- Bridge deck area ($180 or $270/SF tangent or curved bridge)
- Retaining wall length ($600/LF)
- Interstate / ramp / street pavement area ($20/SF)

Pavement area costs are assumed to include curb, shoulder, median, sidewalk, and drainage items. For cost estimating purposes, all retaining walls were assumed to have a constant height of 12 feet over their entire estimated length.

The pavement unit costs applied were developed from unit prices computed from the following awarded local projects:

- 57th/Western (2013) — $5.3 million total, $21.81/SF
- Russell Street (2013) — $15 million total, $18.94/SF
- I-90/Cliff Ave Interchange (2013) — $15.8 million total, $25.61/SF (includes bridge costs)
- Cliff Ave, 61st to 85th (2015) — $8.9 million total, $16.91/SF

Estimated construction costs and property impacts costs for the preliminary concepts are shown in ***Table 4***.

Relocation costs are not included in the ROW cost estimates.

Preliminary Concepts Composite Comparative Assessment

The four types of data compiled for the Preliminary Concepts is shown in ***Table 5***, along with the classification for each measure.

Table 4. Preliminary Concepts Estimated Costs

Concept ID	Description	Bridge		Retaining Wall		Interstate & Ramps		Municipal Street		Contingency		Property Impacts		Total Cost
		Area (ft^2)	Cost	Length (ft)	Cost	Area (ft^2)	Cost	Area (ft^2)	Cost	%	Cost	Area (acre)	Cost	
I229-C1	6-Lanes, From 26th St to 10th St	45,608	$8,300,000	1,802	$1,100,000	747,056	$15,000,000	0	$0	20%	$3,220,000	0.0	$0	$27,620,000
I229-C2	6-Lanes, From 26th St to 10th St + 65 mph improved horizontal curves, 18th St to SE Ave	45,608	$8,300,000	2,241	$1,400,000	745,325	$15,000,000	0	$0	20%	$3,280,000	0.0	$0	$27,980,000
Cliff-1	NB Cliff to SB I-229 Loop ramp auxiliary lane add	4,397	$800,000	779	$500,000	126,136	$2,600,000	0	$0	20%	$620,000	0.0	$0	$4,520,000
Cliff-2	NB/SB Cliff to SB I-229 Loop ramp, eliminate SB diagonal ramp	4,397	$800,000	0	$0	54,534	$1,100,000	0	$0	20%	$220,000	0.0	$0	$2,120,000
Cliff-3	SB Cliff Ave auxiliary lane from 41st St to SB I-229 ramp	4,397	$800,000	779	$500,000	143,663	$2,900,000	0	$0	20%	$680,000	0.0	$0	$4,880,000
Rice-1	NB Rice exit ramp terminal lane additions	0	$0	0	$0	50,147	$1,100,000	148,750	$3,000,000	20%	$820,000	0.4	$400,000	$5,320,000

Table 5. Preliminary Concepts Composite Comparative Assessment

Preliminary Concept		Traffic Assessment				Environmental	Cost	ROW (acre)
		Queues	Delay	Travel Time	Through put			
I229-C1	6-Lanes, From 26th St to 10th St	*n/a*	Poor	Neutral	Neutral	Medium/ potential 4(f) impacts	$27,620,000	0
I229-C2	6-Lanes, From 26th St to 10th St + 65 mph improved horizontal curves, 18th St to SE Ave	*n/a*	Poor	Neutral	Neutral	Medium/ potential 4(f) impacts	$27,980,000	0
Cliff-1	NB Cliff to SB I229 Loop ramp auxiliary lane add	Good	Good	Neutral	*n/a*	Low Impacts	$4,520,000	0
Cliff-2	NB/SB Cliff to SB I229 Loop ramp, eliminate SB diagonal ramp	Good	Neutral	Neutral	*n/a*	Low Impacts	$2,120,000	0
Cliff-3	SB Cliff Ave auxiliary lane from 41st St to SB I229 ramp	Good	Good	Neutral	*n/a*	Low Impacts	$4,880,000	0
Rice-1	NB Rice exit ramp terminal lane additions	Good	Neutral	Poor	*n/a*	Low Impacts	$5,320,000	0.4

Preliminary Concept Screening Workshop Decision Matrix

The following tabulations record SAT decisions at the workshop on July 9, 2015. The purpose of the workshop was to screen preliminary concepts and formulate Build alternatives for the next phase of study. Action items and comments are noted for each of the concepts. **TABLE 6** illustrates the completed preliminary concepts phase of the I-229 Major Investment Study. Screening Workshop Decision:

- ***Carry Ahead*** = Conceptual profile development, noise analysis, HCS traffic analysis, updated costs/impacts, constructability review
- ***Eliminate*** = No further development
- ***Defer*** = No further development in this study. Will be further considered in NEPA phase for specific project

Table 6. Preliminary Concept Screening Workshop Decision Matrix- I-229 Corridor

Concept ID	Type / Details Description	Workshop Decision	Action Items	Comments
I-229 Corridor				
I229-C1	6-Lanes, From 26th St to 10th St	Carry Ahead		
I229-C2	6-Lanes, From 26th St to 10th St + 65 mph improved horizontal curves, 18th St to SE Ave	Carry Ahead		
Cliff Ave Interchange				
Cliff-1	NB Cliff to SB I229 Loop ramp auxiliary lane add	Carry Ahead	- Modify to align loop ramp with 41st St.	- Replace SB I-229 bridge instead of widening because of bridge age. - The SB loop ramp should be modified to look like Cliff-2 to perpetuate the trail on the east side of Cliff, eliminating the conflicting free movement with pedestrians introducing and maintain pedestrians crossing with a signal.
Cliff-2	NB/SB Cliff to SB I229 Loop ramp, eliminate SB diagonal ramp	Carry Ahead (1)		
Cliff-3	SB Cliff Ave auxiliary lane from 41st St to SB I229 ramp	Eliminate		- Auxilliary lane feature of this concept not considered to be beneficial. Otherwise, this concept is identical to Cliff-1.
Rice St Ave Interchange				
Rice-1	NB Rice exit ramp terminal lane additions	Defer	Investigate potential traffic operations at Rice interchange if Cleveland	- Concept not recommended for further consideration

NOTES
(1) Eliminate concept if traffic analysis shows that SB diagonal entrance ramp in Cliff-1 is not needed.

APPENDIX I3 -

DTA MODEL INTERCHANGE AND MODEL SUBAREAS

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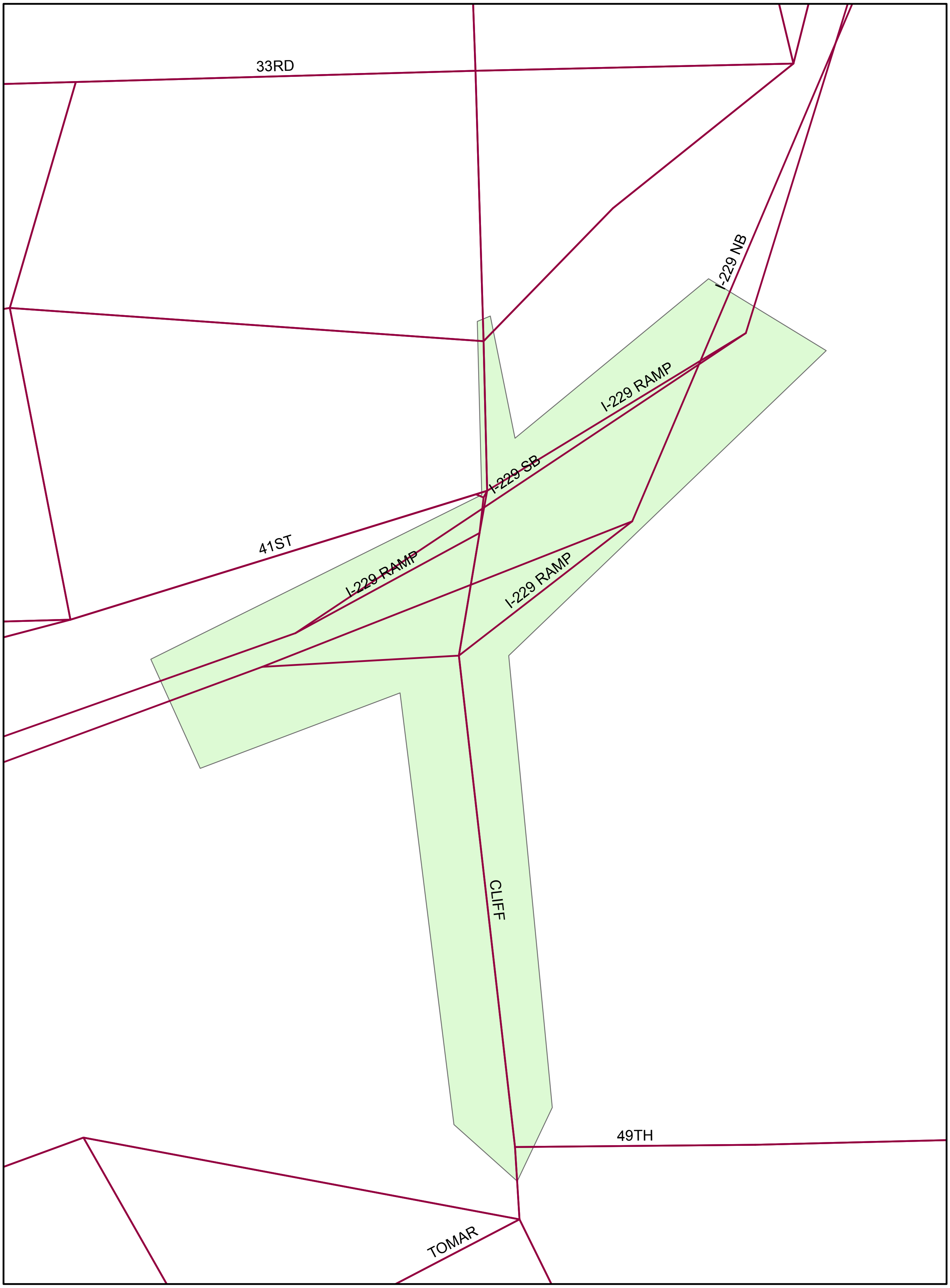
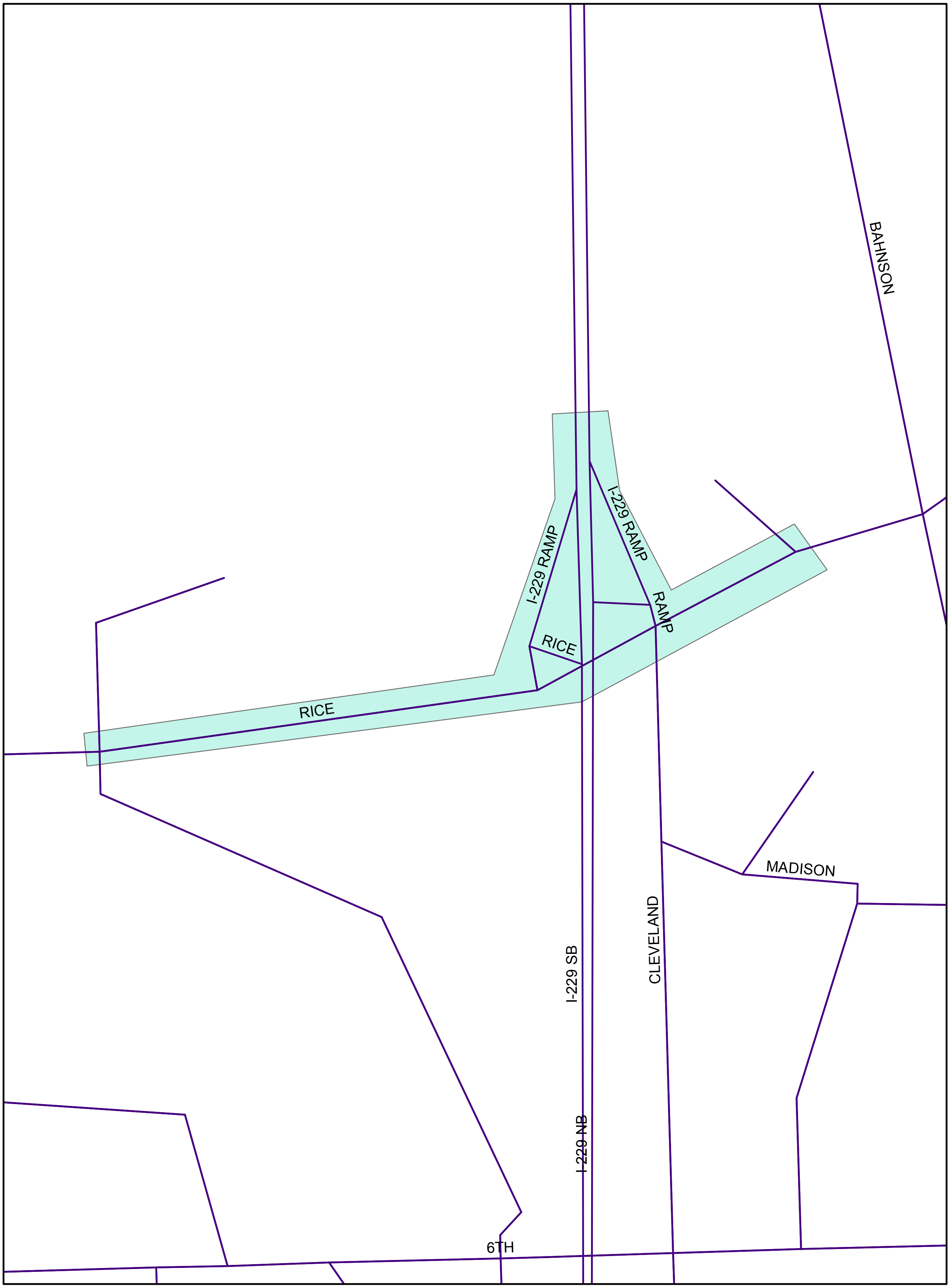
(605) 977-7740

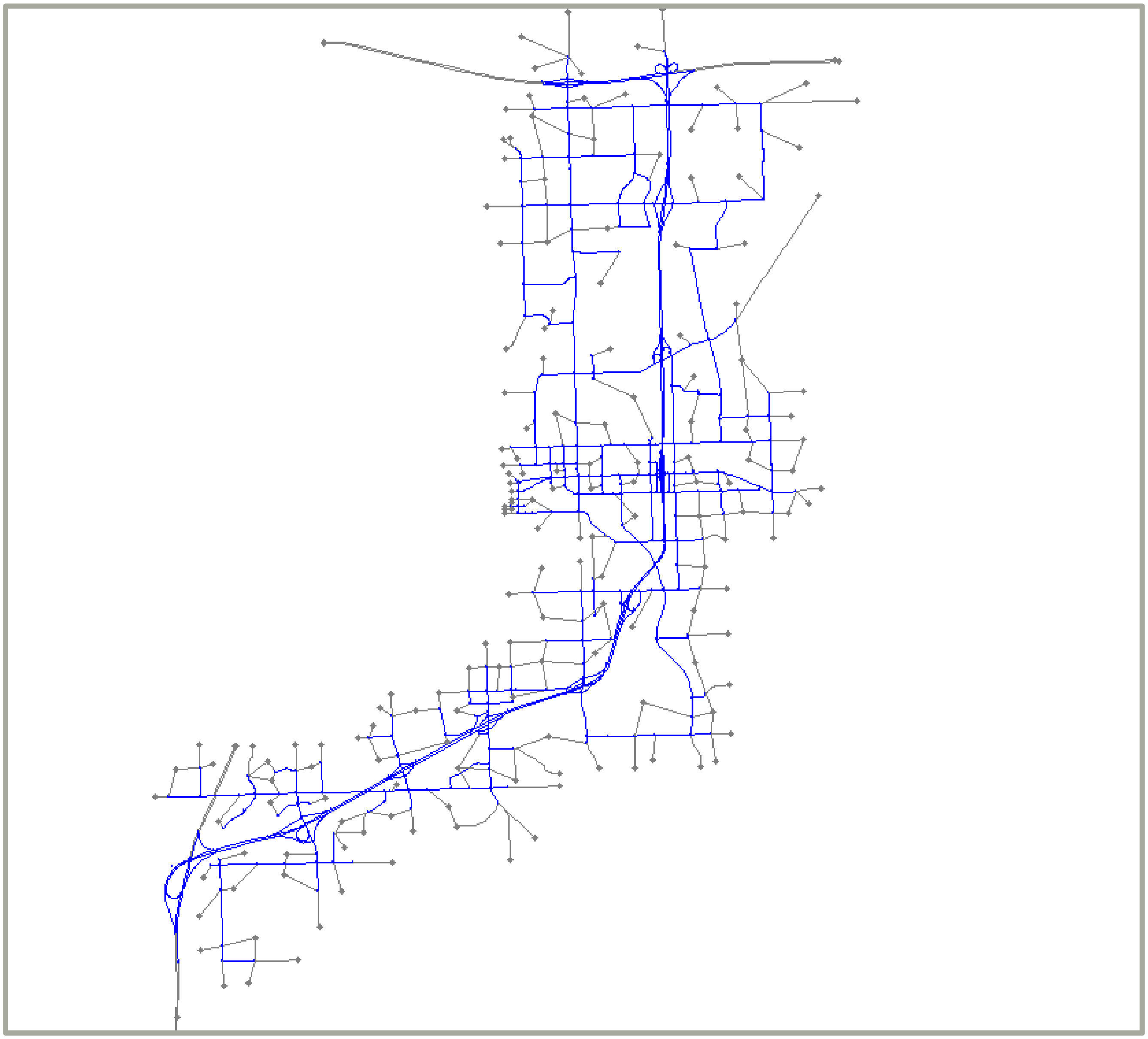
Sub-Study 1 - Cliff Corridor - Interchange Area



Sub-Study 1 - Rice Corridor - Interchange Area



DTA Model Subarea



APPENDIX I4 -

ENVIRONMENTAL CONSTRAINTS MAPS


PEMAd
S MANDY AVE
PEMC
PEMC
PFOC
I 29 N2
S SOLBERG AVE
W 59TH ST
PEMAd
I 229 S
I 29 S1
I 229 N
I 229 S2
I 229 N1
I 29 S
I 29 N
W 69TH ST
PEMC
S TALLGRASS AVE
W 69TH ST
S SHARON AVE
PABFx
PABFx
PEMAd
PABFh
PEMA
PEMC
PEMCd
PABFh
PEMAd
N
W
E
S
200
400
Feet
Legend
Schools
Bike Trail
River
NWI Wetlands
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A.8
A.7
A.6
A.5
A.4
A.3
A.2
A.1
HDR
I-229 MIS CORRIDOR STUDY
I-229 CORRIDOR STUDY
MAP OVERVIEW
DATE
7/8/2015
FIGURE
A.1

W NORIE PL
PEMC
PABF
N
W
E
S
SERTOMA
R2UBGx
S ROLLING GREEN AVE
W 59TH ST
PEMAd
S TENNIS LN
W ROYAL OAKS PL
COLORADO TECH
PEM/FOC
Experienced
W 57TH ST
Future
PEM/FOA
S BUR OAK PL
EXCEL ACHIEVEMENT CENTER
I 229 S2
I 229 S1
I 229 S
I 229 N
W 57TH ST
I 229 N1
I 229 N2
S LOUISE AVE
I 229 N4
PABFh
PEMA
S SHARON AVE
W AVERA DR
W RALPH ROGERS RD
Intermediate
S MOGEN AVE
W 69TH ST
S CONNIE AVE
S LOUISE AVE
S SANDRA DR
S CHUCK DR
S BALDWIN CT
S LOIS LN
W 69TH ST
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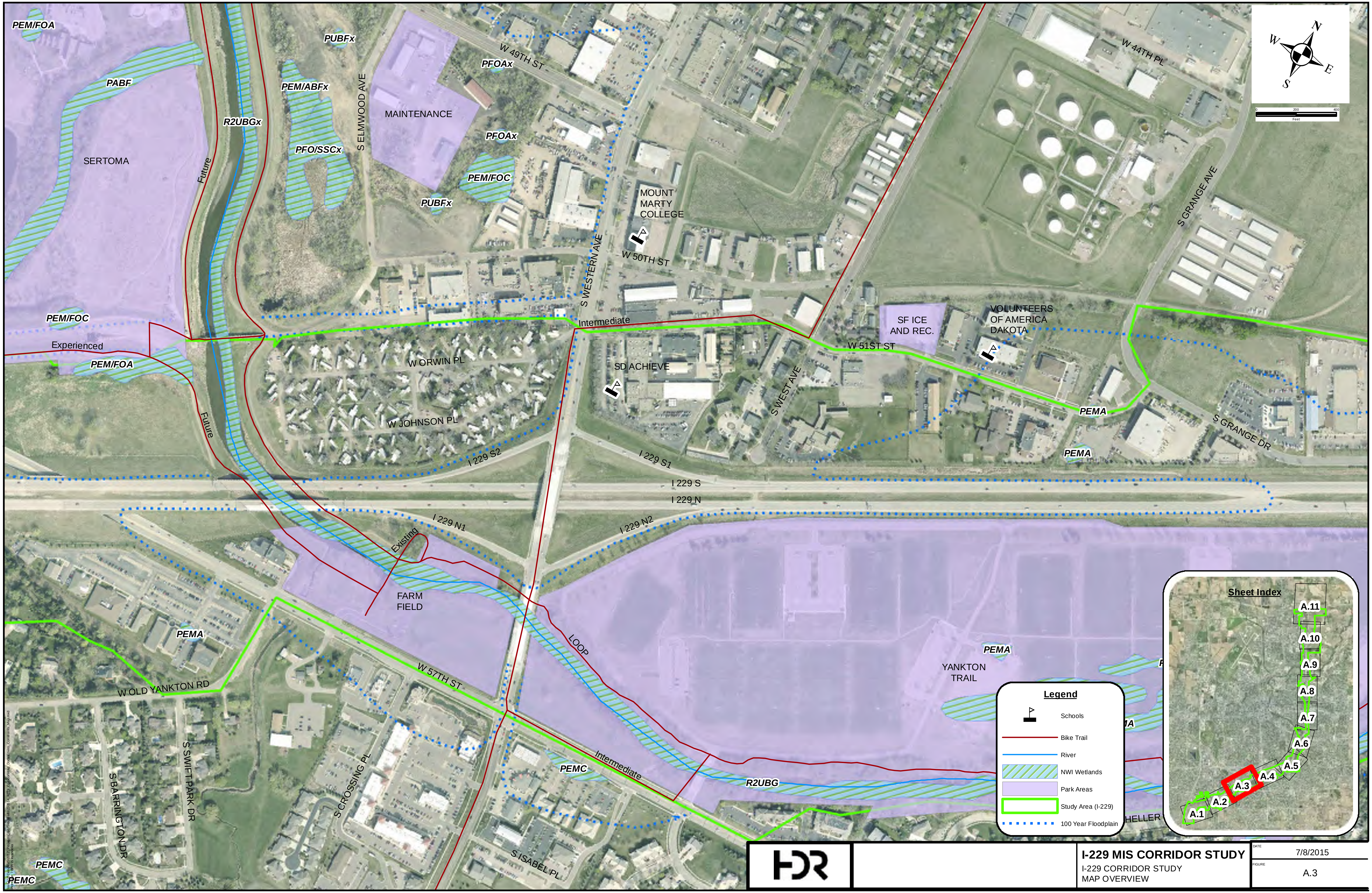
A.4
A.3
A.2
A.1
I-229 MIS CORRIDOR STUDY
I-229 CORRIDOR STUDY
MAP OVERVIEW
7/8/2015
A.2



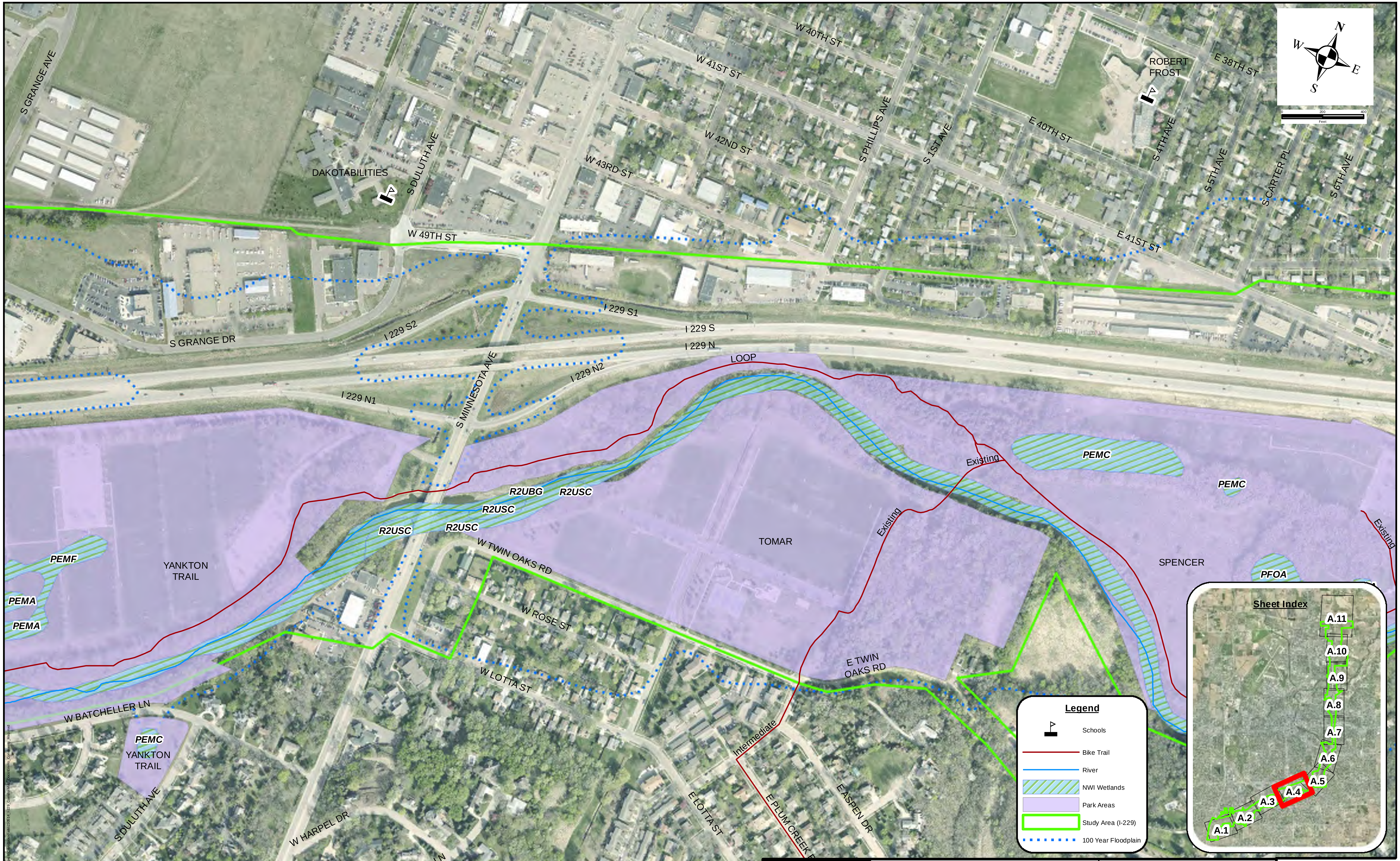
HDR

I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.3

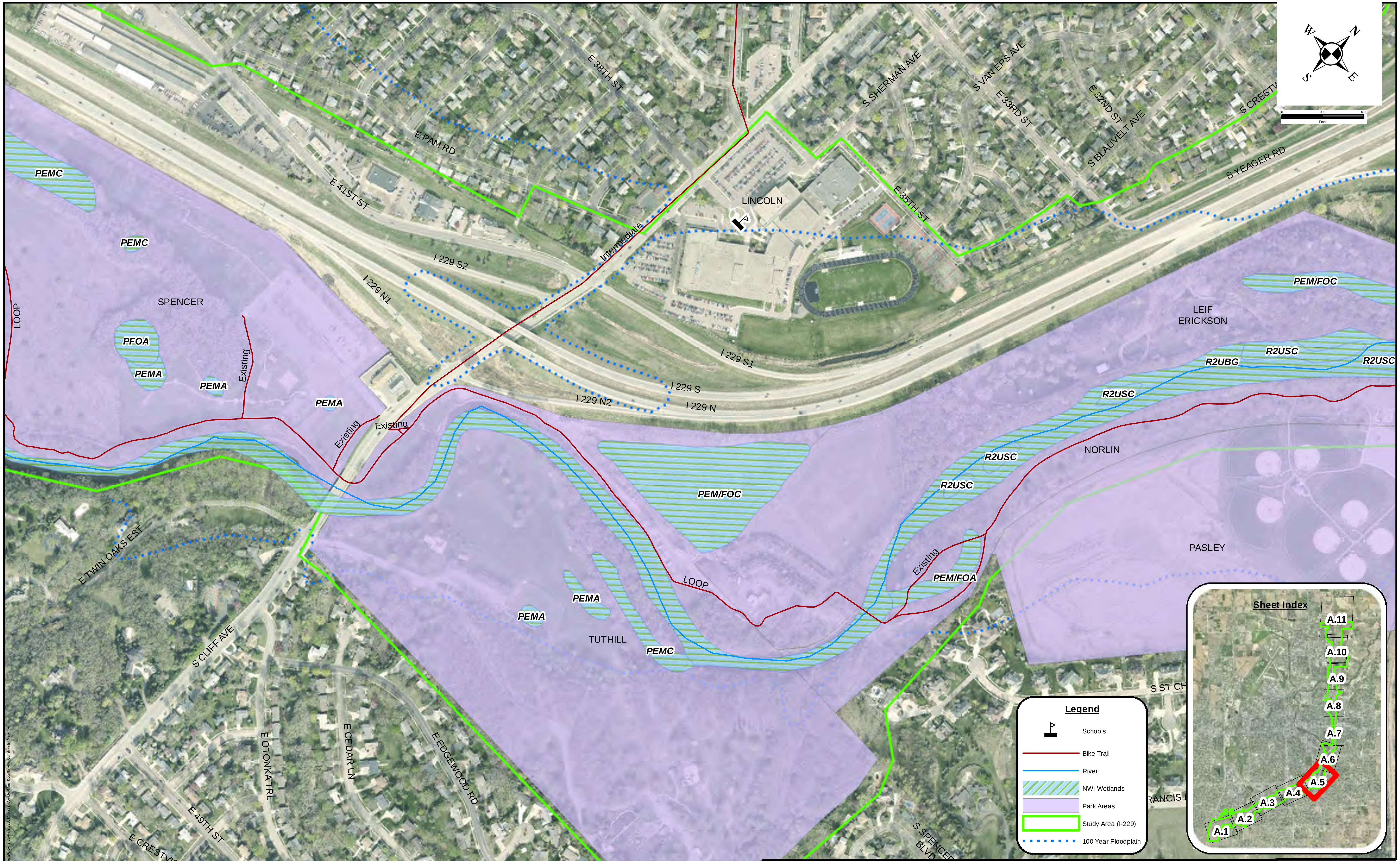


HDR

I-229 MIS CORRIDOR STUDY
I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.4



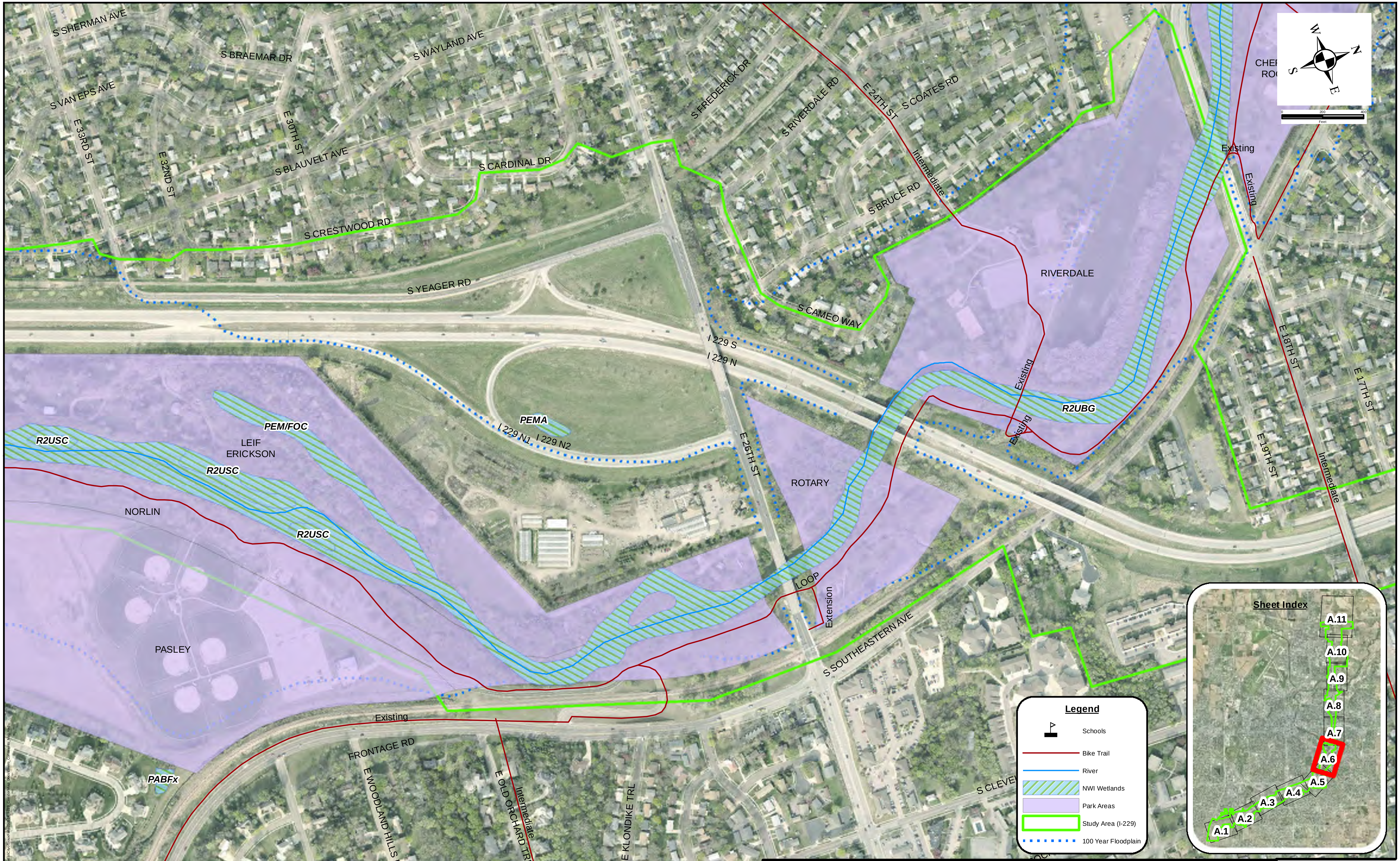
HDR

I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.5



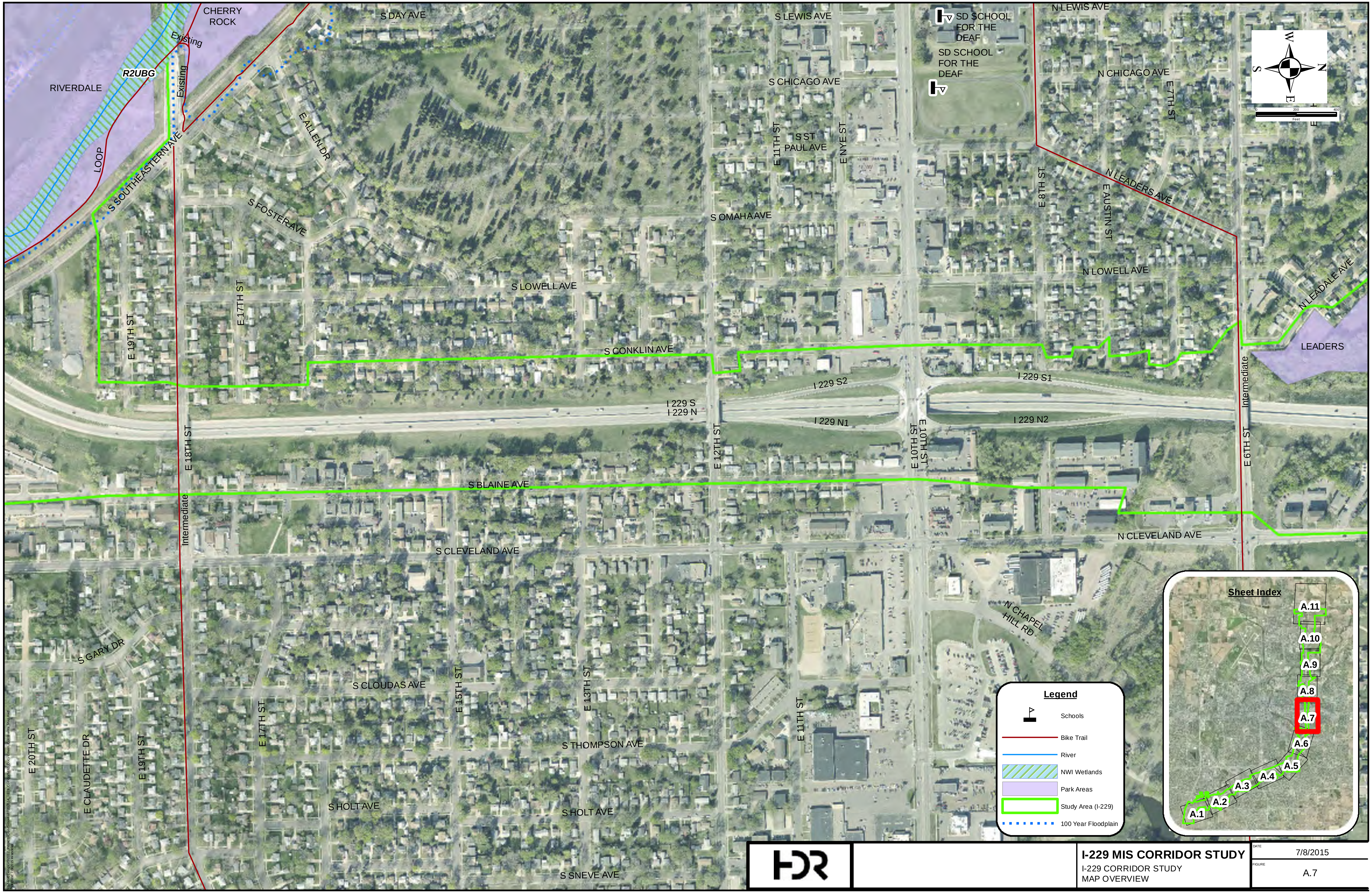
HDR

I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.6



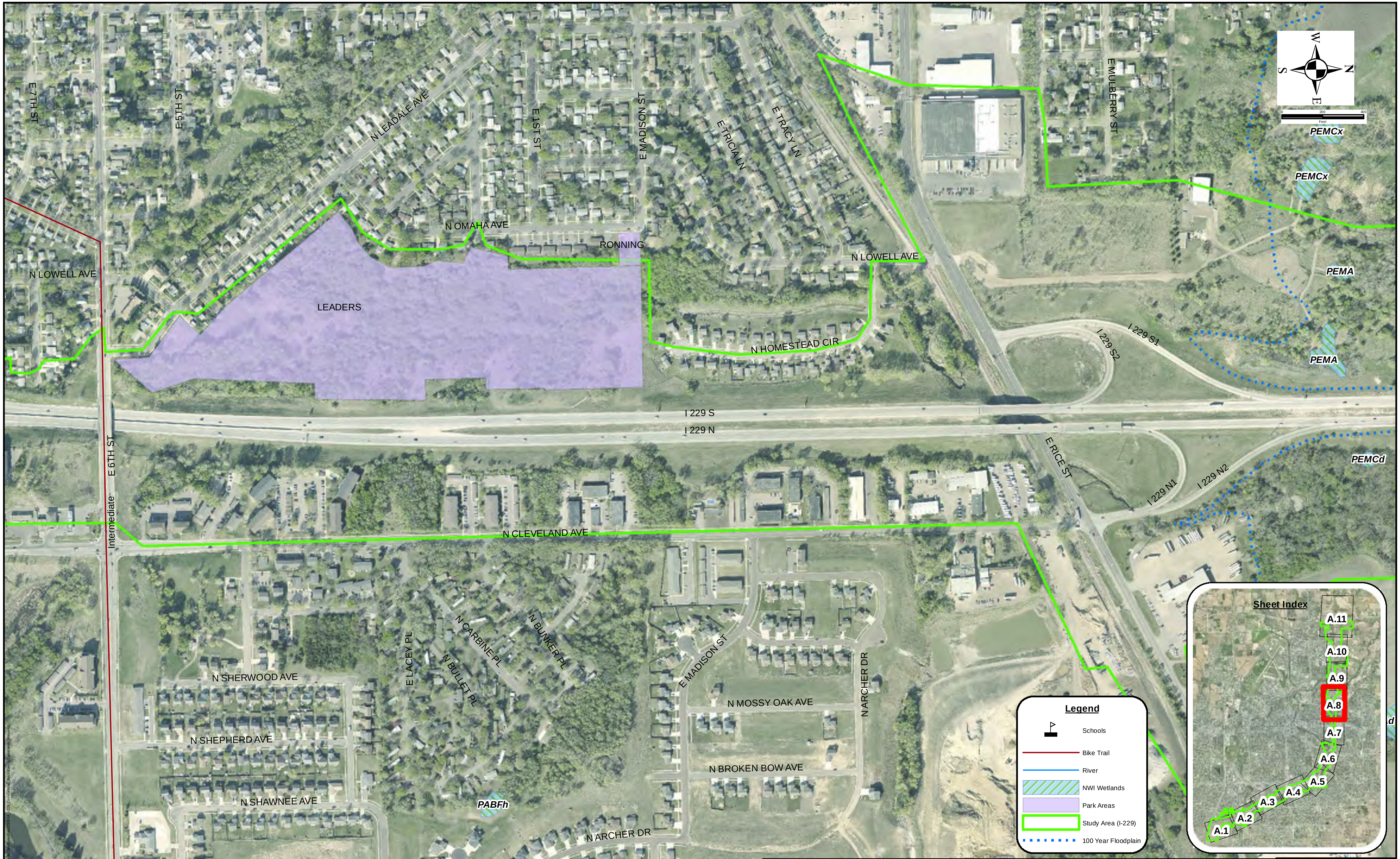
HDR

I-229 MIS CORRIDOR STUDY

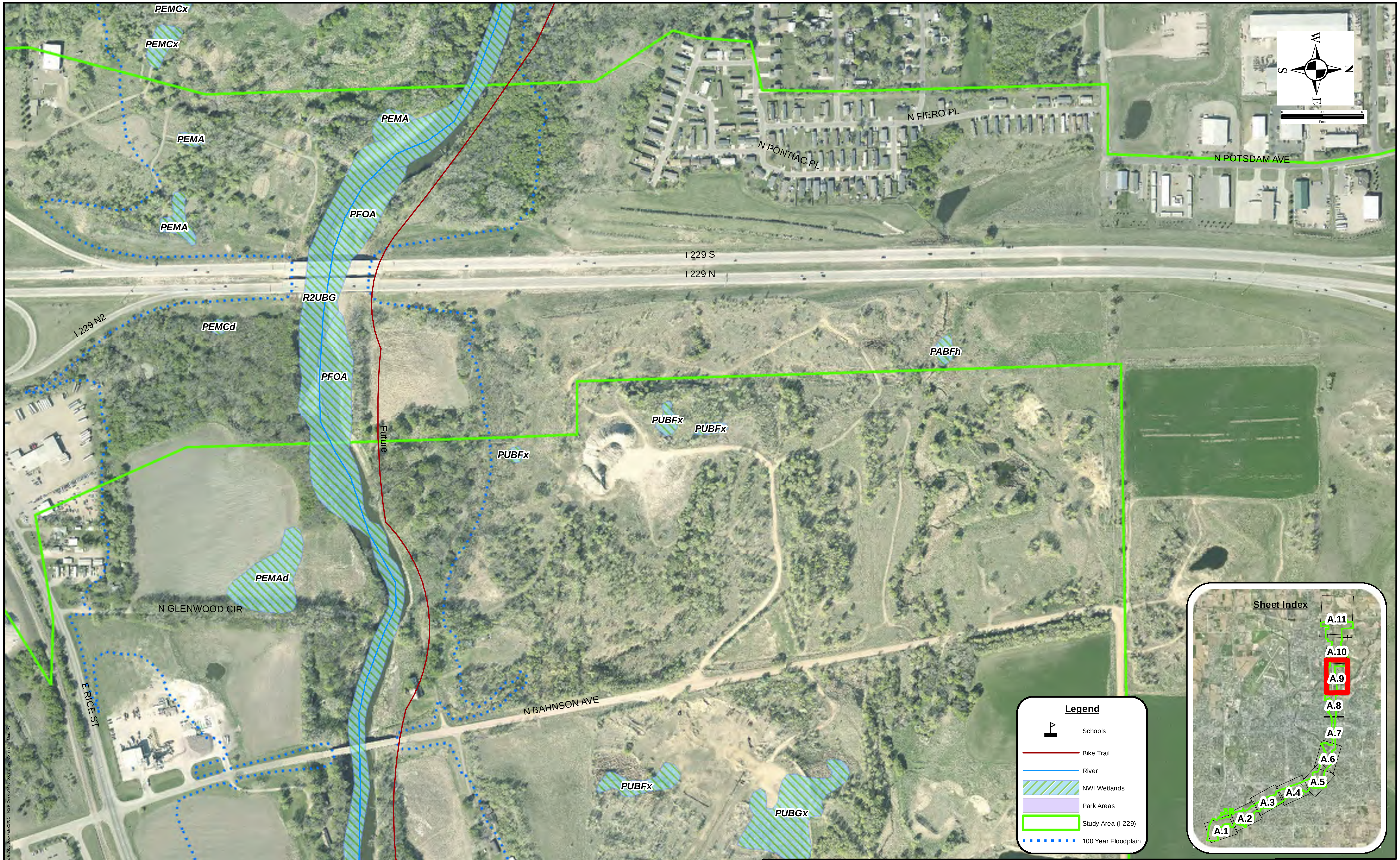
I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.7



HDR		**I-229 MIS CORRIDOR STUDY** I-229 CORRIDOR STUDY MAP OVERVIEW	DATE 7/8/2015 FIGURE A.8



HDR

I-229 MIS CORRIDOR STUDY
I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015
FIGURE A.9

N POTSDAM AVE
E 39TH ST N
E 52ND ST N
E 54TH ST N
N HAINJE AVE
I 229 S2
I 229 S1
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A.1
Legend
Schools
Bike Trail
River
NWI Wetlands
Park Areas
Study Area (I-229)
100 Year Floodplain
HDR
I-229 MIS CORRIDOR STUDY
I-229 CORRIDOR STUDY
MAP OVERVIEW
DATE
7/8/2015
FIGURE
A.10

HDR

I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.11

Appendix J. Predictive Safety Analysis

This memorandum presents a summary of the methodology and findings for the predicted safety performance analysis for the Existing, No-Build and Build conditions for the I-229 MIS.

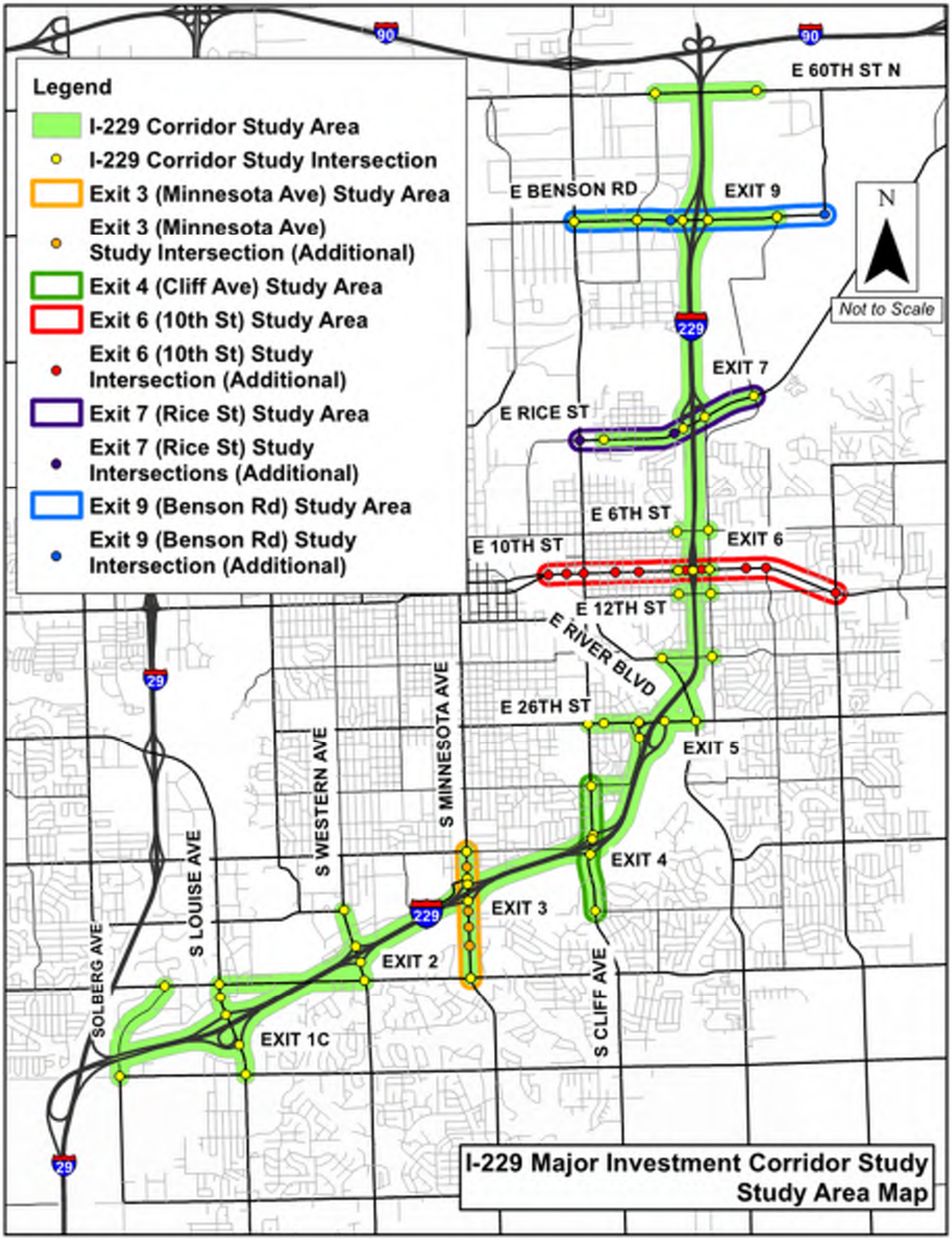
The I-229 MIS has been separated into individual sub-studies. The sub-studies include:

- I-229 Corridor Study
- Minnesota Avenue Corridor Study (Exit 3)
- 10th Street Corridor Study (Exit 6)
- Benson Road Corridor Study (Exit 9)
- Rice Street Corridor Study (Exit 7)
- Cliff Avenue Corridor Study (Exit 4)

A map illustrating the overall study areas for each of the sub-studies is shown in ***Figure 1***. The study limits for the predictive safety analysis differ slightly. In general, the predictive safety analysis limits for the I-229 Corridor Study are focused on the freeway area impacted by the corridor concepts (26th Street to 10th Street) and the remaining sub-studies focus on their respective ramps and ramp terminals. The analysis limits for each sub-study will be detailed later in this memorandum.

The predictive safety analysis presented in this memorandum is based on the principles and methods of the Highway Safety Manual (HSM) as discussed in detail below. It presents a comparative analysis of the predicted crashes anticipated between the Existing (Year 2012) condition and the Future No-Build (Year 2035) condition, as well as a comparative analysis between No-Build and Build alternatives for each sub-study. The Build alternatives to be analyzed for this study will be described later in this memorandum. The results are intended to help guide the selection of the alternatives moving forward to the alternatives analysis stage of planning.

Figure 1. I-229 MIS Study Area Map



Methodology

Predictive safety analysis was completed using the American Association of State Highway and Transportation Officials (AASHTO) HSM methods, including the National Cooperative Highway Research Program (NCHRP) Report 17-45 methods for evaluating freeways and interchanges (now part of the HSM as a supplemental volume published in 2014). FHWA supports, and in many cases now requires, the use of HSM methods for the evaluation of proposed freeway facility improvements, including new or modified Interstate access. According to the HSM preface:

"The focus of the HSM is to provide quantitative information for decision making. The HSM assembles currently available information and methodologies on measuring, estimating, and evaluating roadways in terms of crash frequency (number of crashes per year) and crash severity (level of injures due to crashes). The HSM presents tools and methodologies for consideration of 'safety' across the range of highway activities …"

The HSM goes on to describe a primary benefit of the predictive method, "The predictive method provides a quantitative measure of expected crash frequency under both existing conditions and conditions which have not yet occurred. This allows proposed roadway conditions to be quantitatively assessed …" (HSM, 2010)

HSM-based crash predictions are developed using safety performance functions (SPFs) for specific facility types. The SPFs predict crash frequency for a variety of freeway types with direct consideration of factors of crash risk exposure (e.g. daily traffic volumes and segment lengths). However, crash prediction by SPF alone is limited to facilities with geometric and traffic control features that match a theoretical base condition for that facility type. To overcome this limitation to SPF applicability, crash modification factors (CMFs) are used to make adjustments to the initial SPF results to account for differences between the actual geometric and traffic control conditions and the theoretical base condition. CMFs are multiplicative factors. Thus, if a CMF greater than 1 is combined with an SPF the resulting number of predicted crashes will increase over the original SPF-based crash prediction. Conversely, a CMF less than 1 it will decrease the number of predicted crashes. For example, if an outside shoulder width is less than the assumed 10-foot base condition, then a CMF of greater than 1 is applied to adjust the SPF results for the segment.

The HSM methodology has been in development for many years and is rapidly advancing; however, there are still many limitations where the available tools do not yet offer SPFs and/or CMFs for certain conditions. Where this is the case, recent research and crash data were also considered to overcome analysis limitations. Crash prediction methods beyond the scope of the HSM that were deemed necessary for the I-229 MIS study were agreed upon in the project Methods and Assumptions document and are described later in this section.

Facilities, Segmentation and Data Inputs

The HSM allows for crash prediction to be conducted at the project level or site-specific level. A site-specific analysis parses the project study area into individual homogenous elements, such as, freeway segments, ramp segments, and ramp terminal intersections. The I-229 MIS crash prediction area was segmented into 38 mainline freeway segments, 24 ramp segments, 11 ramp terminal intersections, and 4 arterial intersections. The segmentation will be provided as a digital appendix.

Crash prediction requires geometric and operational inputs to accurately compute the SPFs and apply the correct CMFs. These inputs include information such as segment length, daily traffic volume, ramp locations, merge distances, and horizontal curvature. The geometric inputs were primarily obtained from the conceptual design files and aerial photography. The traffic volume data was based on traffic counts provided by SDDOT and design year volume forecasts from the 2035 Sioux Falls Travel Demand Model.

I-229 Mainline Segments, Entrance and Exit Ramps, and Ramp Terminals
The I-229 mainline segments, entrance and exit ramps, and ramp terminals were evaluated using HSM methods implemented using the Enhanced Interchange Safety Analysis Tools (ISATe) version j software provided by FHWA. The ISATe analysis files are provided as a digital appendix for all freeway, ramp, and ramp terminal intersection sites that were reviewed.

The ISATe does have limitations however. Specifically, the ISATe ramp terminal method does not address Single-Point Urban Interchanges (SPUIs) or Diverging Diamond Interchanges (DDIs). It only predicts crashes for a variety of more typical diamond and partial cloverleaf interchange ramp terminals. Therefore, it was necessary to develop an estimate for an "operationally-similar" diamond interchange design and then use CMFs from HDR's "Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and Two-Lane Loop Ramp" memo dated November 4th, 2015 to modify the results to estimate the predictions for a SPUI and DDI design. Based on available SDDOT data, the preliminary CMF for conversion of a traditional diamond interchange to a SPUI is 0.63 for ramp terminal intersection crashes. Based on research done in Missouri on safety evaluations of DDIs, the preliminary CMF for conversion of a traditional diamond interchange to a DDI is 0.37 for Fatal + Injury (F+I) crashes at ramp terminal intersections and 0.49 for Property Damage Only (PDO) crashes at ramp terminal intersections.

Cross Street Segments
Crashes within an interchange's functional area can be almost entirely predicted by evaluating the crashes from the freeway, freeway ramps, and ramp terminal intersections. However, some crashes near the interchange may be due to roadway segment characteristics of the arterial cross street. If these segment-related crashes are to be included, then HSM methods for urban and suburban arterials need to be applied. In this study, the primary area for crash prediction evaluation was focused on the interchange, and no arterial segment crashes were evaluated between scenarios.

Arterial Intersections
Some arterial intersections were included when the sub-study concepts involved realigning ramps to arterial intersections. Therefore, to make a fair comparison, the predictive safety analysis included the impacted arterial intersection for all sub-study concepts, including

No-Build. Methods from Chapter 12 of the HSM were used for analyzing arterial intersections. The analysis files for the 4 arterial intersections analyzed are provided as a digital appendix.

Calibration Factors

According to the HSM, "the predictive models were developed from the most complete and consistent data sets available." However, the report also recommends that the equations be calibrated for each jurisdiction because "the general level of crash frequencies may vary substantially from one jurisdiction to another." However, SDDOT has not yet conducted the extensive analyses required to develop a complete set of HSM related calibration factors. Therefore, using the national HSM equations is proposed as the best approach for this current analysis.

Empirical Bayes Approach: Considering Historical Crash Data

The HSM method includes an optional step called the Empirical Bayes (EB) approach, which combines "the estimate from a predictive model with observed crash data to obtain a more reliable estimate of the expected average crash frequency." (HSM, 2010) Essentially, the historical crash data is used to adjust the future crash prediction. Typically, the EB method is only used when it can be applied equally to all of the alternatives under consideration. Thus the improvements being considered must be moderate, so that the historical crash data is reasonable to consider for the conditions being compared. When major alignment or traffic control changes are proposed (such as the proposed SPUI's or DDI's), it is not used because "there is typically a small difference in the results obtained from the predictive method when it is used with and without the EB Method." Therefore, "if the EB Method is not applied consistently, such differences will likely introduce a small bias in the comparison of expected crash frequency among alternatives." (HSM Supplement, 2014) Therefore, the results are presented with the EB method adjustment when comparing Existing to No-Build conditions and without the EB method adjustment when comparing No-Build to the Build alternatives.

Planning Horizon Cost Savings

Planning horizon cost savings were calculated for the Build alternatives. The planning horizon cost savings is the discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035. This shows how much money is saved (or loss) from a safety standpoint for each alternative.

Analysis Results

The predicted number of crashes were compared for the Existing (Year 2012) and No-Build (Year 2035) conditions to see the effect on safety of the unimproved I-229 corridor with increased traffic volumes. This comparison of Existing and No-Build conditions comprises the entire crash prediction area for all six sub-studies, allowing adjacent interchanges to be compared for differences in predicted future crash frequency.

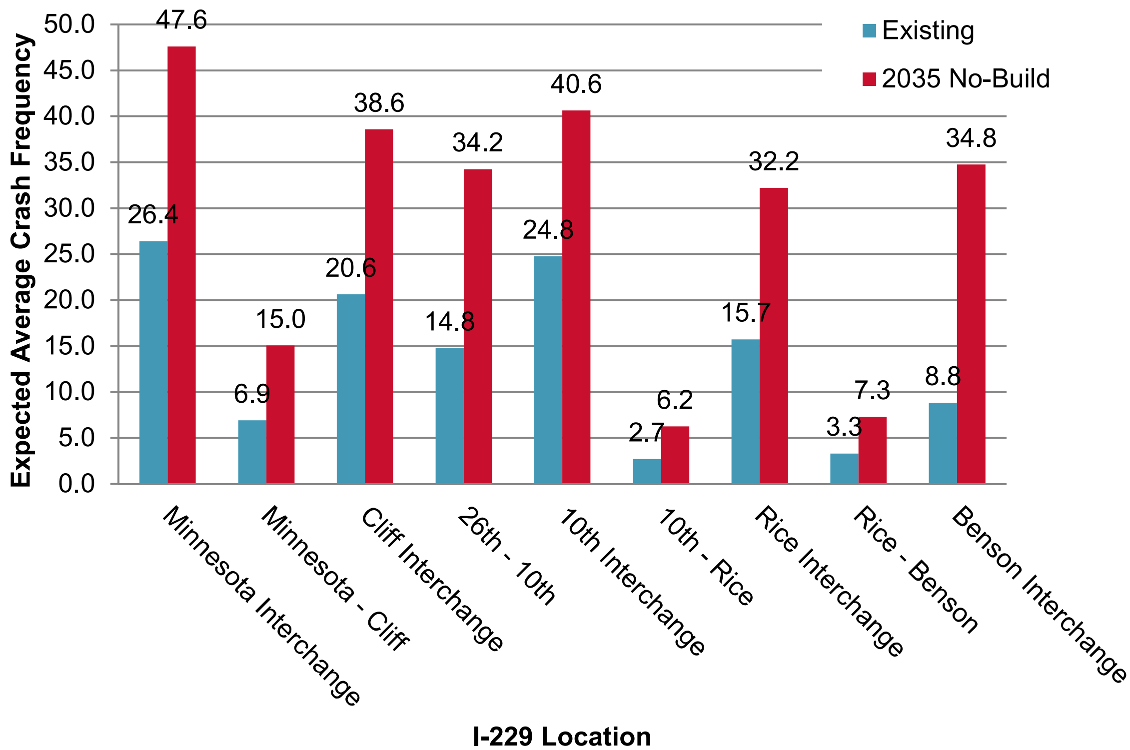
In a similar fashion, Build alternatives for each sub-study were evaluated and the predicted number of crashes was established for the 2012 to 2035 analysis period. The Build alternative crash predictions were then compared to the No-Build crash prediction for subject interchange. Hence, the results of the crash predictions for Build alternatives are presented by sub-study.

Existing vs. No-Build

The first stage of the crash prediction analysis was to compare the safety impact of anticipated traffic volume growth over the study horizon. The predicted annual crash frequencies for the Existing (Year 2012) and No-Build (Year 2035) conditions are presented in ***Table 1***. For the comparison of the Existing and No-Build conditions, historical crash data was applied using the EB method adjustment.

As expected, crashes predicted for each location along I-229 increase because of the increase in traffic volume. Notably, the I-229 interchange areas experience higher levels of existing crashes than the connecting freeway segments. By 2035, those interchange areas all have nearly doubled in annual crashes. Particularly, the Benson Road interchange shows the highest increase in annual predicted crashes at 26 additional crashes per year.

Table 1: Expected Average Crash Frequency – Existing vs. 2035 No-Build



No-Build vs. Build Alternatives

I-229 Corridor Study

STUDY AREA

The ISATe analysis limits for the I-229 Corridor Study focus on the I-229 freeway portion from 26th Street to 10th Street. The analysis limits for the I-229 Corridor Study are shown in ***Figure 2***.

Figure 2: I-229 Corridor ISATe Analysis Limits

Source: Google Earth, December 2016

ALTERNATIVES

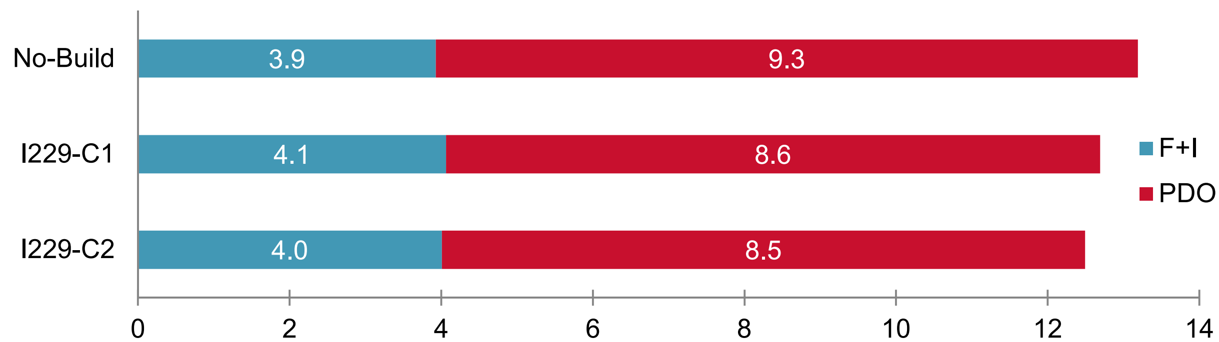
The alternatives to be analyzed for the I-229 Corridor Study are:

- I229-NB
  - No-Build
- I229-C1
  - 6-Lanes, From 26th St to 10th St
- I229-C2
  - 6-Lanes, From 26th St to 10th St
  - 65 MPH Improved Horizontal Curves

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 2*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 2: I-229 Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is slightly lower for both Build alternatives The Build alternatives result in a 4-5% decrease in total crashes and a 7-8% decrease in PDO crashes, but a 2-3% increase in F+I crashes. The cost for an F+I crash is high so this results in a negative cost savings, which is shown below in ***Table 3***.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 3***.

Table 3: I-229 Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 24,600,000	$ -
I229-C1	$ 25,200,000	$ (600,000)
I229-C2	$ 24,900,000	$ (300,000)

[1]Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Minnesota Avenue Corridor Study

STUDY AREA

The ISATe analysis limits for the Minnesota Avenue Corridor Study focus on the I-229 ramps, the ramp terminals, and the arterial intersection of Minnesota Avenue and 49th Street. The arterial intersection was included in the analysis because some of the Build alternatives involve realigning the I-229 westbound off-ramp to 49th Street. The analysis limits for the Minnesota Avenue Corridor Study are shown in ***Figure 3***.

Figure 3: Minnesota Avenue Corridor ISATe Analysis Limits

Source: Google Earth, December 2016

ALTERNATIVES

The alternatives to be analyzed for the Minnesota Avenue Corridor Study are:

- Minn-NB
    - No-Build Interchange Configuration and Corridor Configuration
- Minn-2C
    - Realigns SB exit ramp with 49th Street; full access with signal-control.
    - Constructs loop ramp for NB Minnesota Ave to SB I-229.
    - Provides dual left-turn lanes for all signalized entrance and exit ramps.

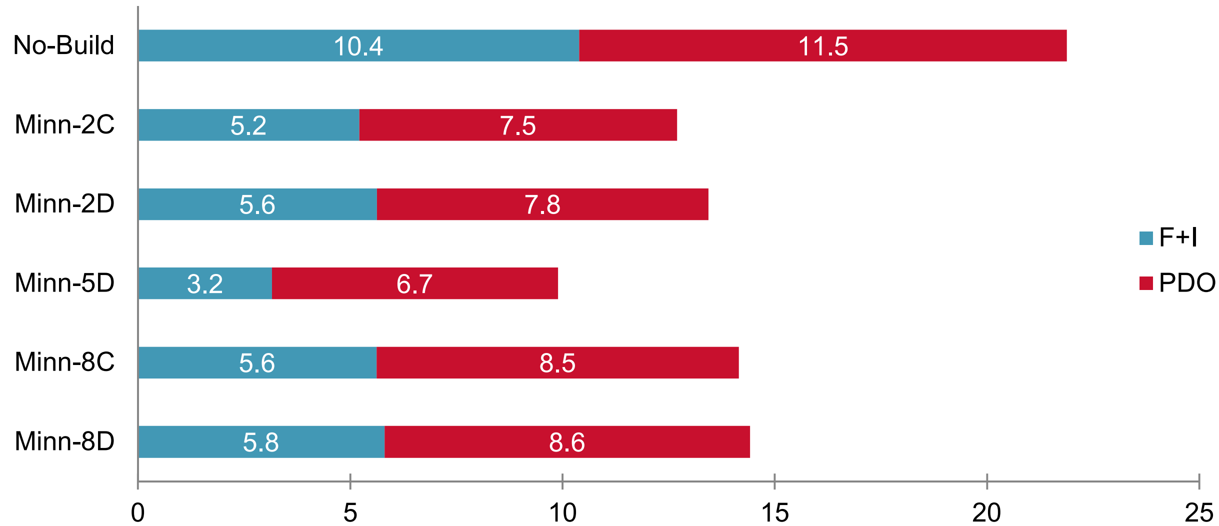
    - Increases separation between ramp terminal / 49th Street intersections.
    - Rebuilds Minnesota Avenue with a median and two lanes in each direction.
    - Third southbound lane added through 49th Street intersection.
- Minn-2D
    - Same as Minn-2C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-5D
    - Replaces Diamond Interchange with Diverging Diamond Interchange (DDI) configuration.
- Minn-8C
    - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI) centered at existing interchange.
    - Provides dual-left turn lanes for all signalized entrance and exit ramps.
    - Incorporates full, signal-controlled access at 49th Street intersection.
    - Rebuilds Minnesota Avenue with a median and two lanes in each direction.
    - Third southbound lane added through 49th Street intersection.
- Minn-8D
    - Same as Minn-8C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-9D (Qualitative Analysis Only)
    - Same as Minn-8D except SB I-229 through and right-turn movements are provided direct connection to 49th Street.

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 4*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

The resulting total number of annual predicted crashes is lower for all the Build alternatives when compared to No-Build, with the DDI alternative expecting the least amount of crashes. The alternatives result in a 34-55% decrease in total crashes, with a 44-70% decrease in F+I crashes and 26-41% decrease in PDO crashes. Minn-9D is an alternative that was originally screened out prior to the concept refinement stage. As concept refinement progressed, Minn-9D was reconsidered and reinstated as a Build alternative. Shortly following the reinstatement of Minn-9D, the overall I-229 MIS entered into the final reporting stage of the project. The project team determined that a full crash prediction analysis of Minn-9D would not provide additional value to study recommendations. The project team's qualitative assessment of Minn-9D is that the concept would likely result in slightly fewer predicted crashes than Minn-8C and Minn-8D. That qualitative assessment is based on quantitative evaluation of very similar concepts at the Cliff Avenue interchange (Cliff-6 and Cliff-7).

Table 4: Minnesota Ave Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 5***.

Table 5: Minnesota Avenue Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 64,600,000	$ -
Minn-2C	$ 32,000,000	$ 32,600,000
Minn-2D	$ 34,400,000	$ 30,100,000
Minn-5D	$ 20,000,000	$ 44,600,000
Minn-8C	$ 34,500,000	$ 30,100,000
Minn-8D	$ 35,600,000	$ 29,000,000

[1]Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

10th Street Corridor Study

STUDY AREA

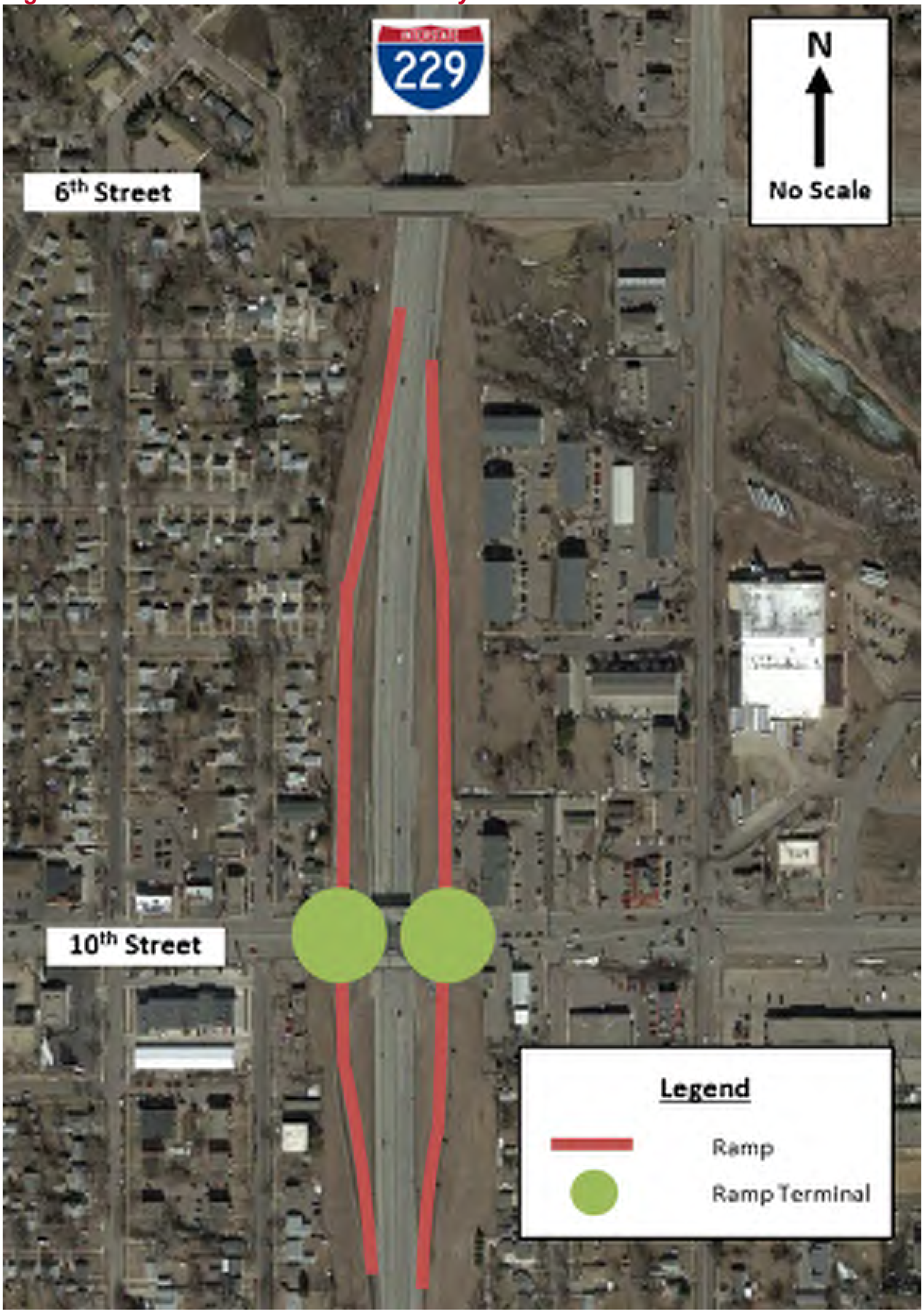
The ISATe analysis limits for the 10th Street Corridor Study focus on the I-229 ramps and the ramp terminals. For the Tight Split Diamond alternative, the proposed 6th Street ramp terminals were also included in the analysis. Because they are new intersections, no arterial intersection was included for the other alternatives. The analysis limits for the 10th Street Corridor Study are shown in ***Figure 4***.

ALTERNATIVES

The alternatives to be analyzed for the 10th Street Corridor Study are:

- 10th-NB
    - No-Build Interchange Configuration and Corridor Configuration

Figure 4: 10th Street Corridor ISATe Analysis Limits



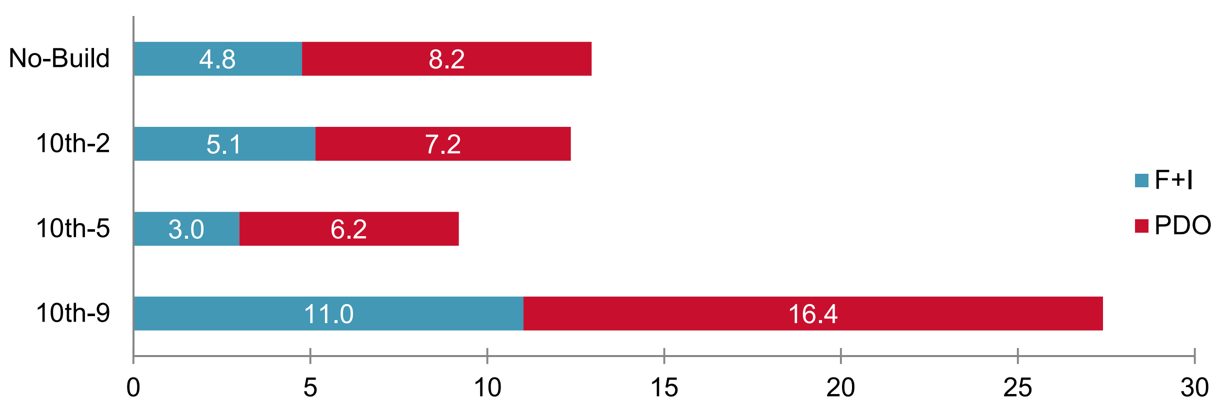
Source: Google Earth, December 2016

- 10th-2
  - Perpetuates Single Point Urban Interchange (SPUI) configuration.
  - Provides dual left-turn lanes for all entrance and exit ramps.
  - Rebuilds 10th Street with a median and three lanes in each direction through the interchange.
- 10th-5
  - Replaces Single Point Urban Interchange (SPUI) configuration with Diverging Diamond Interchange (DDI) configuration.
  - Eliminates left-turn movements on 10th Street by crossing 10th Street traffic to the left side between the ramp terminal intersections.
  - Rebuilds 10th Street with a median and three lanes in each direction through the interchange.
- 10th-9
  - Replaces Single Point Urban Interchange (SPUI) configuration with Tight Split Diamond Interchange (TSD) configuration with I-229 ramp connections to both 10th Street and 6th Street.
  - Provides dual left-turn lanes for all entrance and exit ramps except the NB entrance ramp.
  - Adds traffic signals at new ramp intersections with 6th Street.
- 10th-Var (Qualitative Analysis Only)
  - Unconstrained SB Entrance & NB Exit Ramps

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 6*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 6: 10th Street Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is 5% less for the SPUI alternative, 29% less for the DDI alternative, and 131% more for TSD alternative. Even though the total number of crashes is less for the SPUI alternative, the F+I crashes is slightly higher. The cost for an F+I crash is high so this results in a negative cost savings, which is shown below in ***Table 7***. 10th-9 results in a significant increase in crashes because the Tight Split Diamond alternative adds more exposure and conflict points from the addition of two new ramp terminals at 6th Street and two new collector-distributor roads between 10th Street and 6th Street. The 10th-Var concept would add a minor amount of crashes to 10th-2 and 10th-5 mainly due to added exposure from additional ramp length.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 7***.

Table 7: 10th Street Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 30,000,000	$ -
10th-2	$ 31,900,000	$ (2,000,000)
10th-5	$ 19,100,000	$ 10,900,000
10th-9	$ 67,800,000	$ (37,900,000)

[1]Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Benson Road Corridor Study

STUDY AREA

The ISATe analysis limits for the Benson Road Corridor Study focus on the I-229 ramps and the ramp terminals. The analysis limits for the Benson Road Corridor Study are shown in ***Figure 5***.

ALTERNATIVES

The alternatives to be analyzed for the Benson Road Corridor Study are:

- Benson-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Benson-1A
  - 30 MPH 2-lane loop for NB I-229 to WB Benson Road.
  - Realign I-229 NB off ramp.
  - Dual right-turn lane and free right-turn movement for EB Benson Road to SB I-229.
  - Raised median on Benson Road with left-turn lanes.
- Benson-1B
  - Same as Benson-1A except single (instead of dual) right-turn lane and free right-turn movement for EB Benson Road to SB I-229.

Figure 5: Benson Road Corridor ISATe Analysis Limits

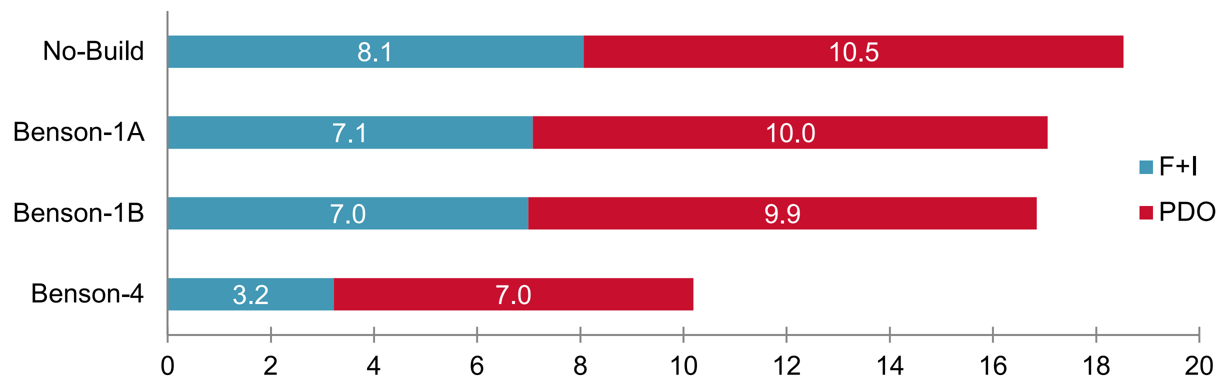
Source: Google Earth, December 2016

- Benson-4
  - Diverging Diamond Interchange (DDI) configuration.
  - Realign W I-229 ramps to maximize separation distance to Potsdam Avenue.
  - Right-turn lane and 2-lane free right-turn movement for EB Benson Road to SB I-229.

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 8*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 8: Benson Road Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is 8-9% less for the loop ramp alternatives and 45% less for the DDI alternative. The resulting annual PDO crashes is 5-6% less for the loop ramp alternatives and 33% less for the DDI alternative. The biggest safety benefit is in the F+I crashes, which is 12-13% less for the loop ramp alternatives and 60% less for the DDI alternative.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 9***.

Table 9: Benson Road Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 47,400,000	$ -
Benson-1A	$ 41,600,000	$ 5,800,000
Benson-1B	$ 41,000,000	$ 6,300,000
Benson-4	$ 19,500,000	$ 27,800,000

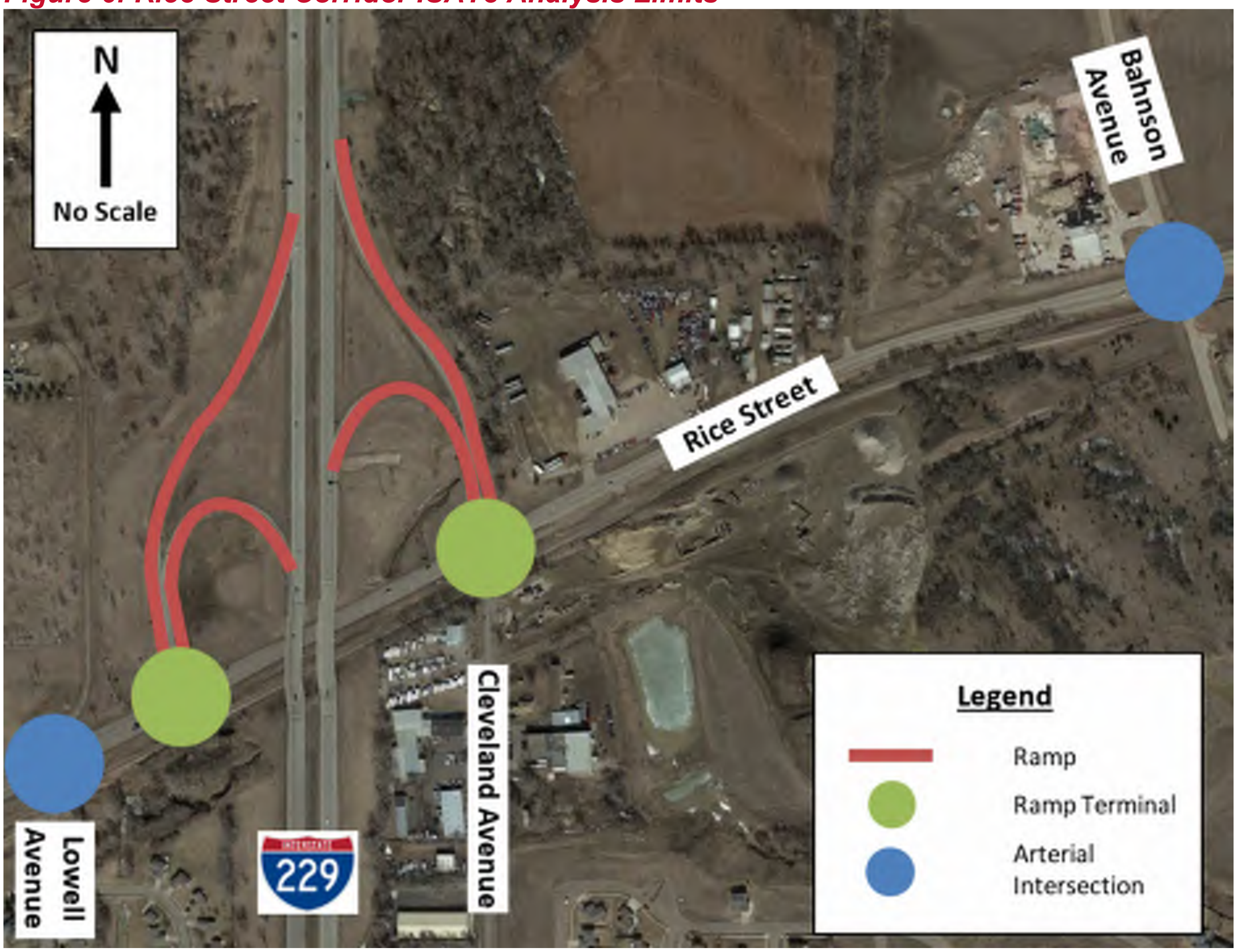
[1]Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Rice Street Corridor Study

STUDY AREA

The ISATe analysis limits for the Rice Street Corridor Study focus on the I-229 ramps, the ramp terminals, and the arterial intersections of Rice Street/Bahnson Avenue and Rice Street/Lowell Avenue. The arterial intersections were included in the analysis because Rice-3C involves realigning Cleveland Avenue to Bahnson Avenue and the I-229 SB Ramps to Lowell Avenue. The analysis limits for the Rice Street Corridor Study are shown in ***Figure 6***.

Figure 6: Rice Street Corridor ISATe Analysis Limits



Source: Google Earth, December 2016

ALTERNATIVES

The alternatives to be analyzed for the Rice Street Corridor Study are:

- Rice-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Rice-2
  - Perpetuates Folded Diamond Interchange configuration.

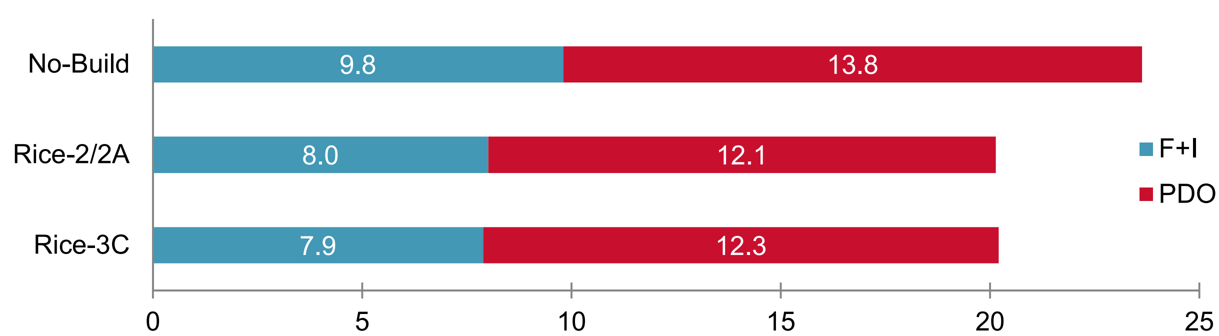
- o Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
  - o Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Rice-2A
  - o Same as Rice-2 except shifts and rebuilds Rice Street north of its current alignment to avoid impacts to BNSF Railroad Right-of-Way.
- Rice-3C
  - o Replaces Folded Diamond Interchange with an improved geometrics Folded Diamond Interchange configuration.
  - o Aligns SB I-229 ramps with Lowell Avenue and improves geometrics at NB I-229 ramps.
  - o Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
  - o Separates conflicting traffic movements at Cleveland Avenue and the NB I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left-turn lane and two lanes in each direction.
  - o Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
  - o Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersections.

Rice-2 and Rice-2A are treated the same for the predictive safety analysis because they comprise of the same cross section. The only difference between the two alternatives is that Rice-2A is shifted to the north.

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 10*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 10: Rice Street Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is lower for all the Build alternatives. The Build alternatives result in a 14-15% decrease in total crashes, an 11-12% decrease in PDO crashes, and an 18-20% decrease in F+I crashes. It should be noted that the results for Rice-3C do not take into effect the safety benefit of removing two railroad at-grade crossings that result from realigning Cleveland Avenue to Bahnson Avenue. Analysis of the Rice-3C option also does not include an estimate of the change in crashes on Rice Street and Cleveland Avenue due to the significant increase in travel distance between Cleveland Avenue and the Northbound I-229 ramps.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 11***.

Table 11: Rice Street Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 58,700,000	$ -
Rice-2/2A	$ 48,300,000	$ 10,400,000
Rice-3c	$ 47,900,000	$ 10,800,000

[1]Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Cliff Avenue Corridor Study

STUDY AREA

The ISATe analysis limits for the Cliff Avenue Corridor Study focus on the I-229 ramps, the ramp terminals, and the arterial intersection of Cliff Avenue and 41st Street. 41st Street is aligned with the I-229 southbound off-ramp for all the alternatives except Cliff-6. 41st Street is realigned to Pam Road in Cliff-6 so Cliff Avenue and 41st Street is analyzed as an arterial intersection. For the other alternatives, 41st Street is analyzed in ISATe as a non-ramp public street leg that is present at the north ramp terminal. The intersection of Cliff Avenue and Pam Road was not analyzed because the existing number of crashes is very low. Therefore, the predicted crashes for this intersection would be negligible. The analysis limits for the Cliff Avenue Corridor Study are shown in ***Figure 7***.

ALTERNATIVES

The alternatives to be analyzed for the Cliff Avenue Corridor Study are:

- Cliff-NB
    - No-Build Interchange Configuration and Corridor Configuration
- Cliff-1
    - Adds a loop on ramp from NB Cliff Avenue to SB I-229.
    - Realigns SB Cliff Avenue to SB I-229 directional ramp.
    - Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/SB I-229 off ramp terminal intersection.

Figure 7: Cliff Avenue Corridor ISATe Analysis Limits

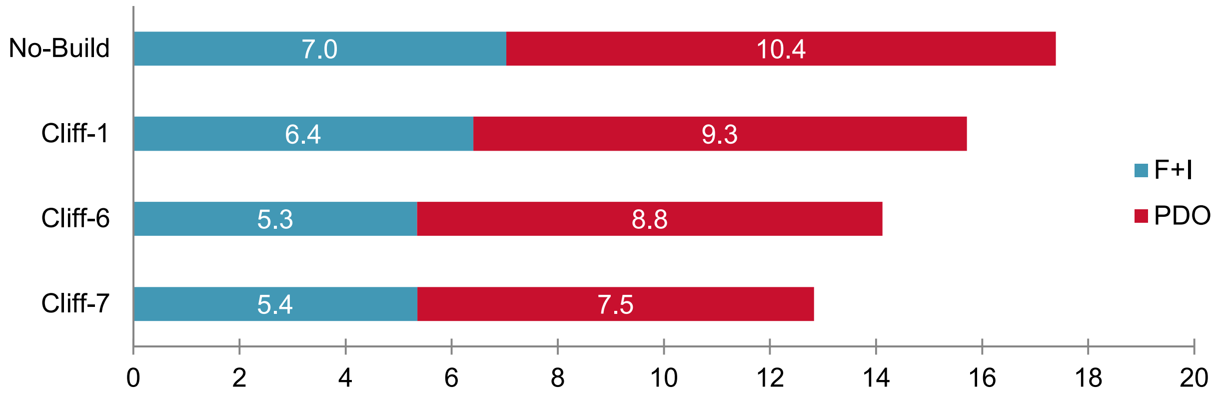
Source: Google Earth, December 2016

- Cliff-6
    - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI)
    - Rebuilds Cliff Avenue with a median and two lanes in each direction.
    - Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
- Cliff-7
    - Same as Cliff-6 except SB I-229 through and right movements utilize existing intersection location at Cliff Avenue.

BUILD AND NO-BUILD CRASH FREQUENCY COMPARISON

The predicted annual crash frequencies for the No-Build and Build alternatives (2012 to 2035) are presented in ***Table 12*** along with the breakdown of Fatal + Injury (F+I) and Property Damage Only (PDO) crashes.

Table 12: Cliff Avenue Corridor 2012-2035 Predicted Build and No-Build Annual Crashes



The resulting total number of annual predicted crashes is lower for all the Build alternatives, with Cliff-7 showing the least amount of crashes. The Build alternatives result in a 10-26% decrease in total crashes, a 10-28% decrease in PDO crashes, and a 9-24% decrease in F+I crashes.

Planning horizon crash cost savings were calculated for the Build alternatives and are shown in ***Table 13***.

Table 13: Cliff Avenue Corridor Planning Horizon Crash Cost Savings

Alternative	Total User Cost[1]	User Cost Savings[2]
No-Build	$ 42,900,000	$ -
Cliff-1	$ 39,100,000	$ 3,800,000
Cliff-6	$ 32,900,000	$ 10,100,000
Cliff-7	$ 32,600,000	$ 10,400,000

[1]Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all years in the period 2012-2035 (rounded to $100,000).

Conclusions

Based on the preceding HSM analysis, the following conclusions can be drawn for the entire I-229 MIS study:

- Crashes predicted for each location along I-229 increase for the No-Build (Year 2035) condition compared to the Existing (Year 2012) condition because of the increase in traffic volume. Notably, the I-229 interchange areas experience higher levels of existing crashes than the connecting freeway segments.
- For the I-229 Corridor Study, both Build alternatives decrease the total number of crashes. However, the fatal and injury crashes increase slightly so there is an increase in user cost.
- For the 10th Street Corridor Study, the SPUI and DDI alternatives decrease the total number of crashes. However, the fatal and injury crashes increase slightly for the SPUI alternative so there is an increase in user cost. The Tight Split

Diamond alternative increases the total number of crashes 131% because it adds two new ramp terminals at 6th Street and two new collector-distributor roads between 10th Street and 6th Street.

- For the remaining corridor studies (Minnesota Avenue, Benson Road, Rice Street, Cliff Avenue), all Build alternatives decrease crashes compared to their respective No-Build alternatives.
- If the alternatives with the highest safety benefit for all sub-studies were chosen, the entire I-229 corridor would see approximately $104 million in user cost savings.

The safety evaluation, along with traffic operations, environmental impacts, property impacts, and construction and right-of-way cost, helped select alternatives and prioritize the phasing of each sub-study.

Appendix K. Year of Failure Analysis

*This technical memorandum documents the Year of Failure analysis for the I-229 Major Investment Study (MIS), serving as part of the overall documentation for the I-229 MIS project. The content provided in **Appendix E1. Traffic Capacity Analysis Methodologies** should be referenced to supplement the content in this memorandum.*

The purpose of the I-229 MIS is to develop a comprehensive plan for improvements needed along I-229, its interchanges, and its cross streets through a horizon year of 2035. While proposed improvement projects recommended by the study were designed to meet operational and design criteria by 2035, elements of existing and proposed corridor infrastructure have service lives beyond 20-30 years after initial construction. The year of failure analysis is one type of analysis that considers conditions beyond the horizon year.

A year of failure analysis helps decision makers roughly assess how long after the design or horizon year a proposed interchange design will operate acceptably. The longer the interchange operates sufficiently, the longer down the road the interchange will have prior to additional investments to deal with future capacity constraints.

This memorandum presents a summary of the methodology and findings for the year of failure analysis for the No-Build and Build alternatives for the I-229 MIS. The Build alternatives to be analyzed for this study will be described later in this memorandum. The results are intended to help guide the selection of the alternatives moving forward to the alternatives analysis stage of planning.

Study Area

The I-229 MIS has been separated into individual sub-studies. The sub-studies include:

- I-229 Corridor Study
- Minnesota Avenue Corridor Study (Exit 3)
- 10th Street Corridor Study (Exit 6)
- Benson Road Corridor Study (Exit 9)
- Rice Street Corridor Study (Exit 7)
- Cliff Avenue Corridor Study (Exit 4)

A map illustrating the overall study areas for each of the sub-studies is shown in ***Figure 1***. For the year of failure analysis, the area of study was reduced to the interchanges. For the I-229 Corridor Study, the year of failure analysis limits focus on two interchanges that do not have their own sub-study: Louise Avenue and Western Avenue. The remaining sub-studies, focus on their respective interchanges. The analysis does not include identifying year of failure for I-229 freeway segments. The first signalized intersection beyond each interchange ramp terminal was also included to model the arrival flow profile approaching the ramp terminal intersections.

Methodology

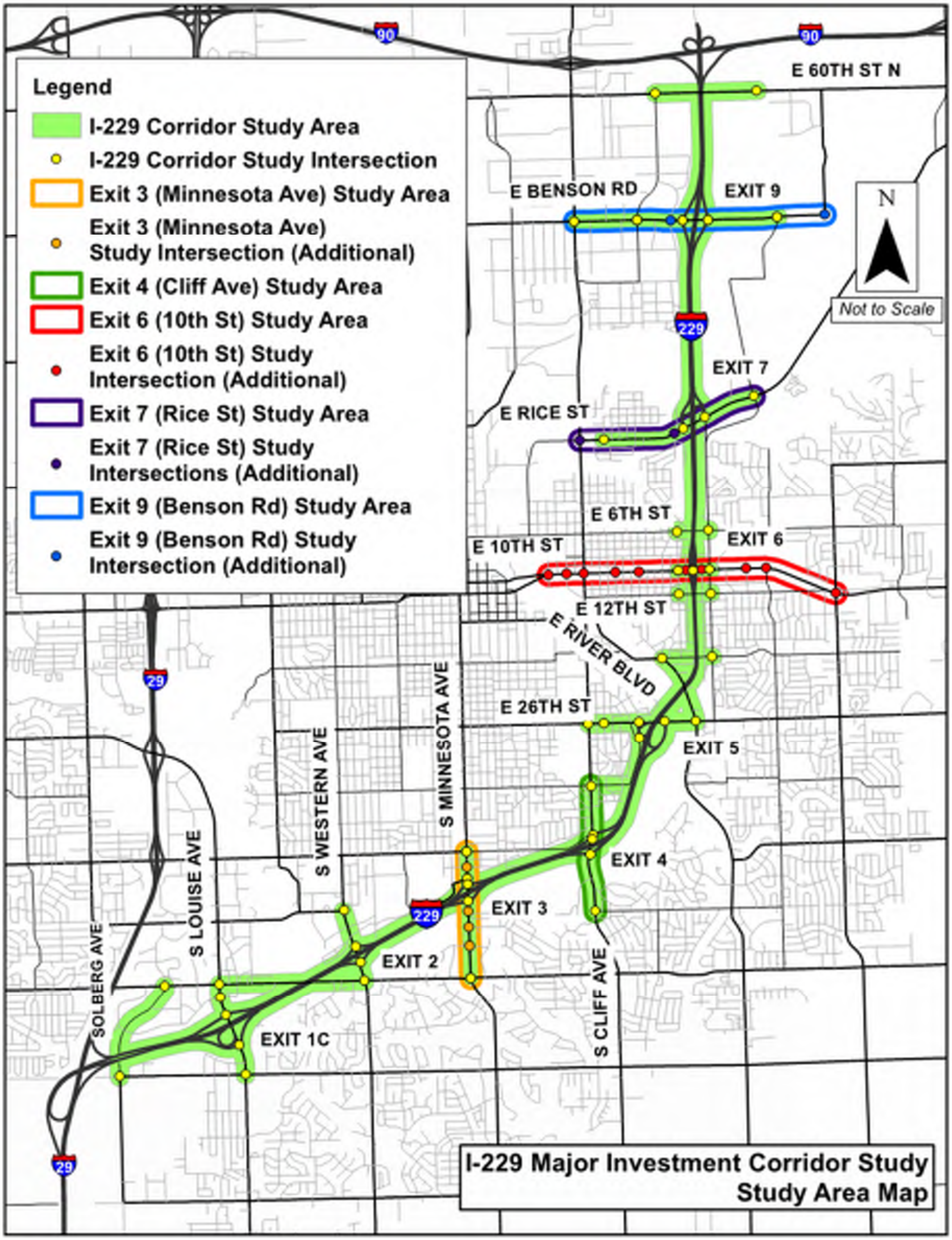
Volume Development

Traffic volumes were developed for the AM and PM peak hours on each cross street and each intersection within the study area until year of failure was identified. Volumes were developed for up to 30 years beyond the project future/design year (Year 2035) and at 5-year increments. The volumes beyond 2035 were linearly extrapolated using existing year (Year 2012) and future year (Year 2035) volumes. The traffic volume data was based on traffic counts provided by SDDOT and design year volume forecasts from the 2035 Sioux Falls Travel Demand Model.

Year of Failure Criteria

For the year of failure analysis, LOS 'D' was used as the worst allowable LOS for future year ramp terminal intersection operations. The interchange alternatives were considered failing when one of the ramp terminals was projected to operate at an average intersection LOS 'E' or 'F' or an intersection turning movement was projected to operate at LOS 'F'.

Figure 1. I-229 MIS Study Area Map



Analysis Results

I-229 Corridor Study

Alternatives

The alternatives to be analyzed for the I-229 Corridor Study are:

- Louise-NB
  - Louise No-Build Interchange
- Western-NB
  - Western No-Build Interchange

Year of Failure Results

The resulting year of failure for the I-229 Corridor Study alternatives is shown in ***Table 1***.

Table 1 – I-229 Corridor Year of Failure

Alternative	Year of Failure
Louise-NB	Beyond 2065
Western-NB	2040

Minnesota Avenue Corridor Study

Alternatives

The alternatives to be analyzed for the Minnesota Avenue Corridor Study are:

- Minn-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Minn-2C
  - Realigns SB exit ramp with 49th Street; full access with signal-control.
  - Constructs loop ramp for NB Minnesota Ave to SB I-229.
  - Provides dual left-turn lanes for all signalized entrance and exit ramps.
  - Increases separation between ramp terminal / 49th Street intersections.
  - Rebuilds Minnesota Avenue with a median and two lanes in each direction.
  - Third southbound lane added through 49th Street intersection.
- Minn-2D
  - Same as Minn-2C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-5D
  - Replaces Diamond Interchange with Diverging Diamond Interchange (DDI) configuration.

- Minn-8C
    - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI) centered at existing interchange.
    - Provides dual-left turn lanes for all signalized entrance and exit ramps.
    - Incorporates full, signal-controlled access at 49th Street intersection.
    - Rebuilds Minnesota Avenue with a median and two lanes in each direction.
    - Third southbound lane added through 49th Street intersection.
- Minn-8D
    - Same as Minn-8C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-9D
    - Same as Minn-8D except SB I-229 through and right-turn movements are provided direct connection to 49th Street.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 2***.

Table 2 – Minnesota Avenue Corridor Year of Failure

Alternative	Year of Failure
Minn-NB	Earlier than 2035
Minn-2C	2045
Minn-2D	2045
Minn-5D	2060
Minn-8C	2040
Minn-8D	2060
Minn-9D	2045

10th Street Corridor Study

Alternatives

The alternatives to be analyzed for the 10th Street Corridor Study are:

- 10th-NB
    - No-Build Interchange Configuration and Corridor Configuration
- 10th-2
    - Perpetuates Single Point Urban Interchange (SPUI) configuration.
    - Provides dual left-turn lanes for all entrance and exit ramps.
    - Rebuilds 10th Street with a median and three lanes in each direction through the interchange.

- 10^{th}-5
  - Replaces Single Point Urban Interchange (SPUI) configuration with Diverging Diamond Interchange (DDI) configuration.
  - Eliminates left-turn movements on 10^{th} Street by crossing 10^{th} Street traffic to the left side between the ramp terminal intersections.
  - Rebuilds 10th Street with a median and three lanes in each direction through the interchange.
- 10^{th}-9
  - Replaces Single Point Urban Interchange (SPUI) configuration with Tight Split Diamond Interchange (TSD) configuration with I-229 ramp connections to both 10^{th} Street and 6^{th} Street.
  - Provides dual left-turn lanes for all entrance and exit ramps except the NB entrance ramp.
  - Adds traffic signals at new ramp intersections with 6^{th} Street.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 3***.

Table 3 – 10^{th} Street Corridor Year of Failure

Alternative	Year of Failure
10th-NB	Earlier than 2035
10^{th}-2	Beyond 2065
10^{th}-5	Beyond 2065
10^{th}-9	Beyond 2065

Benson Road Corridor Study

Alternatives

The alternatives to be analyzed for the Benson Road Corridor Study are:

- Benson-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Benson-1A
  - 30 MPH 2-lane loop for NB I-229 to WB Benson Road.
  - Realign I-229 NB off ramp.
  - Dual right-turn lane and free right-turn movement for EB Benson Road to SB I-229.
  - Raised median on Benson Road with left-turn lanes.
- Benson-1B
  - Same as Benson-1A except single (instead of dual) right-turn lane and free right-turn movement for EB Benson Road to SB I-229.

- Benson-4
  - Diverging Diamond Interchange (DDI) configuration.
  - Realign W I-229 ramps to maximize separation distance to Potsdam Avenue.
  - Right-turn lane and 2-lane free right-turn movement for EB Benson Road to SB I-229.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 4***.

Table 4 – Benson Road Corridor Year of Failure

Alternative	Year of Failure
Benson-NB	Earlier than 2035
Benson-1A	2050
Benson-1B	2050
Benson-4	2045

Rice Street Corridor Study

Alternatives

The alternatives to be analyzed for the Rice Street Corridor Study are:

- Rice-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Rice-2
  - Perpetuates Folded Diamond Interchange configuration.
  - Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
  - Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
- Rice-2A
  - Same as Rice-2 except shifts and rebuilds Rice Street north of its current alignment to avoid impacts to BNSF Railroad Right-of-Way.
- Rice-3C
  - Replaces Folded Diamond Interchange with an improved geometrics Folded Diamond Interchange configuration.
  - Aligns SB I-229 ramps with Lowell Avenue and improves geometrics at NB I-229 ramps.
  - Rebuilds Rice Street with a median and three lanes in each direction through the interchange.

- Separates conflicting traffic movements at Cleveland Avenue and the NB I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left-turn lane and two lanes in each direction.
- Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
- Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersections.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 5***.

Table 5 – Rice Street Corridor Year of Failure

Alternative	Year of Failure
Rice-NB	Earlier than 2035
Rice-2	2045
Rice-2A	2045
Rice-3C	2045

Cliff Avenue Corridor Study

Alternatives

The alternatives to be analyzed for the Cliff Avenue Corridor Study are:

- Cliff-NB
  - No-Build Interchange Configuration and Corridor Configuration
- Cliff-1
  - Adds a loop on ramp from NB Cliff Avenue to SB I-229.
  - Realigns SB Cliff Avenue to SB I-229 directional ramp.
  - Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/SB I-229 off ramp terminal intersection.
- Cliff-6
  - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI)
  - Rebuilds Cliff Avenue with a median and two lanes in each direction.
  - Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
- Cliff-7
  - Same as Cliff-6 except SB I-229 through and right movements utilize existing intersection location at Cliff Avenue.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 6***.

Table 6 – Cliff Avenue Corridor Year of Failure

Alternative	Year of Failure
Cliff-NB	Earlier than 2035
Cliff-1	2050
Cliff-6	2055
Cliff-7	2045

Conclusion

The year of failure analysis, along with safety impacts, environmental impacts, property impacts, construction and right-of-way cost, and other traffic operations, helped screen alternatives and prioritize the phasing of each sub-study. Between the two interchanges in the I-229 Corridor Study (Louise Avenue and Western Avenue), Western Avenue is the next interchange after 2035 that will need to be addressed for operational issues.

APPENDIX L -

SUB-STUDY 1 NOISE STUDY TECHNICAL REPORT

Noise Study Technical Report

I-229 Major Investment Corridor Study

Sub-Study #1

Sioux Falls, South Dakota

HDR Project Number: 207030

March 2016

I-229 Major Investment Corridor Study (Sub-Study #1)

NOISE STUDY TECHNICAL REPORT

EXECUTIVE SUMMARY

The South Dakota Department of Transportation (SDDOT) initiated this study in order to address the current and future transportation needs along the entire I-229 corridor (the Project). Sub-Study #1 assesses existing and future conditions along the entire I-229 corridor, service interchanges, and crossroads, assesses the impact on the transportation system, determines feasible solutions to those impacts, and prioritizes a list of recommendations that will maximize the efficiency of the corridor. Six (6) Build Alternatives were evaluated as part of Sub-Study #1.

On behalf of SDDOT, and as part of the environmental documentation, HDR Engineering, Inc. (HDR) performed a traffic noise analysis along the I-229 corridor's area of influence for the proposed improvements. The analysis included traffic noise monitoring and modeling. HDR used the FHWA Traffic Noise Model (TNM), Version 2.5, to evaluate projected traffic noise levels under both the "Build" and "Existing" alternatives. Traffic noise impacts were identified in accordance with SDDOT Noise Analysis and Abatement Guidance (July 13, 2011). In areas where future noise levels exceed state and federal criteria, the conceptual feasibility of noise mitigation options are discussed.

Noise levels were evaluated for the existing conditions and future Build Alternatives C1, C2, Cliff-1, Cliff-2, Cliff-3, and Rice-1 at 2,194 receptors in the Project area. There are 271 impacts predicted under the Existing Alternative, 452 impacts predicted under Future Build Alternatives C1 and C2, and 437 impacts predicted under Future Build Alternatives Cliff-1, Cliff-2, Cliff-3, and Rice-1.

Table of Contents

1. Introduction

The South Dakota Department of Transportation (SDDOT) initiated this study in order to address the current and future transportation needs along the entire I-229 corridor (the Project). Sub-Study 1 assesses existing and future conditions along the entire I-229 corridor, service interchanges, and crossroads, assesses the impact on the transportation system, determines feasible solutions to those impacts, and prioritizes a list of recommendations that will maximize the efficiency of the corridor. Figure 1 shows the project area.

The study fulfills the following objectives:

1. Complete a traffic level of service analysis for both existing and future (2035) no-build conditions on the I-229 mainline, select interchanges and crossroads.
2. Complete a safety analysis of I-229 mainline, interchanges and crossroads.
3. Identify locations on I-229 not in compliance with current design standards under both the current and forecasted future traffic conditions.
4. Determine the effects of incidents on traffic operations within the I-229 corridor's area of influence.
5. Develop a long range plan consisting of feasible solutions to address the portions of the Interstate System that fail to meet current design standards, traffic level of service expectations, and/or have identifiable safety concerns under both the current and forecasted future traffic conditions.
6. Create final products for use by the SDDOT which will guide the Department in the implementation of recommended improvements that will maximize the efficiency of the system.

Six (6) Build Alternatives were evaluated as part of Sub-Study #1.

1. **C1**: 6-Lanes, from 26th Street to 10th Street
2. **C2**: 6-Lanes, from 26th Street to 10th Street + 65mph Improved Curves
3. **Cliff-1**: NB Cliff to SB I-229 Loop ramp auxiliary lane add
4. **Cliff-2**: NB/SB Cliff to SB I-229 Loop ramp, eliminate SB diagonal ramp
5. **Cliff-3**: SB Cliff Ave auxiliary lane from 41st St to SB I-229 ramp
6. **Rice-1**: NB Rice exit ramp terminal lane additions

HDR Engineering, Inc. (HDR) performed a highway traffic noise analysis for SDDOT in support of the Project, as part of the environmental documentation. The analysis is based on the SDDOT Noise Analysis and Abatement Guidance (July 13, 2011). Where projected traffic noise levels approach or exceed the SDDOT Noise Abatement Criteria (NAC), the conceptual feasibility of noise mitigation options are discussed. Results of the analysis are presented in this report.

2.Nature of Noise

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities, such as sleep, work, speech, or recreation. Vehicle noise is a combination of the noise produced by the engine, exhaust, and tires. Noise levels from highway traffic are affected by three factors: (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, traffic noise increases commensurate with these three factors.

Noise is measured in decibels (dB) – a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, certain frequencies are given more "weight." The A-weighted scale corresponds to the sensitivity range for human hearing. Therefore, noise levels are measured in dBA, the A-weighted sound level in decibels. When noise levels change 3-dBA, the change is considered barely perceptible to human hearing. However, a 5-dBA change in noise level is clearly noticeable. A 10-dBA change in noise levels is perceived as a doubling or halving of noise loudness, while a 20-dBA change is considered a dramatic change in loudness. Table 1 shows noise levels associated with common, everyday sources and helps the reader more fully understand the magnitude of noise levels discussed in this report.

Table 1: Common Noise Sources and Levels

Sound Pressure Level (dB)	Typical Sources
120	Jet aircraft takeoff at 100 feet
110	Same aircraft at 400 feet
90	Motorcycle at 400 feet
80	Garbage disposal
70	City street corner
60	Conversational speech
50	Typical office
40	Living room (without TV)
30	Quiet bedroom at night

Source: Environmental Impact Assessment Handbook, ed. by Rau and Wooten, 1980

Figure 1: Project Location

3. SDDOT Noise Analysis and Abatement Guidance

The updated (July 13, 2011) SDDOT Noise Analysis and Abatement Guidance (Guidance), upon which this analysis is based, is intended to supplement FHWA traffic noise and abatement regulations and guidance. The Guidance provides procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria, and to establish requirements for traffic noise information to be given to those officials who have planning and zoning authority.

The Guidance contains noise abatement criteria that are based on the Leq(h), which is used to analyze traffic noise levels and identify noise impacts. The Leq is defined as the equivalent, steady-state sound level that, in a stated period of time, contains the same acoustic energy as the time-varying sound level during the same period. Therefore, for the purposes of this analysis, Leq can be considered the average sound level and Leq(h) can be considered the average sound level occurring over a one-hour time period. It is representative of the overall (average) traffic-generated noise level expressed on an hourly basis.

Land uses are assigned to an activity category based on the type of activities occurring in each area (i.e. picnic areas, churches, commercial land, and undeveloped land). Activity Categories are then ordered based on their sensitivity to traffic noise levels. NAC are assigned to each Activity Category. These NAC represent the maximum traffic noise levels that allow uninterrupted land use within each Activity Category. Table 2 summarizes noise abatement criteria corresponding to various land use activity categories. Activity categories and related traffic noise impacts are determined based on the actual land use in a given area.

Table 2: Noise Abatement Criteria

23 CFR 772 Noise Abatement Criteria [Hourly A-Weighted Sound Level, decibels (dBA)]			
Activity Category	**Leq(h)**	**Evaluation Location**	**Activity Description**
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve as an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	Exterior	Residential
C	67	Exterior	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools television studios, trails and trail crossings
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recordings studios, schools, and television studios.
E	72	Exterior	Hotels, motels, office, restaurant/bars, and other developed lands, properties or activities not included in A-D or F.
F	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical) and warehousing
G	--	--	Undeveloped lands that are not permitted

Highway traffic noise impacts occur when the predicted traffic noise levels for the design year approach (reach 1 decibel less than) or exceed the NAC contained in 23 CFR 772 (Table 2), or when the predicted traffic noise levels substantially exceed the existing noise levels by 15 dBA, even though the predicted levels may not exceed the NAC.

4. Noise Prediction Method

Existing and future “Build” traffic noise levels were determined by using the FHWA Traffic Noise Model (TNM), Version 2.5. Basic model inputs are:

- Existing and Preliminary project concept and geometry
- 2012 and 2035 traffic volumes in the Project Area (**Error! Reference source not found.** A)
- The operational speed for I-229: 65 miles per hour (mph); arterial streets: 30-45 mph

The traffic volume used for this analysis is the AM Peak Hourly Volume (PHV) traffic. Traffic was provided in a February 2015 HDR Technical Memo. Traffic volumes for the future “Build” condition were assumed to be the same as the future “No-Build” volumes.

5. Adjacent Land Use

Two-thousand one-hundred ninety-four (2,194) receptors were identified in the project area. The I-229 corridor is located east of I-29 in the Sioux Falls metropolitan area. The mainline interstate study limits include a 10.5 mile section from the Solberg Avenue overpass (currently under construction) to the 60th Street North overpass. Eight service interchanges are located on I-229 within the study area, including:

- Exit 1: Louise Avenue
- Exit 2: Western Avenue
- Exit 3: Minnesota Avenue
- Exit 4: Cliff Avenue
- Exit 5: 26th Street
- Exit 6: 10th Street
- Exit 7: Rice Street
- Exit 9: Benson Road

A subset of the arterial street network that connects to the I-229 corridor is included in the study area as well, including the following crossroad corridors:

- Solberg Avenue from 69th Street to 57th Street
- Louise Avenue from 69th Street to 57th Street
- 57th Street from Louise Avenue to Western Avenue
- Western Avenue from 57th Street to 49th Street
- Minnesota Avenue from 57th Street to 41st Street
- Cliff Avenue from 49th Street to 33rd Street
- 26th Street from Cliff Avenue to Southeastern Drive
- 33rd Street from Cliff Avenue to Yeager Road
- Yeager Road from 33rd Street to 26th Street
- Southeastern Avenue from 18th Street to 26th Street
- 18th Street from Southeastern Drive to Cleveland Avenue
- 12th Street from Lowell Avenue to Cleveland Avenue
- 10th Street from Jessica Avenue to Bahnson Avenue
- 6th Street from Lowell Avenue to Cleveland Avenue
- Rice Street from Wayland Avenue to Bahnson Avenue
- Benson Road from Cliff Avenue to Sycamore Avenue
- 60th Street North from Lewis Avenue to Bahnson Avenue (Proposed)

Land use immediately adjacent to this Project is a combination of commercial/retail and residential. If no exterior areas of frequent human use are present at the commercial/retail locations, no further noise analysis is required. Figure 1 Appendix B provide an aerial view of the project area.

6.Model Validation

Existing traffic noise levels were measured in the field and then compared against computer modeling results to verify the accuracy of the computer model. When modeled and measured levels are within + or – 3 dBA of one another, this indicates that the model is within the accepted level of accuracy.

6.1. Field Testing Procedure

On November 2, 2015, HDR staff measured traffic noise levels at representative sites throughout the project corridor. Traffic noise measurements were conducted in accordance with the FHWA-PD-96-046 Measurement of Highway Related Noise (May 1996). The average meteorological conditions were reported as shown in Table 3 below.

Table 3: Meteorological Conditions

Temperature	≅ 56-67 °F
Humidity	≅ 52-69%
Wind	< 12 mph
Conditions	Partly Cloudy
Barometric Pressure	≅ 29.81 inches

6.2. Instrumentation

Traffic noise monitoring was conducted using a Larson Davis 824 Sound Level Meter (SLM). The meter was set at a height of approximately 5 feet for all measurements. The microphone was covered with a windscreen. Table 4 summarizes the instruments used to collect the data for this noise analysis report.

Table 4: Noise Analysis Instrumentation Summary

Instrument	Make	Model	Serial Number
Sound Analyzer 1	Larson Davis	824	824A2636
Calibrator	Larson Davis	CAL200	3722

6.3. Field Measurement Methods

The SLM was programmed to compute the Leq(h). The following procedures were used for noise monitoring:

- The duration of the Leq(h) measurements was 15 minutes.
- The SLM was calibrated before and after monitoring. No significant calibration drifts were detected.
- The microphone was mounted on a tripod 5 feet above the ground.
- The microphone was covered with a windscreen.

6.4. Field Measurement Locations

Table 5 describes the locations of each of the validation sites throughout the project corridor.

Table 5: Noise Validation Location Summary

Measurement Location	Description
A	≈ 53' south of E 60th Street N
B	≈ 42' north of E Benson Road
C	≈ 195' west of I-229
D	≈ 335' west of I-229
E	≈ 30' south of E Rice Street
F	≈ 170' east of I-229
G	≈ 315' north of E 10th Street
H	≈ 90' east of I-229
I	≈ 75' north of E 26th Street
J	≈ 225' west of I-229
K	≈ 35' of S Cliff Ave
L	≈ 130' east of S Minnesota Ave
M	≈ 180' south of I-229
N	≈ 40' north of W 57th Street
O	≈ 70' east of S Solberg Avenue

Validation locations are shown in Appendix B, and are within 30 to 335 feet of the nearest roadway outside lane.

6.5. Model Validation Results

The measured and modeled noise levels for each of the monitoring sites selected along the project corridor are presented in

Table 6. Each set of predicted and measured data was found to be within the acceptable + or – 3 dBA tolerance; therefore, the model is considered to be validated.

Table 6: Model Validation Results

Measurement Location	Leq(h)(dBA) Measured	Modeled	Difference
A	64.7	63.5	-1.2
B	65.8	65.1	-0.7
C	63.8	61.1	-2.7
D	62.5	59.7	-2.8
E	69.1	66.2	-2.9
F	64.9	64.1	-0.8
G	56.2	53.4	-2.8
H	70.4	68.5	-1.9
I	61.5	61.1	-0.4
J	64.7	62.0	-2.7
K	66.2	63.6	-2.6
L	62.8	60.2	-2.6
M	63.6	65.1	+1.5
N	64.9	67.2	+2.3
O	54.9	52.0	-2.9

7. Traffic Noise Prediction

HDR used the FHWA TNM, Version 2.5, to evaluate future traffic noise levels at noise sensitive receptors within the limits of the Project. The predicted traffic noise levels reflect the elevation differences and the proposed roadway alignment in relation to the noise-sensitive sites. Table 7 lists the NAC, existing Leq(h), and the future (2035) predicted Leq(h) for both the “Existing” and “Build” alternatives.

Noise receptor locations are shown in Appendix B.

Table 7: Predicted Noise Levels at Receptors

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1	B	66	52.7	55.3	55.3	55.3	55.3	55.3	55.3	2.6	2.6	2.6	2.6	2.6	2.6
2	B	66	51.9	54.3	54.3	54.3	54.3	54.3	54.3	2.4	2.4	2.4	2.4	2.4	2.4
3	B	66	51.6	54.0	54.0	54.0	54.0	54.0	54.0	2.4	2.4	2.4	2.4	2.4	2.4
4	B	66	51.3	53.5	53.5	53.5	53.5	53.5	53.5	2.2	2.2	2.2	2.2	2.2	2.2
5	B	66	51.0	53.1	53.1	53.1	53.1	53.1	53.1	2.1	2.1	2.1	2.1	2.1	2.1
6	B	66	50.7	52.7	52.7	52.7	52.7	52.7	52.7	2.0	2.0	2.0	2.0	2.0	2.0
7	B	66	50.5	52.5	52.5	52.5	52.5	52.5	52.5	2.0	2.0	2.0	2.0	2.0	2.0
8	B	66	52.1	54.6	54.6	54.6	54.6	54.6	54.6	2.5	2.5	2.5	2.5	2.5	2.5
9	B	66	51.8	54.2	54.2	54.2	54.2	54.2	54.2	2.4	2.4	2.4	2.4	2.4	2.4
10	B	66	51.4	53.8	53.8	53.8	53.8	53.8	53.8	2.4	2.4	2.4	2.4	2.4	2.4
11	B	66	51.1	53.2	53.2	53.2	53.2	53.2	53.2	2.1	2.1	2.1	2.1	2.1	2.1
12	B	66	50.7	52.7	52.7	52.7	52.7	52.7	52.7	2.0	2.0	2.0	2.0	2.0	2.0
13	B	66	50.6	52.6	52.6	52.6	52.6	52.6	52.6	2.0	2.0	2.0	2.0	2.0	2.0
14	B	66	52.6	55.2	55.2	55.2	55.2	55.2	55.2	2.6	2.6	2.6	2.6	2.6	2.6
15	B	66	52.4	54.8	54.8	54.8	54.8	54.8	54.8	2.4	2.4	2.4	2.4	2.4	2.4
16	B	66	52.1	54.4	54.4	54.4	54.4	54.4	54.4	2.3	2.3	2.3	2.3	2.3	2.3
17	B	66	51.5	53.6	53.6	53.6	53.6	53.6	53.6	2.1	2.1	2.1	2.1	2.1	2.1
18	B	66	51.2	53.3	53.3	53.3	53.3	53.3	53.3	2.1	2.1	2.1	2.1	2.1	2.1
19	B	66	51.0	53.0	53.0	53.0	53.0	53.0	53.0	2.0	2.0	2.0	2.0	2.0	2.0
20	B	66	50.8	52.7	52.7	52.7	52.7	52.7	52.7	1.9	1.9	1.9	1.9	1.9	1.9
21	B	66	51.9	54.3	54.3	54.3	54.3	54.3	54.3	2.4	2.4	2.4	2.4	2.4	2.4
22	B	66	51.7	53.9	53.9	53.9	53.9	53.9	53.9	2.2	2.2	2.2	2.2	2.2	2.2
23	B	66	51.4	53.5	53.5	53.5	53.5	53.5	53.5	2.1	2.1	2.1	2.1	2.1	2.1
24	B	66	51.1	53.1	53.1	53.1	53.1	53.1	53.1	2.0	2.0	2.0	2.0	2.0	2.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
25	B	66	50.8	52.8	52.8	52.8	52.8	52.8	52.8	2.0	2.0	2.0	2.0	2.0	2.0
26	C	66	52.1	54.9	54.9	54.9	54.9	54.9	54.9	2.8	2.8	2.8	2.8	2.8	2.8
27	D	51	39.1	40.2	40.2	40.2	40.2	40.2	40.2	1.1	1.1	1.1	1.1	1.1	1.1
28	D	51	40.4	41.6	41.6	41.6	41.6	41.6	41.6	1.2	1.2	1.2	1.2	1.2	1.2
29	B	66	64.3	65.8	65.8	65.8	65.8	65.8	65.8	1.5	1.5	1.5	1.5	1.5	1.5
30	B	66	64.4	65.8	65.8	65.8	65.8	65.8	65.8	1.4	1.4	1.4	1.4	1.4	1.4
31	B	66	64.4	65.9	65.9	65.9	65.9	65.9	65.9	1.5	1.5	1.5	1.5	1.5	1.5
32	B	66	64.4	65.9	65.9	65.9	65.9	65.9	65.9	1.5	1.5	1.5	1.5	1.5	1.5
33	B	66	64.5	65.9	65.9	65.9	65.9	65.9	65.9	1.4	1.4	1.4	1.4	1.4	1.4
34	B	66	64.5	65.9	65.9	65.9	65.9	65.9	65.9	1.4	1.4	1.4	1.4	1.4	1.4
35	B	66	64.6	66.1	66.1	66.1	66.1	66.1	66.1	1.5	1.5	1.5	1.5	1.5	1.5
36	B	66	64.7	66.1	66.1	66.1	66.1	66.1	66.1	1.4	1.4	1.4	1.4	1.4	1.4
37	B	66	65.8	67.3	67.3	67.3	67.3	67.3	67.3	1.5	1.5	1.5	1.5	1.5	1.5
38	B	66	65.1	66.5	66.5	66.5	66.5	66.5	66.5	1.4	1.4	1.4	1.4	1.4	1.4
39	B	66	64.6	66.0	66.0	66.0	66.0	66.0	66.0	1.4	1.4	1.4	1.4	1.4	1.4
40	B	66	64.3	65.7	65.7	65.7	65.7	65.7	65.7	1.4	1.4	1.4	1.4	1.4	1.4
41	B	66	63.6	65.0	65.0	65.0	65.0	65.0	65.0	1.4	1.4	1.4	1.4	1.4	1.4
42	B	66	63.3	64.7	64.7	64.7	64.7	64.7	64.7	1.4	1.4	1.4	1.4	1.4	1.4
43	B	66	63.1	64.4	64.4	64.4	64.4	64.4	64.4	1.3	1.3	1.3	1.3	1.3	1.3
44	B	66	62.7	64.0	64.0	64.0	64.0	64.0	64.0	1.3	1.3	1.3	1.3	1.3	1.3
45	B	66	60.7	61.8	61.8	61.8	61.8	61.8	61.8	1.1	1.1	1.1	1.1	1.1	1.1
46	B	66	57.2	58.4	58.4	58.4	58.4	58.4	58.4	1.2	1.2	1.2	1.2	1.2	1.2
47	B	66	56.7	57.8	57.8	57.8	57.8	57.8	57.8	1.1	1.1	1.1	1.1	1.1	1.1
48	B	66	55.3	56.5	56.5	56.5	56.5	56.5	56.5	1.2	1.2	1.2	1.2	1.2	1.2
49	B	66	64.4	65.4	65.4	65.4	65.4	65.4	65.4	1.0	1.0	1.0	1.0	1.0	1.0
50	B	66	57.7	58.9	58.9	58.9	58.9	58.9	58.9	1.2	1.2	1.2	1.2	1.2	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
51	B	66	65.1	66.1	66.1	66.1	66.1	66.1	66.1	1.0	1.0	1.0	1.0	1.0	1.0
52	B	66	65.4	66.5	66.5	66.5	66.5	66.5	66.5	1.1	1.1	1.1	1.1	1.1	1.1
53	B	66	59.4	60.5	60.5	60.5	60.5	60.5	60.5	1.1	1.1	1.1	1.1	1.1	1.1
54	B	66	63.3	64.6	64.6	64.6	64.6	64.6	64.6	1.3	1.3	1.3	1.3	1.3	1.3
55	B	66	69.5	71.0	71.0	71.0	71.0	71.0	71.0	1.5	1.5	1.5	1.5	1.5	1.5
56	B	66	64.5	65.8	65.8	65.8	65.8	65.8	65.8	1.3	1.3	1.3	1.3	1.3	1.3
57	B	66	61.6	62.8	62.8	62.8	62.8	62.8	62.8	1.2	1.2	1.2	1.2	1.2	1.2
58	B	66	59.1	60.3	60.3	60.3	60.3	60.3	60.3	1.2	1.2	1.2	1.2	1.2	1.2
59	B	66	57.2	58.4	58.4	58.4	58.4	58.4	58.4	1.2	1.2	1.2	1.2	1.2	1.2
60	B	66	54.8	55.9	55.9	55.9	55.9	55.9	55.9	1.1	1.1	1.1	1.1	1.1	1.1
61	B	66	54.4	55.6	55.6	55.6	55.6	55.6	55.6	1.2	1.2	1.2	1.2	1.2	1.2
62	B	66	53.8	55.0	55.0	55.0	55.0	55.0	55.0	1.2	1.2	1.2	1.2	1.2	1.2
63	B	66	55.9	57.1	57.1	57.1	57.1	57.1	57.1	1.2	1.2	1.2	1.2	1.2	1.2
64	B	66	56.5	57.7	57.7	57.7	57.7	57.7	57.7	1.2	1.2	1.2	1.2	1.2	1.2
65	B	66	56.9	58.1	58.1	58.1	58.1	58.1	58.1	1.2	1.2	1.2	1.2	1.2	1.2
66	B	66	57.3	58.6	58.6	58.6	58.6	58.6	58.6	1.3	1.3	1.3	1.3	1.3	1.3
67	B	66	57.8	59.1	59.1	59.1	59.1	59.1	59.1	1.3	1.3	1.3	1.3	1.3	1.3
68	B	66	60.1	61.5	61.5	61.5	61.5	61.5	61.5	1.4	1.4	1.4	1.4	1.4	1.4
69	B	66	67.5	69.0	69.0	69.0	69.0	69.0	69.0	1.5	1.5	1.5	1.5	1.5	1.5
70	B	66	67.6	69.1	69.1	69.1	69.1	69.1	69.1	1.5	1.5	1.5	1.5	1.5	1.5
71	B	66	62.4	63.8	63.8	63.8	63.8	63.8	63.8	1.4	1.4	1.4	1.4	1.4	1.4
72	B	66	61.1	62.4	62.4	62.4	62.4	62.4	62.4	1.3	1.3	1.3	1.3	1.3	1.3
73	B	66	60.2	61.5	61.5	61.5	61.5	61.5	61.5	1.3	1.3	1.3	1.3	1.3	1.3
74	B	66	59.9	61.2	61.2	61.2	61.2	61.2	61.2	1.3	1.3	1.3	1.3	1.3	1.3
75	B	66	59.1	60.3	60.3	60.3	60.3	60.3	60.3	1.2	1.2	1.2	1.2	1.2	1.2
76	B	66	56.7	58.0	58.0	58.0	58.0	58.0	58.0	1.3	1.3	1.3	1.3	1.3	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
77	B	66	55.8	57.0	57.0	57.0	57.0	57.0	57.0	1.2	1.2	1.2	1.2	1.2	1.2
78	B	66	55.3	56.5	56.5	56.5	56.5	56.5	56.5	1.2	1.2	1.2	1.2	1.2	1.2
79	B	66	54.5	55.7	55.7	55.7	55.7	55.7	55.7	1.2	1.2	1.2	1.2	1.2	1.2
80	B	66	54.0	55.3	55.3	55.3	55.3	55.3	55.3	1.3	1.3	1.3	1.3	1.3	1.3
81	B	66	53.8	55.1	55.1	55.1	55.1	55.1	55.1	1.3	1.3	1.3	1.3	1.3	1.3
82	B	66	54.0	55.3	55.3	55.3	55.3	55.3	55.3	1.3	1.3	1.3	1.3	1.3	1.3
83	B	66	63.7	65.3	65.3	65.3	65.3	65.3	65.3	1.6	1.6	1.6	1.6	1.6	1.6
84	B	66	60.3	61.9	61.9	61.9	61.9	61.9	61.9	1.6	1.6	1.6	1.6	1.6	1.6
85	B	66	59.2	60.7	60.7	60.7	60.7	60.7	60.7	1.5	1.5	1.5	1.5	1.5	1.5
86	B	66	58.2	59.7	59.7	59.7	59.7	59.7	59.7	1.5	1.5	1.5	1.5	1.5	1.5
87	B	66	58.2	59.6	59.6	59.6	59.6	59.6	59.6	1.4	1.4	1.4	1.4	1.4	1.4
88	B	66	57.3	58.7	58.7	58.7	58.7	58.7	58.7	1.4	1.4	1.4	1.4	1.4	1.4
89	B	66	56.2	57.5	57.5	57.5	57.5	57.5	57.5	1.3	1.3	1.3	1.3	1.3	1.3
90	B	66	55.8	57.1	57.1	57.1	57.1	57.1	57.1	1.3	1.3	1.3	1.3	1.3	1.3
91	B	66	55.5	56.8	56.8	56.8	56.8	56.8	56.8	1.3	1.3	1.3	1.3	1.3	1.3
92	B	66	55.1	56.5	56.5	56.5	56.5	56.5	56.5	1.4	1.4	1.4	1.4	1.4	1.4
93	B	66	54.9	56.2	56.2	56.2	56.2	56.2	56.2	1.3	1.3	1.3	1.3	1.3	1.3
94	B	66	54.8	56.0	56.0	56.0	56.0	56.0	56.0	1.2	1.2	1.2	1.2	1.2	1.2
95	B	66	54.8	56.1	56.1	56.1	56.1	56.1	56.1	1.3	1.3	1.3	1.3	1.3	1.3
96	B	66	54.8	56.0	56.0	56.0	56.0	56.0	56.0	1.2	1.2	1.2	1.2	1.2	1.2
97	B	66	54.7	56.0	56.0	56.0	56.0	56.0	56.0	1.3	1.3	1.3	1.3	1.3	1.3
98	B	66	54.7	56.0	56.0	56.0	56.0	56.0	56.0	1.3	1.3	1.3	1.3	1.3	1.3
99	B	66	64.4	65.9	65.9	65.9	65.9	65.9	65.9	1.5	1.5	1.5	1.5	1.5	1.5
100	B	66	62.2	63.5	63.5	63.5	63.5	63.5	63.5	1.3	1.3	1.3	1.3	1.3	1.3
101	B	66	61.4	62.7	62.7	62.7	62.7	62.7	62.7	1.3	1.3	1.3	1.3	1.3	1.3
102	B	66	60.6	61.9	61.9	61.9	61.9	61.9	61.9	1.3	1.3	1.3	1.3	1.3	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
103	B	66	60.1	61.4	61.4	61.4	61.4	61.4	61.4	1.3	1.3	1.3	1.3	1.3	1.3
104	B	66	59.6	60.9	60.9	60.8	60.8	60.8	60.8	1.3	1.3	1.2	1.2	1.2	1.2
105	B	66	61.8	63.1	63.1	63.1	63.1	63.1	63.1	1.3	1.3	1.3	1.3	1.3	1.3
106	B	66	62.3	63.6	63.6	63.6	63.6	63.6	63.6	1.3	1.3	1.3	1.3	1.3	1.3
107	B	66	62.8	64.1	64.1	64.1	64.1	64.1	64.1	1.3	1.3	1.3	1.3	1.3	1.3
108	B	66	63.9	65.3	65.3	65.3	65.3	65.3	65.3	1.4	1.4	1.4	1.4	1.4	1.4
109	B	66	64.7	66.1	66.1	66.1	66.1	66.1	66.1	1.4	1.4	1.4	1.4	1.4	1.4
110	B	66	66.0	67.4	67.4	67.4	67.4	67.4	67.4	1.4	1.4	1.4	1.4	1.4	1.4
111	B	66	59.1	60.4	60.4	60.4	60.4	60.4	60.4	1.3	1.3	1.3	1.3	1.3	1.3
112	B	66	59.6	60.8	60.8	60.8	60.8	60.8	60.8	1.2	1.2	1.2	1.2	1.2	1.2
113	B	66	59.8	61.1	61.1	61.1	61.1	61.1	61.1	1.3	1.3	1.3	1.3	1.3	1.3
114	B	66	60.0	61.3	61.3	61.3	61.3	61.3	61.3	1.3	1.3	1.3	1.3	1.3	1.3
115	B	66	60.4	61.7	61.7	61.7	61.7	61.7	61.7	1.3	1.3	1.3	1.3	1.3	1.3
116	B	66	59.5	60.7	60.7	60.7	60.7	60.7	60.7	1.2	1.2	1.2	1.2	1.2	1.2
117	B	66	59.4	60.6	60.6	60.6	60.6	60.6	60.6	1.2	1.2	1.2	1.2	1.2	1.2
118	B	66	59.5	60.7	60.7	60.7	60.7	60.7	60.7	1.2	1.2	1.2	1.2	1.2	1.2
119	B	66	59.6	60.9	60.9	60.9	60.9	60.9	60.9	1.3	1.3	1.3	1.3	1.3	1.3
120	B	66	59.7	61.0	61.0	61.0	61.0	61.0	61.0	1.3	1.3	1.3	1.3	1.3	1.3
121	B	66	59.7	60.9	60.9	60.9	60.9	60.9	60.9	1.2	1.2	1.2	1.2	1.2	1.2
122	B	66	59.7	61.0	61.0	61.0	61.0	61.0	61.0	1.3	1.3	1.3	1.3	1.3	1.3
123	B	66	59.8	61.1	61.1	61.1	61.1	61.1	61.1	1.3	1.3	1.3	1.3	1.3	1.3
124	B	66	59.7	61.0	61.0	61.0	61.0	61.0	61.0	1.3	1.3	1.3	1.3	1.3	1.3
125	B	66	60.8	62.1	62.1	62.1	62.1	62.1	62.1	1.3	1.3	1.3	1.3	1.3	1.3
126	B	66	60.4	61.6	61.6	61.6	61.6	61.6	61.6	1.2	1.2	1.2	1.2	1.2	1.2
127	B	66	60.1	61.3	61.3	61.3	61.3	61.3	61.3	1.2	1.2	1.2	1.2	1.2	1.2
128	B	66	59.8	61.0	61.0	61.0	61.0	61.0	61.0	1.2	1.2	1.2	1.2	1.2	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
129	B	66	59.3	60.6	60.6	60.6	60.6	60.6	60.6	1.3	1.3	1.3	1.3	1.3	1.3
130	B	66	59.1	60.4	60.4	60.4	60.4	60.4	60.4	1.3	1.3	1.3	1.3	1.3	1.3
131	B	66	58.8	60.0	60.0	60.0	60.0	60.0	60.0	1.2	1.2	1.2	1.2	1.2	1.2
132	B	66	58.9	60.2	60.2	60.2	60.2	60.2	60.2	1.3	1.3	1.3	1.3	1.3	1.3
133	B	66	56.3	57.5	57.5	57.5	57.5	57.5	57.5	1.2	1.2	1.2	1.2	1.2	1.2
134	B	66	56.2	57.5	57.5	57.5	57.5	57.5	57.5	1.3	1.3	1.3	1.3	1.3	1.3
135	B	66	56.1	57.4	57.4	57.4	57.4	57.4	57.4	1.3	1.3	1.3	1.3	1.3	1.3
136	B	66	56.1	57.3	57.3	57.3	57.3	57.3	57.3	1.2	1.2	1.2	1.2	1.2	1.2
137	B	66	56.2	57.5	57.5	57.5	57.5	57.5	57.5	1.3	1.3	1.3	1.3	1.3	1.3
138	B	66	56.2	57.5	57.5	57.5	57.5	57.5	57.5	1.3	1.3	1.3	1.3	1.3	1.3
139	B	66	56.2	57.4	57.4	57.4	57.4	57.4	57.4	1.2	1.2	1.2	1.2	1.2	1.2
140	B	66	56.3	57.6	57.6	57.6	57.6	57.6	57.6	1.3	1.3	1.3	1.3	1.3	1.3
141	B	66	56.3	57.6	57.6	57.6	57.6	57.6	57.6	1.3	1.3	1.3	1.3	1.3	1.3
142	B	66	56.6	57.8	57.8	57.8	57.8	57.8	57.8	1.2	1.2	1.2	1.2	1.2	1.2
143	B	66	56.7	58.0	58.0	58.0	58.0	58.0	58.0	1.3	1.3	1.3	1.3	1.3	1.3
144	B	66	57.1	58.4	58.4	58.4	58.4	58.4	58.4	1.3	1.3	1.3	1.3	1.3	1.3
145	B	66	57.3	58.6	58.6	58.6	58.6	58.6	58.6	1.3	1.3	1.3	1.3	1.3	1.3
146	B	66	57.5	58.8	58.8	58.8	58.8	58.8	58.8	1.3	1.3	1.3	1.3	1.3	1.3
147	B	66	57.6	58.9	58.9	58.9	58.9	58.9	58.9	1.3	1.3	1.3	1.3	1.3	1.3
148	B	66	54.4	55.7	55.7	55.7	55.7	55.7	55.7	1.3	1.3	1.3	1.3	1.3	1.3
149	B	66	54.7	55.9	55.9	55.9	55.9	55.9	55.9	1.2	1.2	1.2	1.2	1.2	1.2
150	B	66	54.6	55.9	55.9	55.9	55.9	55.9	55.9	1.3	1.3	1.3	1.3	1.3	1.3
151	B	66	54.6	55.8	55.8	55.8	55.8	55.8	55.8	1.2	1.2	1.2	1.2	1.2	1.2
152	B	66	54.6	55.9	55.9	55.9	55.9	55.9	55.9	1.3	1.3	1.3	1.3	1.3	1.3
153	B	66	54.6	55.8	55.8	55.8	55.8	55.8	55.8	1.2	1.2	1.2	1.2	1.2	1.2
154	B	66	54.6	55.9	55.9	55.9	55.9	55.9	55.9	1.3	1.3	1.3	1.3	1.3	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
155	B	66	55.0	56.3	56.3	56.3	56.3	56.3	56.3	1.3	1.3	1.3	1.3	1.3	1.3
156	B	66	55.2	56.5	56.5	56.5	56.5	56.5	56.5	1.3	1.3	1.3	1.3	1.3	1.3
157	B	66	55.4	56.7	56.7	56.7	56.7	56.7	56.7	1.3	1.3	1.3	1.3	1.3	1.3
158	B	66	55.6	56.9	56.9	56.9	56.9	56.9	56.9	1.3	1.3	1.3	1.3	1.3	1.3
159	B	66	56.2	57.5	57.5	57.5	57.5	57.5	57.5	1.3	1.3	1.3	1.3	1.3	1.3
160	B	66	56.2	57.5	57.5	57.5	57.5	57.5	57.5	1.3	1.3	1.3	1.3	1.3	1.3
161	B	66	56.4	57.7	57.7	57.7	57.7	57.7	57.7	1.3	1.3	1.3	1.3	1.3	1.3
162	B	66	57.4	58.6	58.6	58.6	58.6	58.6	58.6	1.2	1.2	1.2	1.2	1.2	1.2
163	B	66	57.7	58.9	58.9	58.9	58.9	58.9	58.9	1.2	1.2	1.2	1.2	1.2	1.2
164	B	66	58.2	59.4	59.4	59.4	59.4	59.4	59.4	1.2	1.2	1.2	1.2	1.2	1.2
165	B	66	58.8	60.0	60.0	60.0	60.0	60.0	60.0	1.2	1.2	1.2	1.2	1.2	1.2
166	B	66	60.0	61.1	61.1	61.1	61.1	61.1	61.1	1.1	1.1	1.1	1.1	1.1	1.1
167	B	66	60.6	61.7	61.7	61.7	61.7	61.7	61.7	1.1	1.1	1.1	1.1	1.1	1.1
168	B	66	60.0	61.2	61.2	61.2	61.2	61.2	61.2	1.2	1.2	1.2	1.2	1.2	1.2
169	B	66	59.6	60.8	60.8	60.8	60.8	60.8	60.8	1.2	1.2	1.2	1.2	1.2	1.2
170	B	66	59.2	60.4	60.4	60.4	60.4	60.4	60.4	1.2	1.2	1.2	1.2	1.2	1.2
171	B	66	58.7	59.9	59.9	59.9	59.9	59.9	59.9	1.2	1.2	1.2	1.2	1.2	1.2
172	B	66	58.6	59.8	59.8	59.8	59.8	59.8	59.8	1.2	1.2	1.2	1.2	1.2	1.2
173	B	66	58.3	59.6	59.6	59.6	59.6	59.6	59.6	1.3	1.3	1.3	1.3	1.3	1.3
174	B	66	58.7	59.9	59.9	59.9	59.9	59.9	59.9	1.2	1.2	1.2	1.2	1.2	1.2
175	B	66	59.1	60.3	60.3	60.3	60.3	60.3	60.3	1.2	1.2	1.2	1.2	1.2	1.2
176	B	66	59.4	60.7	60.7	60.7	60.7	60.7	60.7	1.3	1.3	1.3	1.3	1.3	1.3
177	B	66	59.9	61.2	61.2	61.2	61.2	61.2	61.2	1.3	1.3	1.3	1.3	1.3	1.3
178	B	66	60.7	62.0	62.0	62.0	62.0	62.0	62.0	1.3	1.3	1.3	1.3	1.3	1.3
179	B	66	61.7	62.9	62.9	62.9	62.9	62.9	62.9	1.2	1.2	1.2	1.2	1.2	1.2
180	B	66	62.1	63.3	63.3	63.3	63.3	63.3	63.3	1.2	1.2	1.2	1.2	1.2	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
181	B	66	61.8	63.1	63.1	63.1	63.1	63.1	63.1	1.3	1.3	1.3	1.3	1.3	1.3
182	B	66	61.5	62.7	62.7	62.7	62.7	62.7	62.7	1.2	1.2	1.2	1.2	1.2	1.2
183	B	66	60.4	61.6	61.6	61.6	61.6	61.6	61.6	1.2	1.2	1.2	1.2	1.2	1.2
184	B	66	60.2	61.5	61.5	61.5	61.5	61.5	61.5	1.3	1.3	1.3	1.3	1.3	1.3
185	B	66	59.9	61.2	61.2	61.1	61.1	61.1	61.1	1.3	1.3	1.2	1.2	1.2	1.2
186	B	66	59.5	60.8	60.8	60.8	60.8	60.8	60.8	1.3	1.3	1.3	1.3	1.3	1.3
187	B	66	59.2	60.4	60.4	60.4	60.4	60.4	60.4	1.2	1.2	1.2	1.2	1.2	1.2
188	B	66	59.1	60.3	60.3	60.3	60.3	60.3	60.3	1.2	1.2	1.2	1.2	1.2	1.2
189	B	66	59.2	60.4	60.4	60.4	60.4	60.4	60.4	1.2	1.2	1.2	1.2	1.2	1.2
190	B	66	59.1	60.3	60.3	60.3	60.3	60.3	60.3	1.2	1.2	1.2	1.2	1.2	1.2
191	B	66	58.7	60.0	60.0	60.0	60.0	60.0	60.0	1.3	1.3	1.3	1.3	1.3	1.3
192	B	66	61.3	62.6	62.6	62.6	62.6	62.6	62.6	1.3	1.3	1.3	1.3	1.3	1.3
193	B	66	61.6	62.9	62.9	62.9	62.9	62.9	62.9	1.3	1.3	1.3	1.3	1.3	1.3
194	B	66	61.8	63.1	63.1	63.1	63.1	63.1	63.1	1.3	1.3	1.3	1.3	1.3	1.3
195	B	66	62.4	63.7	63.7	63.7	63.7	63.7	63.7	1.3	1.3	1.3	1.3	1.3	1.3
196	B	66	62.5	63.8	63.8	63.8	63.8	63.8	63.8	1.3	1.3	1.3	1.3	1.3	1.3
197	B	66	62.6	63.9	63.9	63.9	63.9	63.9	63.9	1.3	1.3	1.3	1.3	1.3	1.3
198	B	66	63.0	64.3	64.3	64.3	64.3	64.3	64.3	1.3	1.3	1.3	1.3	1.3	1.3
199	B	66	59.6	60.9	60.9	60.9	60.9	60.9	60.9	1.3	1.3	1.3	1.3	1.3	1.3
200	B	66	59.7	61.0	61.0	61.0	61.0	61.0	61.0	1.3	1.3	1.3	1.3	1.3	1.3
201	B	66	60.1	61.4	61.4	61.4	61.4	61.4	61.4	1.3	1.3	1.3	1.3	1.3	1.3
202	B	66	60.3	61.6	61.6	61.6	61.6	61.6	61.6	1.3	1.3	1.3	1.3	1.3	1.3
203	B	66	61.5	62.8	62.8	62.8	62.8	62.8	62.8	1.3	1.3	1.3	1.3	1.3	1.3
204	B	66	71.6	73.0	73.0	73.0	73.0	73.0	73.0	1.4	1.4	1.4	1.4	1.4	1.4
205	B	66	71.8	73.2	73.2	73.2	73.2	73.2	73.2	1.4	1.4	1.4	1.4	1.4	1.4
206	B	66	68.4	69.9	69.9	69.9	69.9	69.9	69.9	1.5	1.5	1.5	1.5	1.5	1.5

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
207	B	66	71.2	72.7	72.7	72.7	72.7	72.7	72.7	1.5	1.5	1.5	1.5	1.5	1.5
208	B	66	67.4	68.9	68.9	68.9	68.9	68.9	68.9	1.5	1.5	1.5	1.5	1.5	1.5
209	B	66	67.8	69.3	69.3	69.3	69.3	69.3	69.3	1.5	1.5	1.5	1.5	1.5	1.5
210	B	66	70.2	71.7	71.7	71.7	71.7	71.7	71.7	1.5	1.5	1.5	1.5	1.5	1.5
211	B	66	70.0	71.5	71.5	71.5	71.5	71.5	71.5	1.5	1.5	1.5	1.5	1.5	1.5
212	B	66	68.4	69.9	69.9	69.9	69.9	69.9	69.9	1.5	1.5	1.5	1.5	1.5	1.5
213	B	66	68.5	70.0	70.0	70.0	70.0	70.0	70.0	1.5	1.5	1.5	1.5	1.5	1.5
214	B	66	67.0	68.5	68.5	68.5	68.5	68.5	68.5	1.5	1.5	1.5	1.5	1.5	1.5
215	B	66	65.7	67.2	67.2	67.2	67.2	67.2	67.2	1.5	1.5	1.5	1.5	1.5	1.5
216	B	66	65.6	67.0	67.0	67.0	67.0	67.0	67.0	1.4	1.4	1.4	1.4	1.4	1.4
217	B	66	66.9	68.3	68.3	68.3	68.3	68.3	68.3	1.4	1.4	1.4	1.4	1.4	1.4
218	B	66	66.7	68.2	68.2	68.2	68.2	68.2	68.2	1.5	1.5	1.5	1.5	1.5	1.5
219	B	66	65.1	66.6	66.6	66.6	66.6	66.6	66.6	1.5	1.5	1.5	1.5	1.5	1.5
220	B	66	64.6	66.1	66.1	66.1	66.1	66.1	66.1	1.5	1.5	1.5	1.5	1.5	1.5
221	B	66	65.7	67.2	67.2	67.2	67.2	67.2	67.2	1.5	1.5	1.5	1.5	1.5	1.5
222	B	66	65.3	66.7	66.7	66.7	66.7	66.7	66.7	1.4	1.4	1.4	1.4	1.4	1.4
223	B	66	63.8	65.3	65.3	65.3	65.3	65.3	65.3	1.5	1.5	1.5	1.5	1.5	1.5
224	B	66	64.2	65.7	65.7	65.7	65.7	65.7	65.7	1.5	1.5	1.5	1.5	1.5	1.5
225	B	66	65.4	66.8	66.8	66.8	66.8	66.8	66.8	1.4	1.4	1.4	1.4	1.4	1.4
226	B	66	63.9	65.3	65.3	65.3	65.3	65.3	65.3	1.4	1.4	1.4	1.4	1.4	1.4
227	B	66	64.2	65.6	65.6	65.6	65.6	65.6	65.6	1.4	1.4	1.4	1.4	1.4	1.4
228	B	66	63.1	64.5	64.5	64.5	64.5	64.5	64.5	1.4	1.4	1.4	1.4	1.4	1.4
229	B	66	63.5	64.9	64.9	64.9	64.9	64.9	64.9	1.4	1.4	1.4	1.4	1.4	1.4
230	B	66	61.7	63.1	63.1	63.1	63.1	63.1	63.1	1.4	1.4	1.4	1.4	1.4	1.4
231	B	66	61.8	63.1	63.1	63.1	63.1	63.1	63.1	1.3	1.3	1.3	1.3	1.3	1.3
232	B	66	60.8	62.1	62.1	62.1	62.1	62.1	62.1	1.3	1.3	1.3	1.3	1.3	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
233	B	66	60.1	61.3	61.3	61.3	61.3	61.3	61.3	1.2	1.2	1.2	1.2	1.2	1.2
234	B	66	60.2	61.5	61.5	61.5	61.5	61.5	61.5	1.3	1.3	1.3	1.3	1.3	1.3
235	B	66	59.9	61.2	61.2	61.2	61.2	61.2	61.2	1.3	1.3	1.3	1.3	1.3	1.3
236	B	66	60.1	61.3	61.3	61.3	61.3	61.3	61.3	1.2	1.2	1.2	1.2	1.2	1.2
237	B	66	60.7	61.8	61.8	61.8	61.8	61.8	61.8	1.1	1.1	1.1	1.1	1.1	1.1
238	B	66	60.2	61.3	61.3	61.3	61.3	61.3	61.3	1.1	1.1	1.1	1.1	1.1	1.1
239	B	66	60.5	61.7	61.7	61.7	61.7	61.7	61.7	1.2	1.2	1.2	1.2	1.2	1.2
240	B	66	60.6	61.7	61.7	61.7	61.7	61.7	61.7	1.1	1.1	1.1	1.1	1.1	1.1
241	B	66	60.7	61.9	61.9	61.9	61.9	61.9	61.9	1.2	1.2	1.2	1.2	1.2	1.2
242	B	66	61.4	62.5	62.5	62.5	62.5	62.5	62.5	1.1	1.1	1.1	1.1	1.1	1.1
243	B	66	61.0	62.2	62.2	62.2	62.2	62.2	62.2	1.2	1.2	1.2	1.2	1.2	1.2
244	B	66	61.9	63.1	63.1	63.1	63.1	63.1	63.1	1.2	1.2	1.2	1.2	1.2	1.2
245	B	66	63.7	64.9	64.9	64.9	64.9	64.9	64.9	1.2	1.2	1.2	1.2	1.2	1.2
246	B	66	65.4	66.8	66.8	66.8	66.8	66.8	66.8	1.4	1.4	1.4	1.4	1.4	1.4
247	B	66	65.2	66.6	66.6	66.6	66.6	66.6	66.6	1.4	1.4	1.4	1.4	1.4	1.4
248	B	66	64.5	65.9	65.9	65.9	65.9	65.9	65.9	1.4	1.4	1.4	1.4	1.4	1.4
249	B	66	63.9	65.3	65.3	65.3	65.3	65.3	65.3	1.4	1.4	1.4	1.4	1.4	1.4
250	B	66	64.6	66.0	66.0	66.0	66.0	66.0	66.0	1.4	1.4	1.4	1.4	1.4	1.4
251	B	66	62.9	64.3	64.3	64.3	64.3	64.3	64.3	1.4	1.4	1.4	1.4	1.4	1.4
252	B	66	64.2	65.6	65.6	65.6	65.6	65.6	65.6	1.4	1.4	1.4	1.4	1.4	1.4
253	B	66	62.6	64.0	64.0	64.0	64.0	64.0	64.0	1.4	1.4	1.4	1.4	1.4	1.4
254	B	66	64.0	65.4	65.4	65.4	65.4	65.4	65.4	1.4	1.4	1.4	1.4	1.4	1.4
255	B	66	62.2	63.7	63.7	63.7	63.7	63.7	63.7	1.5	1.5	1.5	1.5	1.5	1.5
256	B	66	63.5	65.0	65.0	65.0	65.0	65.0	65.0	1.5	1.5	1.5	1.5	1.5	1.5
257	B	66	63.1	64.6	64.6	64.6	64.6	64.6	64.6	1.5	1.5	1.5	1.5	1.5	1.5
258	B	66	62.7	64.1	64.1	64.1	64.1	64.1	64.1	1.4	1.4	1.4	1.4	1.4	1.4

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
259	B	66	62.6	64.0	64.0	64.0	64.0	64.0	64.0	1.4	1.4	1.4	1.4	1.4	1.4
260	B	66	61.8	63.2	63.2	63.2	63.2	63.2	63.2	1.4	1.4	1.4	1.4	1.4	1.4
261	B	66	61.2	62.6	62.6	62.6	62.6	62.6	62.6	1.4	1.4	1.4	1.4	1.4	1.4
262	B	66	60.7	62.1	62.1	62.1	62.1	62.1	62.1	1.4	1.4	1.4	1.4	1.4	1.4
263	B	66	62.6	64.0	64.0	64.0	64.0	64.0	64.0	1.4	1.4	1.4	1.4	1.4	1.4
264	B	66	61.9	63.3	63.3	63.3	63.3	63.3	63.3	1.4	1.4	1.4	1.4	1.4	1.4
265	B	66	61.9	63.3	63.3	63.3	63.3	63.3	63.3	1.4	1.4	1.4	1.4	1.4	1.4
266	B	66	61.5	62.9	62.9	62.9	62.9	62.9	62.9	1.4	1.4	1.4	1.4	1.4	1.4
267	B	66	61.2	62.6	62.6	62.6	62.6	62.6	62.6	1.4	1.4	1.4	1.4	1.4	1.4
268	B	66	61.0	62.4	62.4	62.4	62.4	62.4	62.4	1.4	1.4	1.4	1.4	1.4	1.4
269	B	66	61.3	62.7	62.7	62.7	62.7	62.7	62.7	1.4	1.4	1.4	1.4	1.4	1.4
270	B	66	61.2	62.6	62.6	62.6	62.6	62.6	62.6	1.4	1.4	1.4	1.4	1.4	1.4
271	B	66	60.2	61.6	61.6	61.6	61.6	61.6	61.6	1.4	1.4	1.4	1.4	1.4	1.4
272	B	66	60.7	62.1	62.1	62.1	62.1	62.1	62.1	1.4	1.4	1.4	1.4	1.4	1.4
273	B	66	60.5	61.9	61.9	61.9	61.9	61.9	61.9	1.4	1.4	1.4	1.4	1.4	1.4
274	B	66	59.8	61.2	61.2	61.2	61.2	61.2	61.2	1.4	1.4	1.4	1.4	1.4	1.4
275	B	66	59.6	61.0	61.0	61.0	61.0	61.0	61.0	1.4	1.4	1.4	1.4	1.4	1.4
276	B	66	60.2	61.6	61.6	61.6	61.6	61.6	61.6	1.4	1.4	1.4	1.4	1.4	1.4
277	B	66	59.9	61.3	61.3	61.3	61.3	61.3	61.3	1.4	1.4	1.4	1.4	1.4	1.4
278	B	66	59.6	61.0	61.0	61.0	61.0	61.0	61.0	1.4	1.4	1.4	1.4	1.4	1.4
279	B	66	58.7	60.1	60.1	60.1	60.1	60.1	60.1	1.4	1.4	1.4	1.4	1.4	1.4
280	B	66	61.1	62.5	62.5	62.5	62.5	62.5	62.5	1.4	1.4	1.4	1.4	1.4	1.4
281	B	66	60.3	61.7	61.7	61.7	61.7	61.7	61.7	1.4	1.4	1.4	1.4	1.4	1.4
282	B	66	60.1	61.5	61.5	61.5	61.5	61.5	61.5	1.4	1.4	1.4	1.4	1.4	1.4
283	B	66	60.0	61.3	61.3	61.3	61.3	61.3	61.3	1.3	1.3	1.3	1.3	1.3	1.3
284	B	66	59.8	61.1	61.1	61.1	61.1	61.1	61.1	1.3	1.3	1.3	1.3	1.3	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
285	B	66	59.4	60.6	60.6	60.6	60.6	60.6	60.6	1.2	1.2	1.2	1.2	1.2	1.2
286	B	66	59.1	60.3	60.3	60.3	60.3	60.3	60.3	1.2	1.2	1.2	1.2	1.2	1.2
287	B	66	59.1	60.3	60.3	60.3	60.3	60.3	60.3	1.2	1.2	1.2	1.2	1.2	1.2
288	B	66	60.1	61.5	61.5	61.5	61.5	61.5	61.5	1.4	1.4	1.4	1.4	1.4	1.4
289	B	66	59.0	60.4	60.4	60.4	60.4	60.4	60.4	1.4	1.4	1.4	1.4	1.4	1.4
290	B	66	59.2	60.5	60.5	60.5	60.5	60.5	60.5	1.3	1.3	1.3	1.3	1.3	1.3
291	B	66	59.0	60.3	60.3	60.3	60.3	60.3	60.3	1.3	1.3	1.3	1.3	1.3	1.3
292	B	66	58.9	60.2	60.2	60.2	60.2	60.2	60.2	1.3	1.3	1.3	1.3	1.3	1.3
293	B	66	59.0	60.2	60.2	60.2	60.2	60.2	60.2	1.2	1.2	1.2	1.2	1.2	1.2
294	B	66	58.1	59.4	59.4	59.4	59.4	59.4	59.4	1.3	1.3	1.3	1.3	1.3	1.3
295	B	66	58.5	59.7	59.7	59.7	59.7	59.7	59.7	1.2	1.2	1.2	1.2	1.2	1.2
296	B	66	57.6	58.9	58.9	58.9	58.9	58.9	58.9	1.3	1.3	1.3	1.3	1.3	1.3
297	B	66	58.1	59.3	59.3	59.3	59.3	59.3	59.3	1.2	1.2	1.2	1.2	1.2	1.2
298	B	66	58.8	59.9	59.9	59.9	59.9	59.9	59.9	1.1	1.1	1.1	1.1	1.1	1.1
299	B	66	59.3	60.5	60.5	60.5	60.5	60.5	60.5	1.2	1.2	1.2	1.2	1.2	1.2
300	B	66	59.5	60.7	60.7	60.7	60.7	60.7	60.7	1.2	1.2	1.2	1.2	1.2	1.2
301	B	66	60.4	61.6	61.6	61.6	61.6	61.6	61.6	1.2	1.2	1.2	1.2	1.2	1.2
302	B	66	60.2	61.4	61.4	61.4	61.4	61.4	61.4	1.2	1.2	1.2	1.2	1.2	1.2
303	B	66	62.2	63.3	63.3	63.3	63.3	63.3	63.3	1.1	1.1	1.1	1.1	1.1	1.1
304	B	66	64.1	65.2	65.2	65.2	65.2	65.2	65.2	1.1	1.1	1.1	1.1	1.1	1.1
305	C	66	60.4	61.9	61.9	61.9	61.9	61.9	61.9	1.5	1.5	1.5	1.5	1.5	1.5
306	B	66	67.7	69.0	69.0	69.0	69.0	69.0	69.0	1.3	1.3	1.3	1.3	1.3	1.3
307	B	66	66.5	67.8	67.8	67.8	67.8	67.8	67.8	1.3	1.3	1.3	1.3	1.3	1.3
308	B	66	66.7	68.1	68.1	68.1	68.1	68.1	68.1	1.4	1.4	1.4	1.4	1.4	1.4
309	B	66	65.3	66.6	66.6	66.6	66.6	66.6	66.6	1.3	1.3	1.3	1.3	1.3	1.3
310	B	66	64.9	66.2	66.2	66.2	66.2	66.2	66.2	1.3	1.3	1.3	1.3	1.3	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
311	B	66	64.0	65.2	65.2	65.2	65.2	65.2	65.2	1.2	1.2	1.2	1.2	1.2	1.2
312	B	66	63.9	65.2	65.2	65.2	65.2	65.2	65.2	1.3	1.3	1.3	1.3	1.3	1.3
313	B	66	63.1	64.4	64.4	64.4	64.4	64.4	64.4	1.3	1.3	1.3	1.3	1.3	1.3
314	B	66	61.0	62.3	62.3	62.3	62.3	62.3	62.3	1.3	1.3	1.3	1.3	1.3	1.3
315	B	66	60.9	62.1	62.1	62.1	62.1	62.1	62.1	1.2	1.2	1.2	1.2	1.2	1.2
316	B	66	59.8	61.1	61.1	61.1	61.1	61.1	61.1	1.3	1.3	1.3	1.3	1.3	1.3
317	B	66	59.7	60.9	60.9	60.9	60.9	60.9	60.9	1.2	1.2	1.2	1.2	1.2	1.2
318	B	66	62.3	63.6	63.6	63.5	63.5	63.5	63.5	1.3	1.3	1.2	1.2	1.2	1.2
319	B	66	62.6	63.9	63.9	63.9	63.9	63.9	63.9	1.3	1.3	1.3	1.3	1.3	1.3
320	B	66	61.5	62.7	62.7	62.7	62.7	62.7	62.7	1.2	1.2	1.2	1.2	1.2	1.2
321	B	66	61.1	62.4	62.4	62.4	62.4	62.4	62.4	1.3	1.3	1.3	1.3	1.3	1.3
322	B	66	58.7	59.9	59.9	59.9	59.9	59.9	59.9	1.2	1.2	1.2	1.2	1.2	1.2
323	B	66	58.3	59.6	59.6	59.6	59.6	59.6	59.6	1.3	1.3	1.3	1.3	1.3	1.3
324	B	66	59.1	60.4	60.4	60.4	60.4	60.4	60.4	1.3	1.3	1.3	1.3	1.3	1.3
325	B	66	58.7	59.9	59.9	59.9	59.9	59.9	59.9	1.2	1.2	1.2	1.2	1.2	1.2
326	B	66	59.2	60.5	60.5	60.5	60.5	60.5	60.5	1.3	1.3	1.3	1.3	1.3	1.3
327	B	66	58.8	60.0	60.0	60.0	60.0	60.0	60.0	1.2	1.2	1.2	1.2	1.2	1.2
328	B	66	59.6	60.8	60.8	60.8	60.8	60.8	60.8	1.2	1.2	1.2	1.2	1.2	1.2
329	B	66	59.2	60.4	60.4	60.4	60.4	60.4	60.4	1.2	1.2	1.2	1.2	1.2	1.2
330	C	66	57.4	58.6	58.6	58.6	58.6	58.6	58.6	1.2	1.2	1.2	1.2	1.2	1.2
331	C	66	59.5	60.7	60.7	60.7	60.7	60.7	60.7	1.2	1.2	1.2	1.2	1.2	1.2
332	C	66	60.7	61.9	61.9	61.9	61.9	61.9	61.9	1.2	1.2	1.2	1.2	1.2	1.2
333	C	66	61.0	62.1	62.1	62.1	62.1	62.1	62.1	1.1	1.1	1.1	1.1	1.1	1.1
334	C	66	62.2	63.3	63.3	63.3	63.3	63.3	63.3	1.1	1.1	1.1	1.1	1.1	1.1
335	C	66	59.8	60.9	60.9	60.9	60.9	60.9	60.9	1.1	1.1	1.1	1.1	1.1	1.1
336	C	66	61.1	62.1	62.1	62.1	62.1	62.1	62.1	1.0	1.0	1.0	1.0	1.0	1.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
337	C	66	60.6	61.7	61.7	61.7	61.7	61.7	61.7	1.1	1.1	1.1	1.1	1.1	1.1
338	C	66	60.1	61.2	61.2	61.2	61.2	61.2	61.2	1.1	1.1	1.1	1.1	1.1	1.1
339	C	66	60.6	61.7	61.7	61.7	61.7	61.7	61.7	1.1	1.1	1.1	1.1	1.1	1.1
340	C	66	61.2	62.4	62.4	62.4	62.4	62.4	62.4	1.2	1.2	1.2	1.2	1.2	1.2
341	C	66	67.6	68.7	68.7	68.7	68.7	68.7	68.7	1.1	1.1	1.1	1.1	1.1	1.1
342	D	51	43.9	45.1	45.1	45.1	45.1	45.1	45.1	1.2	1.2	1.2	1.2	1.2	1.2
343	B	66	59.8	60.6	60.6	60.6	60.6	60.6	60.6	0.8	0.8	0.8	0.8	0.8	0.8
344	B	66	56.9	57.8	57.8	57.8	57.8	57.8	57.8	0.9	0.9	0.9	0.9	0.9	0.9
345	B	66	59.1	60.0	60.0	60.0	60.0	60.0	60.0	0.9	0.9	0.9	0.9	0.9	0.9
346	B	66	57.6	58.6	58.6	58.6	58.6	58.6	58.6	1.0	1.0	1.0	1.0	1.0	1.0
347	B	66	57.2	58.2	58.2	58.2	58.2	58.2	58.2	1.0	1.0	1.0	1.0	1.0	1.0
348	B	66	56.9	57.9	57.9	57.9	57.9	57.9	57.9	1.0	1.0	1.0	1.0	1.0	1.0
349	B	66	56.4	57.5	57.5	57.5	57.5	57.5	57.5	1.1	1.1	1.1	1.1	1.1	1.1
350	B	66	59.2	60.1	60.1	60.1	60.1	60.1	60.1	0.9	0.9	0.9	0.9	0.9	0.9
351	B	66	58.2	59.2	59.2	59.2	59.2	59.2	59.2	1.0	1.0	1.0	1.0	1.0	1.0
352	B	66	59.9	61.2	61.2	61.3	61.1	61.3	61.2	1.3	1.3	1.4	1.2	1.4	1.3
353	B	66	60.4	61.6	61.6	61.7	61.6	61.7	61.6	1.2	1.2	1.3	1.2	1.3	1.2
354	B	66	59.9	61.2	61.2	61.2	61.1	61.2	61.2	1.3	1.3	1.3	1.2	1.3	1.3
355	B	66	60.2	61.4	61.4	61.5	61.4	61.5	61.4	1.2	1.2	1.3	1.2	1.3	1.2
356	B	66	60.4	61.6	61.6	61.7	61.6	61.7	61.6	1.2	1.2	1.3	1.2	1.3	1.2
357	B	66	60.2	61.4	61.4	61.4	61.4	61.4	61.4	1.2	1.2	1.2	1.2	1.2	1.2
358	B	66	60.5	61.7	61.7	61.8	61.7	61.8	61.7	1.2	1.2	1.3	1.2	1.3	1.2
359	B	66	60.8	62.0	62.0	62.1	62.0	62.1	62.0	1.2	1.2	1.3	1.2	1.3	1.2
360	B	66	60.7	61.9	61.9	61.9	61.9	61.9	61.9	1.2	1.2	1.2	1.2	1.2	1.2
361	B	66	60.6	61.9	61.9	61.9	61.8	61.9	61.9	1.3	1.3	1.3	1.2	1.3	1.3
362	B	66	60.6	61.8	61.8	61.9	61.8	61.9	61.8	1.2	1.2	1.3	1.2	1.3	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
363	B	66	60.6	61.8	61.8	61.9	61.8	61.9	61.8	1.2	1.2	1.3	1.2	1.3	1.2
364	B	66	60.8	62.0	62.0	62.0	62.0	62.0	62.0	1.2	1.2	1.2	1.2	1.2	1.2
365	B	66	59.1	60.3	60.3	60.3	60.3	60.3	60.3	1.2	1.2	1.2	1.2	1.2	1.2
366	B	66	60.1	61.3	61.3	61.4	61.3	61.3	61.3	1.2	1.2	1.3	1.2	1.2	1.2
367	B	66	61.5	62.7	62.7	62.7	62.7	62.7	62.7	1.2	1.2	1.2	1.2	1.2	1.2
368	B	66	59.3	60.5	60.5	60.5	60.5	60.5	60.5	1.2	1.2	1.2	1.2	1.2	1.2
369	B	66	60.4	61.6	61.6	61.7	61.6	61.7	61.6	1.2	1.2	1.3	1.2	1.3	1.2
370	B	66	61.5	62.8	62.8	62.8	62.7	62.8	62.8	1.3	1.3	1.3	1.2	1.3	1.3
371	B	66	60.4	61.7	61.7	61.7	61.7	61.7	61.7	1.3	1.3	1.3	1.3	1.3	1.3
372	B	66	59.9	61.1	61.1	61.1	61.1	61.1	61.1	1.2	1.2	1.2	1.2	1.2	1.2
373	B	66	59.0	60.2	60.2	60.8	60.3	60.8	60.2	1.2	1.2	1.8	1.3	1.8	1.2
374	B	66	59.8	61.0	61.0	61.8	61.0	61.8	61.0	1.2	1.2	2.0	1.2	2.0	1.2
375	B	66	59.8	61.1	61.1	62.0	61.1	62.0	61.1	1.3	1.3	2.2	1.3	2.2	1.3
376	B	66	59.7	60.9	60.9	61.9	60.9	61.9	60.9	1.2	1.2	2.2	1.2	2.2	1.2
377	B	66	59.7	60.9	60.9	62.0	60.9	62.0	60.9	1.2	1.2	2.3	1.2	2.3	1.2
378	B	66	59.5	60.8	60.8	61.9	60.7	61.9	60.8	1.3	1.3	2.4	1.2	2.4	1.3
379	B	66	59.4	60.6	60.6	61.8	60.6	61.8	60.6	1.2	1.2	2.4	1.2	2.4	1.2
380	B	66	59.3	60.5	60.5	61.8	60.5	61.8	60.5	1.2	1.2	2.5	1.2	2.5	1.2
381	B	66	59.5	60.8	60.8	62.0	60.6	62.0	60.8	1.3	1.3	2.5	1.1	2.5	1.3
382	B	66	59.4	60.8	60.8	61.9	60.6	61.9	60.8	1.4	1.4	2.5	1.2	2.5	1.4
383	B	66	59.2	60.5	60.5	61.6	60.3	61.6	60.5	1.3	1.3	2.4	1.1	2.4	1.3
384	B	66	59.2	60.5	60.5	61.6	60.4	61.6	60.5	1.3	1.3	2.4	1.2	2.4	1.3
385	B	66	59.6	60.9	60.9	62.0	60.8	62.0	60.9	1.3	1.3	2.4	1.2	2.4	1.3
386	B	66	59.6	60.9	60.9	61.9	60.8	61.9	60.9	1.3	1.3	2.3	1.2	2.3	1.3
387	B	66	59.9	61.3	61.3	62.2	61.1	62.2	61.3	1.4	1.4	2.3	1.2	2.3	1.4
388	B	66	60.2	61.5	61.5	62.4	61.3	62.4	61.5	1.3	1.3	2.2	1.1	2.2	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
389	B	66	60.3	61.6	61.6	62.2	61.2	62.2	61.6	1.3	1.3	1.9	0.9	1.9	1.3
390	B	66	60.3	61.7	61.7	62.2	61.2	62.2	61.7	1.4	1.4	1.9	0.9	1.9	1.4
391	B	66	60.2	61.6	61.6	62.1	61.2	62.1	61.6	1.4	1.4	1.9	1.0	1.9	1.4
392	B	66	60.2	61.6	61.6	62.0	61.1	62.0	61.6	1.4	1.4	1.8	0.9	1.8	1.4
393	B	66	60.2	61.6	61.6	62.0	61.1	62.0	61.6	1.4	1.4	1.8	0.9	1.8	1.4
394	B	66	60.4	61.7	61.7	62.3	61.3	62.2	61.7	1.3	1.3	1.9	0.9	1.8	1.3
395	B	66	67.5	68.6	68.6	68.7	68.7	68.8	68.6	1.1	1.1	1.2	1.2	1.3	1.1
396	B	66	65.8	66.9	66.9	67.2	67.0	67.2	66.9	1.1	1.1	1.4	1.2	1.4	1.1
397	B	66	65.1	66.2	66.2	66.5	66.3	66.6	66.2	1.1	1.1	1.4	1.2	1.5	1.1
398	B	66	64.1	65.3	65.3	65.6	65.3	65.7	65.3	1.2	1.2	1.5	1.2	1.6	1.2
399	B	66	63.2	64.4	64.4	64.9	64.2	64.9	64.4	1.2	1.2	1.7	1.0	1.7	1.2
400	B	66	62.7	64.0	64.0	64.5	63.8	64.6	64.0	1.3	1.3	1.8	1.1	1.9	1.3
401	B	66	62.4	63.6	63.6	64.1	63.4	64.3	63.6	1.2	1.2	1.7	1.0	1.9	1.2
402	B	66	61.6	62.9	62.9	63.4	62.5	63.6	62.9	1.3	1.3	1.8	0.9	2.0	1.3
403	B	66	61.0	62.3	62.3	62.9	61.8	62.9	62.3	1.3	1.3	1.9	0.8	1.9	1.3
404	B	66	60.5	61.9	61.9	62.4	61.4	62.5	61.9	1.4	1.4	1.9	0.9	2.0	1.4
405	D	51	44.2	45.6	45.6	45.9	45.0	45.8	45.6	1.4	1.4	1.7	0.8	1.6	1.4
406	C	66	62.8	64.1	64.1	64.2	64.2	64.2	64.1	1.3	1.3	1.4	1.4	1.4	1.3
407	C	66	63.2	64.5	64.5	64.6	64.6	64.6	64.5	1.3	1.3	1.4	1.4	1.4	1.3
408	C	66	63.4	64.7	64.7	64.7	64.7	64.7	64.7	1.3	1.3	1.3	1.3	1.3	1.3
409	C	66	63.5	64.7	64.7	64.8	64.7	64.8	64.7	1.2	1.2	1.3	1.2	1.3	1.2
410	C	66	65.0	66.4	66.4	66.4	66.4	66.4	66.4	1.4	1.4	1.4	1.4	1.4	1.4
411	C	66	65.8	67.2	67.2	67.2	67.2	67.2	67.2	1.4	1.4	1.4	1.4	1.4	1.4
412	C	66	64.9	66.2	66.2	66.2	66.2	66.2	66.2	1.3	1.3	1.3	1.3	1.3	1.3
413	C	66	64.8	66.1	66.1	66.1	66.1	66.1	66.1	1.3	1.3	1.3	1.3	1.3	1.3
414	C	66	65.1	66.3	66.3	66.4	66.3	66.3	66.3	1.2	1.2	1.3	1.2	1.2	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
415	C	66	65.0	66.2	66.2	66.2	66.2	66.2	66.2	1.2	1.2	1.2	1.2	1.2	1.2
416	C	66	65.2	66.4	66.4	66.4	66.4	66.4	66.4	1.2	1.2	1.2	1.2	1.2	1.2
417	C	66	65.2	66.4	66.4	66.4	66.4	66.4	66.4	1.2	1.2	1.2	1.2	1.2	1.2
418	C	66	62.1	63.5	63.5	63.5	63.6	63.5	63.5	1.4	1.4	1.4	1.5	1.4	1.4
419	C	66	56.2	57.6	57.6	57.7	57.7	57.7	57.6	1.4	1.4	1.5	1.5	1.5	1.4
420	B	66	59.8	61.2	61.2	61.2	61.2	61.2	61.2	1.4	1.4	1.4	1.4	1.4	1.4
421	B	66	62.0	63.4	63.4	63.4	63.4	63.4	63.4	1.4	1.4	1.4	1.4	1.4	1.4
422	B	66	57.5	59.0	59.0	59.0	59.0	59.0	59.0	1.5	1.5	1.5	1.5	1.5	1.5
423	B	66	57.0	58.4	58.4	58.4	58.4	58.4	58.4	1.4	1.4	1.4	1.4	1.4	1.4
424	B	66	55.6	57.0	57.0	57.0	57.0	57.0	57.0	1.4	1.4	1.4	1.4	1.4	1.4
425	B	66	59.0	60.4	60.4	60.4	60.4	60.4	60.4	1.4	1.4	1.4	1.4	1.4	1.4
426	B	66	72.3	73.4	73.4	73.4	73.4	73.4	73.4	1.1	1.1	1.1	1.1	1.1	1.1
427	B	66	63.1	64.6	64.6	64.6	64.6	64.6	64.6	1.5	1.5	1.5	1.5	1.5	1.5
428	B	66	71.0	72.1	72.1	72.1	72.1	72.1	72.1	1.1	1.1	1.1	1.1	1.1	1.1
429	B	66	61.6	63.1	63.1	63.1	63.1	63.1	63.1	1.5	1.5	1.5	1.5	1.5	1.5
430	B	66	70.3	71.4	71.4	71.4	71.4	71.4	71.4	1.1	1.1	1.1	1.1	1.1	1.1
431	B	66	60.1	61.5	61.5	61.5	61.5	61.5	61.5	1.4	1.4	1.4	1.4	1.4	1.4
432	B	66	69.4	70.6	70.6	70.6	70.6	70.6	70.6	1.2	1.2	1.2	1.2	1.2	1.2
433	B	66	59.5	60.9	60.9	60.9	60.9	60.9	60.9	1.4	1.4	1.4	1.4	1.4	1.4
434	B	66	68.0	69.2	69.2	69.2	69.2	69.2	69.2	1.2	1.2	1.2	1.2	1.2	1.2
435	B	66	58.8	60.1	60.1	60.1	60.1	60.1	60.1	1.3	1.3	1.3	1.3	1.3	1.3
436	B	66	67.2	68.4	68.4	68.4	68.4	68.4	68.4	1.2	1.2	1.2	1.2	1.2	1.2
437	B	66	57.1	58.5	58.5	58.5	58.5	58.5	58.5	1.4	1.4	1.4	1.4	1.4	1.4
438	B	66	58.5	59.9	59.9	59.9	59.9	59.9	59.9	1.4	1.4	1.4	1.4	1.4	1.4
439	B	66	66.6	67.9	67.9	67.9	67.9	67.9	67.9	1.3	1.3	1.3	1.3	1.3	1.3
440	B	66	59.9	61.4	61.4	61.4	61.4	61.4	61.4	1.5	1.5	1.5	1.5	1.5	1.5

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
441	B	66	56.7	58.2	58.2	58.2	58.2	58.2	58.2	1.5	1.5	1.5	1.5	1.5	1.5
442	B	66	54.6	56.2	56.2	56.2	56.2	56.2	56.1	1.6	1.6	1.6	1.6	1.6	1.5
443	B	66	56.4	57.9	57.9	57.9	57.9	57.9	57.9	1.5	1.5	1.5	1.5	1.5	1.5
444	B	66	54.1	55.5	55.5	55.5	55.5	55.5	55.5	1.4	1.4	1.4	1.4	1.4	1.4
445	B	66	56.0	57.5	57.5	57.5	57.5	57.5	57.5	1.5	1.5	1.5	1.5	1.5	1.5
446	B	66	55.6	57.1	57.1	57.1	57.1	57.1	57.1	1.5	1.5	1.5	1.5	1.5	1.5
447	B	66	55.4	56.8	56.8	56.8	56.8	56.8	56.8	1.4	1.4	1.4	1.4	1.4	1.4
448	B	66	54.3	55.8	55.8	55.8	55.8	55.8	55.7	1.5	1.5	1.5	1.5	1.5	1.4
449	B	66	54.0	55.4	55.4	55.4	55.4	55.4	55.4	1.4	1.4	1.4	1.4	1.4	1.4
450	B	66	65.8	67.2	67.2	67.2	67.2	67.2	67.2	1.4	1.4	1.4	1.4	1.4	1.4
451	B	66	67.4	68.7	68.7	68.7	68.7	68.7	68.7	1.3	1.3	1.3	1.3	1.3	1.3
452	B	66	54.6	56.0	56.0	56.0	56.0	56.0	56.0	1.4	1.4	1.4	1.4	1.4	1.4
453	B	66	55.2	56.6	56.6	56.6	56.6	56.6	56.6	1.4	1.4	1.4	1.4	1.4	1.4
454	B	66	55.9	57.4	57.4	57.4	57.4	57.4	57.4	1.5	1.5	1.5	1.5	1.5	1.5
455	B	66	56.7	58.2	58.2	58.2	58.2	58.2	58.2	1.5	1.5	1.5	1.5	1.5	1.5
456	B	66	59.3	61.0	61.0	61.0	61.0	61.0	61.0	1.7	1.7	1.7	1.7	1.7	1.7
457	B	66	61.3	62.9	62.9	62.9	62.9	62.9	62.9	1.6	1.6	1.6	1.6	1.6	1.6
458	B	66	64.0	65.5	65.5	65.5	65.5	65.5	65.5	1.5	1.5	1.5	1.5	1.5	1.5
459	B	66	66.1	67.4	67.4	67.4	67.4	67.4	67.4	1.3	1.3	1.3	1.3	1.3	1.3
460	B	66	65.7	67.0	67.0	67.0	67.0	67.0	67.0	1.3	1.3	1.3	1.3	1.3	1.3
461	B	66	65.1	66.5	66.5	66.5	66.5	66.5	66.5	1.4	1.4	1.4	1.4	1.4	1.4
462	B	66	54.5	56.0	56.0	56.0	56.0	56.0	56.0	1.5	1.5	1.5	1.5	1.5	1.5
463	B	66	56.2	57.8	57.8	57.8	57.9	57.8	57.8	1.6	1.6	1.6	1.7	1.6	1.6
464	B	66	57.4	59.1	59.1	59.1	59.1	59.1	59.1	1.7	1.7	1.7	1.7	1.7	1.7
465	B	66	56.3	57.9	57.9	57.9	57.9	57.9	57.9	1.6	1.6	1.6	1.6	1.6	1.6
466	B	66	55.1	56.6	56.6	56.6	56.6	56.6	56.6	1.5	1.5	1.5	1.5	1.5	1.5

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
467	B	66	54.8	56.3	56.3	56.3	56.3	56.3	56.3	1.5	1.5	1.5	1.5	1.5	1.5
468	B	66	60.4	61.0	61.0	61.0	61.0	61.0	61.0	0.6	0.6	0.6	0.6	0.6	0.6
469	B	66	61.9	62.7	62.7	62.7	62.7	62.7	62.7	0.8	0.8	0.8	0.8	0.8	0.8
470	B	66	67.9	68.9	68.9	68.9	68.9	68.9	68.9	1.0	1.0	1.0	1.0	1.0	1.0
471	B	66	59.4	60.7	60.7	60.7	60.7	60.7	60.6	1.3	1.3	1.3	1.3	1.3	1.2
472	B	66	59.6	60.9	60.9	60.9	60.9	60.9	60.9	1.3	1.3	1.3	1.3	1.3	1.3
473	B	66	59.3	60.6	60.6	60.6	60.6	60.6	60.6	1.3	1.3	1.3	1.3	1.3	1.3
474	B	66	59.7	61.0	61.0	61.0	61.0	61.0	61.0	1.3	1.3	1.3	1.3	1.3	1.3
475	B	66	59.7	61.0	61.0	61.1	61.1	61.1	61.0	1.3	1.3	1.4	1.4	1.4	1.3
476	B	66	59.7	61.0	61.0	61.1	61.1	61.1	61.0	1.3	1.3	1.4	1.4	1.4	1.3
477	B	66	59.7	61.0	61.0	61.1	61.1	61.1	61.0	1.3	1.3	1.4	1.4	1.4	1.3
478	B	66	60.3	61.6	61.6	61.7	61.7	61.7	61.6	1.3	1.3	1.4	1.4	1.4	1.3
479	B	66	63.0	64.2	64.2	64.2	64.2	64.2	64.2	1.2	1.2	1.2	1.2	1.2	1.2
480	B	66	65.4	66.6	66.6	66.6	66.6	66.6	66.6	1.2	1.2	1.2	1.2	1.2	1.2
481	B	66	65.5	66.6	66.6	66.6	66.6	66.6	66.6	1.1	1.1	1.1	1.1	1.1	1.1
482	B	66	67.1	68.1	68.1	68.1	68.1	68.1	68.1	1.0	1.0	1.0	1.0	1.0	1.0
483	B	66	66.6	67.5	67.5	67.5	67.5	67.5	67.5	0.9	0.9	0.9	0.9	0.9	0.9
484	B	66	60.1	61.5	61.5	61.5	61.5	61.5	61.5	1.4	1.4	1.4	1.4	1.4	1.4
485	B	66	65.4	66.8	66.8	66.8	66.8	66.8	66.8	1.4	1.4	1.4	1.4	1.4	1.4
486	B	66	54.0	55.3	55.3	55.4	55.4	55.4	55.3	1.3	1.3	1.4	1.4	1.4	1.3
487	B	66	54.4	55.7	55.7	55.7	55.7	55.8	55.7	1.3	1.3	1.3	1.3	1.4	1.3
488	B	66	55.2	56.4	56.4	56.5	56.5	56.5	56.4	1.2	1.2	1.3	1.3	1.3	1.2
489	B	66	55.7	56.9	56.9	57.0	57.0	57.0	56.9	1.2	1.2	1.3	1.3	1.3	1.2
490	B	66	56.8	58.0	58.0	58.0	58.0	58.1	58.0	1.2	1.2	1.2	1.2	1.3	1.2
491	B	66	57.7	58.9	58.9	58.9	58.9	58.9	58.9	1.2	1.2	1.2	1.2	1.2	1.2
492	B	66	58.4	59.6	59.6	59.6	59.6	59.7	59.6	1.2	1.2	1.2	1.2	1.3	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
493	B	66	59.8	61.0	61.0	61.0	61.0	61.0	61.0	1.2	1.2	1.2	1.2	1.2	1.2
494	B	66	60.2	61.4	61.4	61.4	61.4	61.4	61.4	1.2	1.2	1.2	1.2	1.2	1.2
495	B	66	62.6	63.7	63.7	63.8	63.8	63.8	63.7	1.1	1.1	1.2	1.2	1.2	1.1
496	B	66	53.4	54.7	54.7	54.8	54.8	54.9	54.7	1.3	1.3	1.4	1.4	1.5	1.3
497	B	66	53.9	55.1	55.1	55.2	55.2	55.3	55.1	1.2	1.2	1.3	1.3	1.4	1.2
498	B	66	53.7	55.0	55.0	55.1	55.0	55.1	55.0	1.3	1.3	1.4	1.3	1.4	1.3
499	B	66	54.5	55.7	55.7	55.8	55.8	55.9	55.7	1.2	1.2	1.3	1.3	1.4	1.2
500	B	66	54.8	56.0	56.0	56.1	56.1	56.2	56.0	1.2	1.2	1.3	1.3	1.4	1.2
501	B	66	55.6	56.8	56.8	56.9	56.8	56.9	56.8	1.2	1.2	1.3	1.2	1.3	1.2
502	B	66	56.3	57.4	57.4	57.5	57.5	57.6	57.4	1.1	1.1	1.2	1.2	1.3	1.1
503	B	66	56.9	58.0	58.0	58.1	58.0	58.1	58.0	1.1	1.1	1.2	1.1	1.2	1.1
504	B	66	54.7	55.9	55.9	56.0	56.0	56.1	55.9	1.2	1.2	1.3	1.3	1.4	1.2
505	B	66	56.0	57.1	57.1	57.2	57.2	57.3	57.1	1.1	1.1	1.2	1.2	1.3	1.1
506	B	66	54.2	55.4	55.4	55.5	55.5	55.7	55.4	1.2	1.2	1.3	1.3	1.5	1.2
507	B	66	58.1	59.2	59.2	59.2	59.2	59.3	59.2	1.1	1.1	1.1	1.1	1.2	1.1
508	B	66	58.6	59.7	59.7	59.7	59.7	59.8	59.7	1.1	1.1	1.1	1.1	1.2	1.1
509	B	66	57.8	58.9	58.9	58.9	58.9	59.0	58.9	1.1	1.1	1.1	1.1	1.2	1.1
510	B	66	54.8	56.0	56.0	56.2	56.1	56.3	56.0	1.2	1.2	1.4	1.3	1.5	1.2
511	B	66	55.7	56.9	56.9	57.0	56.9	57.1	56.8	1.2	1.2	1.3	1.2	1.4	1.1
512	B	66	56.8	57.9	57.9	58.1	58.0	58.2	57.9	1.1	1.1	1.3	1.2	1.4	1.1
513	B	66	55.6	56.8	56.8	57.0	56.8	57.1	56.8	1.2	1.2	1.4	1.2	1.5	1.2
514	B	66	56.6	57.8	57.8	57.9	57.8	58.0	57.8	1.2	1.2	1.3	1.2	1.4	1.2
515	B	66	57.5	58.6	58.6	58.8	58.7	58.9	58.6	1.1	1.1	1.3	1.2	1.4	1.1
516	B	66	57.2	58.4	58.4	58.6	58.4	58.8	58.4	1.2	1.2	1.4	1.2	1.6	1.2
517	B	66	57.9	59.1	59.1	59.2	59.1	59.4	59.1	1.2	1.2	1.3	1.2	1.5	1.2
518	B	66	59.8	60.8	60.8	60.9	60.9	61.0	60.8	1.0	1.0	1.1	1.1	1.2	1.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
519	B	66	62.5	63.6	63.6	63.6	63.6	63.7	63.6	1.1	1.1	1.1	1.1	1.2	1.1
520	B	66	64.5	65.6	65.6	65.6	65.6	65.7	65.6	1.1	1.1	1.1	1.1	1.2	1.1
521	B	66	56.5	57.8	57.8	58.0	57.8	58.3	57.8	1.3	1.3	1.5	1.3	1.8	1.3
522	B	66	57.2	58.4	58.4	58.6	58.4	58.9	58.4	1.2	1.2	1.4	1.2	1.7	1.2
523	B	66	58.0	59.1	59.1	59.3	59.2	59.5	59.1	1.1	1.1	1.3	1.2	1.5	1.1
524	B	66	59.0	60.0	60.0	60.2	60.1	60.4	60.0	1.0	1.0	1.2	1.1	1.4	1.0
525	B	66	60.3	61.4	61.4	61.5	61.4	61.6	61.4	1.1	1.1	1.2	1.1	1.3	1.1
526	B	66	62.7	63.7	63.7	63.8	63.8	63.8	63.7	1.0	1.0	1.1	1.1	1.1	1.0
527	B	66	65.0	66.1	66.1	66.2	66.2	66.2	66.1	1.1	1.1	1.2	1.2	1.2	1.1
528	B	66	57.0	58.2	58.2	58.6	58.2	58.9	58.2	1.2	1.2	1.6	1.2	1.9	1.2
529	B	66	57.7	58.9	58.9	59.1	58.9	59.4	58.9	1.2	1.2	1.4	1.2	1.7	1.2
530	B	66	57.3	58.6	58.6	59.0	58.6	59.3	58.6	1.3	1.3	1.7	1.3	2.0	1.3
531	B	66	57.9	59.2	59.2	59.6	59.1	59.9	59.2	1.3	1.3	1.7	1.2	2.0	1.3
532	B	66	58.2	59.5	59.5	59.9	59.4	60.2	59.5	1.3	1.3	1.7	1.2	2.0	1.3
533	B	66	58.9	60.2	60.2	60.6	60.0	60.9	60.2	1.3	1.3	1.7	1.1	2.0	1.3
534	B	66	59.8	61.1	61.1	61.5	60.8	61.8	61.1	1.3	1.3	1.7	1.0	2.0	1.3
535	B	66	60.2	61.5	61.5	62.0	61.3	62.3	61.5	1.3	1.3	1.8	1.1	2.1	1.3
536	B	66	58.7	59.8	59.8	60.1	59.8	60.3	59.8	1.1	1.1	1.4	1.1	1.6	1.1
537	B	66	59.0	60.2	60.2	60.5	60.3	60.7	60.2	1.2	1.2	1.5	1.3	1.7	1.2
538	B	66	59.5	60.6	60.6	61.0	60.7	61.2	60.6	1.1	1.1	1.5	1.2	1.7	1.1
539	B	66	59.6	60.8	60.8	61.1	60.8	61.4	60.8	1.2	1.2	1.5	1.2	1.8	1.2
540	B	66	60.1	61.2	61.2	61.6	61.3	61.9	61.2	1.1	1.1	1.5	1.2	1.8	1.1
541	B	66	61.2	62.4	62.4	62.8	62.3	63.0	62.4	1.2	1.2	1.6	1.1	1.8	1.2
542	B	66	61.2	62.2	62.2	62.4	62.3	62.5	62.2	1.0	1.0	1.2	1.1	1.3	1.0
543	B	66	62.8	63.8	63.8	63.9	63.9	64.0	63.8	1.0	1.0	1.1	1.1	1.2	1.0
544	B	66	61.9	63.0	63.0	63.2	63.1	63.2	63.0	1.1	1.1	1.3	1.2	1.3	1.1

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA 2012 Existing	2035 Build C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	Difference between Existing/Build C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
545	B	66	62.0	63.1	63.1	63.2	63.2	63.4	63.1	1.1	1.1	1.2	1.2	1.4	1.1
546	B	66	62.2	63.3	63.3	63.5	63.5	63.7	63.3	1.1	1.1	1.3	1.3	1.5	1.1
547	B	66	63.2	64.3	64.3	64.5	64.4	64.6	64.3	1.1	1.1	1.3	1.2	1.4	1.1
548	B	66	65.5	66.7	66.7	66.7	66.7	66.7	66.6	1.2	1.2	1.2	1.2	1.2	1.1
549	B	66	63.4	64.5	64.5	64.6	64.6	64.7	64.5	1.1	1.1	1.2	1.2	1.3	1.1
550	B	66	63.6	64.7	64.7	64.8	64.8	64.9	64.7	1.1	1.1	1.2	1.2	1.3	1.1
551	B	66	64.8	65.9	65.9	66.0	66.0	66.1	65.9	1.1	1.1	1.2	1.2	1.3	1.1
552	B	66	64.2	65.3	65.3	65.4	65.4	65.5	65.3	1.1	1.1	1.2	1.2	1.3	1.1
553	C	66	67.7	69.2	69.2	69.2	69.2	69.2	69.2	1.5	1.5	1.5	1.5	1.5	1.5
554	C	66	65.4	66.9	66.9	66.9	66.9	66.9	66.9	1.5	1.5	1.5	1.5	1.5	1.5
555	C	66	63.6	65.0	65.0	65.1	65.1	65.1	65.0	1.4	1.4	1.5	1.5	1.5	1.4
556	C	66	61.9	63.3	63.3	63.3	63.3	63.3	63.3	1.4	1.4	1.4	1.4	1.4	1.4
557	C	66	61.0	62.4	62.4	62.5	62.5	62.5	62.4	1.4	1.4	1.5	1.5	1.5	1.4
558	C	66	59.8	61.2	61.2	61.3	61.3	61.3	61.2	1.4	1.4	1.5	1.5	1.5	1.4
559	B	66	54.4	55.7	55.7	55.7	55.7	55.7	55.7	1.3	1.3	1.3	1.3	1.3	1.3
560	B	66	53.6	55.0	55.0	55.0	55.0	55.0	54.9	1.4	1.4	1.4	1.4	1.4	1.3
561	B	66	53.4	54.7	54.7	54.7	54.7	54.7	54.7	1.3	1.3	1.3	1.3	1.3	1.3
562	B	66	58.7	59.6	59.6	59.6	59.6	59.6	59.6	0.9	0.9	0.9	0.9	0.9	0.9
563	B	66	56.3	57.5	57.5	57.5	57.5	57.5	57.5	1.2	1.2	1.2	1.2	1.2	1.2
564	B	66	56.2	57.5	57.5	57.5	57.5	57.5	57.5	1.3	1.3	1.3	1.3	1.3	1.3
565	B	66	55.1	56.4	56.4	56.4	56.4	56.4	56.4	1.3	1.3	1.3	1.3	1.3	1.3
566	B	66	54.5	55.9	55.9	55.9	55.9	55.9	55.9	1.4	1.4	1.4	1.4	1.4	1.4
567	B	66	54.1	55.5	55.5	55.5	55.5	55.5	55.4	1.4	1.4	1.4	1.4	1.4	1.3
568	B	66	54.0	55.4	55.4	55.4	55.4	55.4	55.4	1.4	1.4	1.4	1.4	1.4	1.4
569	B	66	59.8	60.7	60.7	60.7	60.7	60.7	60.7	0.9	0.9	0.9	0.9	0.9	0.9
570	B	66	58.2	59.2	59.2	59.3	59.3	59.3	59.2	1.0	1.0	1.1	1.1	1.1	1.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
571	B	66	55.9	57.2	57.2	57.2	57.2	57.2	57.2	1.3	1.3	1.3	1.3	1.3	1.3
572	B	66	55.5	56.9	56.9	56.9	56.9	56.9	56.9	1.4	1.4	1.4	1.4	1.4	1.4
573	B	66	54.8	56.2	56.2	56.1	56.1	56.1	56.1	1.4	1.4	1.3	1.3	1.3	1.3
574	B	66	54.5	56.0	56.0	55.9	55.9	55.9	55.9	1.5	1.5	1.4	1.4	1.4	1.4
575	B	66	54.6	56.1	56.1	56.0	56.0	56.0	56.0	1.5	1.5	1.4	1.4	1.4	1.4
576	B	66	56.9	58.2	58.2	58.3	58.3	58.3	58.2	1.3	1.3	1.4	1.4	1.4	1.3
577	B	66	56.8	58.2	58.2	58.3	58.3	58.3	58.2	1.4	1.4	1.5	1.5	1.5	1.4
578	B	66	56.6	57.9	57.9	58.0	58.0	58.0	57.9	1.3	1.3	1.4	1.4	1.4	1.3
579	B	66	56.2	57.5	57.5	57.6	57.6	57.6	57.5	1.3	1.3	1.4	1.4	1.4	1.3
580	B	66	57.6	58.3	58.3	58.4	58.4	58.4	58.3	0.7	0.7	0.8	0.8	0.8	0.7
581	B	66	57.2	58.0	58.0	58.1	58.1	58.1	58.0	0.8	0.8	0.9	0.9	0.9	0.8
582	B	66	57.1	58.0	58.0	58.0	58.1	58.1	58.0	0.9	0.9	0.9	1.0	1.0	0.9
583	B	66	56.1	57.4	57.4	57.5	57.5	57.5	57.4	1.3	1.3	1.4	1.4	1.4	1.3
584	B	66	56.0	57.3	57.3	57.4	57.4	57.4	57.3	1.3	1.3	1.4	1.4	1.4	1.3
585	B	66	55.7	57.0	57.0	57.1	57.1	57.2	57.0	1.3	1.3	1.4	1.4	1.5	1.3
586	B	66	55.8	57.1	57.1	57.2	57.2	57.2	57.1	1.3	1.3	1.4	1.4	1.4	1.3
587	B	66	55.7	57.0	57.0	57.1	57.1	57.1	57.0	1.3	1.3	1.4	1.4	1.4	1.3
588	B	66	55.8	57.2	57.2	57.3	57.3	57.3	57.2	1.4	1.4	1.5	1.5	1.5	1.4
589	B	66	56.2	57.5	57.5	57.6	57.6	57.6	57.5	1.3	1.3	1.4	1.4	1.4	1.3
590	B	66	55.8	57.1	57.1	57.2	57.2	57.2	57.1	1.3	1.3	1.4	1.4	1.4	1.3
591	B	66	55.8	57.2	57.2	57.3	57.3	57.3	57.2	1.4	1.4	1.5	1.5	1.5	1.4
592	B	66	55.9	57.2	57.2	57.3	57.3	57.3	57.2	1.3	1.3	1.4	1.4	1.4	1.3
593	B	66	56.1	57.5	57.5	57.6	57.6	57.6	57.5	1.4	1.4	1.5	1.5	1.5	1.4
594	B	66	56.2	57.6	57.6	57.6	57.6	57.7	57.6	1.4	1.4	1.4	1.4	1.5	1.4
595	B	66	56.5	57.8	57.8	57.9	57.9	57.9	57.8	1.3	1.3	1.4	1.4	1.4	1.3
596	B	66	56.8	58.2	58.2	58.3	58.3	58.3	58.2	1.4	1.4	1.5	1.5	1.5	1.4

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
597	B	66	59.8	60.8	60.8	60.8	60.8	60.8	60.8	1.0	1.0	1.0	1.0	1.0	1.0
598	B	66	59.3	60.3	60.3	60.3	60.3	60.3	60.3	1.0	1.0	1.0	1.0	1.0	1.0
599	B	66	59.3	60.3	60.3	60.3	60.3	60.3	60.3	1.0	1.0	1.0	1.0	1.0	1.0
600	B	66	59.5	60.6	60.6	60.6	60.6	60.6	60.6	1.1	1.1	1.1	1.1	1.1	1.1
601	B	66	59.3	60.4	60.4	60.4	60.4	60.4	60.4	1.1	1.1	1.1	1.1	1.1	1.1
602	B	66	59.6	60.8	60.8	60.8	60.8	60.8	60.8	1.2	1.2	1.2	1.2	1.2	1.2
603	B	66	60.1	61.4	61.4	61.4	61.4	61.4	61.4	1.3	1.3	1.3	1.3	1.3	1.3
604	B	66	60.2	61.5	61.5	61.5	61.5	61.5	61.5	1.3	1.3	1.3	1.3	1.3	1.3
605	B	66	57.8	59.2	59.2	59.2	59.2	59.2	59.2	1.4	1.4	1.4	1.4	1.4	1.4
606	B	66	56.7	58.1	58.1	58.2	58.2	58.2	58.1	1.4	1.4	1.5	1.5	1.5	1.4
607	B	66	57.4	58.8	58.8	58.8	58.8	58.8	58.8	1.4	1.4	1.4	1.4	1.4	1.4
608	B	66	57.8	59.2	59.2	59.2	59.2	59.2	59.2	1.4	1.4	1.4	1.4	1.4	1.4
609	B	66	57.7	59.1	59.1	59.1	59.1	59.1	59.1	1.4	1.4	1.4	1.4	1.4	1.4
610	B	66	58.0	59.4	59.4	59.4	59.4	59.4	59.4	1.4	1.4	1.4	1.4	1.4	1.4
611	B	66	58.9	60.3	60.3	60.3	60.3	60.3	60.3	1.4	1.4	1.4	1.4	1.4	1.4
612	B	66	59.7	61.1	61.1	61.1	61.1	61.1	61.1	1.4	1.4	1.4	1.4	1.4	1.4
613	B	66	59.4	60.8	60.8	60.8	60.8	60.8	60.8	1.4	1.4	1.4	1.4	1.4	1.4
614	B	66	58.8	60.2	60.2	60.2	60.2	60.2	60.2	1.4	1.4	1.4	1.4	1.4	1.4
615	B	66	56.4	57.8	57.8	57.8	57.8	57.8	57.8	1.4	1.4	1.4	1.4	1.4	1.4
616	B	66	57.3	58.8	58.8	58.8	58.8	58.8	58.8	1.5	1.5	1.5	1.5	1.5	1.5
617	B	66	56.9	58.3	58.3	58.3	58.3	58.3	58.3	1.4	1.4	1.4	1.4	1.4	1.4
618	B	66	57.8	59.2	59.2	59.2	59.2	59.2	59.2	1.4	1.4	1.4	1.4	1.4	1.4
619	B	66	57.9	59.4	59.4	59.4	59.4	59.4	59.4	1.5	1.5	1.5	1.5	1.5	1.5
620	B	66	58.4	59.9	59.9	59.9	59.9	59.9	59.9	1.5	1.5	1.5	1.5	1.5	1.5
621	B	66	58.3	59.8	59.8	59.8	59.8	59.8	59.8	1.5	1.5	1.5	1.5	1.5	1.5
622	B	66	58.9	59.7	59.7	59.8	59.8	59.8	59.7	0.8	0.8	0.9	0.9	0.9	0.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
623	B	66	56.8	58.1	58.1	58.1	58.1	58.1	58.1	1.3	1.3	1.3	1.3	1.3	1.3
624	B	66	58.5	59.5	59.5	59.5	59.5	59.5	59.5	1.0	1.0	1.0	1.0	1.0	1.0
625	B	66	56.4	57.8	57.8	57.8	57.8	57.8	57.7	1.4	1.4	1.4	1.4	1.4	1.3
626	B	66	57.9	59.0	59.0	59.0	59.0	59.0	59.0	1.1	1.1	1.1	1.1	1.1	1.1
627	B	66	57.9	59.0	59.0	59.0	59.0	59.0	59.0	1.1	1.1	1.1	1.1	1.1	1.1
628	B	66	58.4	59.5	59.5	59.6	59.6	59.6	59.5	1.1	1.1	1.2	1.2	1.2	1.1
629	B	66	58.9	60.1	60.1	60.1	60.1	60.1	60.1	1.2	1.2	1.2	1.2	1.2	1.2
630	B	66	59.8	61.1	61.1	61.1	61.1	61.1	61.1	1.3	1.3	1.3	1.3	1.3	1.3
631	B	66	56.5	57.9	57.9	57.9	57.9	57.9	57.9	1.4	1.4	1.4	1.4	1.4	1.4
632	B	66	57.2	58.5	58.5	58.6	58.6	58.6	58.5	1.3	1.3	1.4	1.4	1.4	1.3
633	B	66	57.9	59.2	59.3	59.3	59.3	59.3	59.2	1.3	1.4	1.4	1.4	1.4	1.3
634	B	66	58.8	60.2	60.2	60.2	60.2	60.2	60.2	1.4	1.4	1.4	1.4	1.4	1.4
635	B	66	59.7	61.1	61.1	61.1	61.1	61.1	61.1	1.4	1.4	1.4	1.4	1.4	1.4
636	B	66	59.9	61.3	61.3	61.3	61.3	61.3	61.3	1.4	1.4	1.4	1.4	1.4	1.4
637	B	66	58.6	59.9	59.9	59.9	59.9	59.9	59.9	1.3	1.3	1.3	1.3	1.3	1.3
638	B	66	59.2	60.6	60.6	60.6	60.6	60.6	60.6	1.4	1.4	1.4	1.4	1.4	1.4
639	B	66	59.9	61.0	61.0	61.0	61.0	61.0	61.0	1.1	1.1	1.1	1.1	1.1	1.1
640	B	66	60.1	61.3	61.3	61.3	61.3	61.3	61.3	1.2	1.2	1.2	1.2	1.2	1.2
641	B	66	60.2	61.4	61.4	61.4	61.4	61.4	61.4	1.2	1.2	1.2	1.2	1.2	1.2
642	B	66	60.6	61.9	61.9	61.8	61.8	61.8	61.8	1.3	1.3	1.2	1.2	1.2	1.2
643	B	66	60.9	62.2	62.2	62.2	62.2	62.2	62.2	1.3	1.3	1.3	1.3	1.3	1.3
644	B	66	61.3	62.8	62.8	62.8	62.8	62.8	62.8	1.5	1.5	1.5	1.5	1.5	1.5
645	B	66	61.8	63.4	63.4	63.4	63.4	63.4	63.4	1.6	1.6	1.6	1.6	1.6	1.6
646	B	66	61.5	63.1	63.1	63.1	63.1	63.1	63.1	1.6	1.6	1.6	1.6	1.6	1.6
647	B	66	62.9	64.5	64.5	64.5	64.5	64.5	64.5	1.6	1.6	1.6	1.6	1.6	1.6
648	B	66	61.9	63.5	63.5	63.5	63.5	63.5	63.5	1.6	1.6	1.6	1.6	1.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
649	B	66	62.0	63.6	63.6	63.6	63.6	63.6	63.6	1.6	1.6	1.6	1.6	1.6	1.6
650	B	66	61.3	62.9	62.9	62.9	62.9	62.9	62.9	1.6	1.6	1.6	1.6	1.6	1.6
651	B	66	61.7	63.3	63.3	63.3	63.3	63.3	63.3	1.6	1.6	1.6	1.6	1.6	1.6
652	B	66	61.4	63.0	63.0	63.0	63.0	63.0	63.0	1.6	1.6	1.6	1.6	1.6	1.6
653	B	66	61.5	63.0	63.0	63.0	63.0	63.0	63.0	1.5	1.5	1.5	1.5	1.5	1.5
654	B	66	61.2	62.7	62.7	62.7	62.7	62.7	62.7	1.5	1.5	1.5	1.5	1.5	1.5
655	B	66	60.5	62.1	62.1	62.1	62.1	62.1	62.1	1.6	1.6	1.6	1.6	1.6	1.6
656	B	66	60.0	61.6	61.6	61.6	61.6	61.6	61.6	1.6	1.6	1.6	1.6	1.6	1.6
657	B	66	60.8	62.3	62.3	62.3	62.3	62.3	62.3	1.5	1.5	1.5	1.5	1.5	1.5
658	B	66	63.6	65.2	65.2	65.2	65.2	65.2	65.2	1.6	1.6	1.6	1.6	1.6	1.6
659	B	66	64.2	65.9	65.9	65.9	65.9	65.9	65.9	1.7	1.7	1.7	1.7	1.7	1.7
660	B	66	64.1	65.8	65.8	65.8	65.8	65.8	65.8	1.7	1.7	1.7	1.7	1.7	1.7
661	B	66	64.0	65.6	65.6	65.6	65.6	65.6	65.6	1.6	1.6	1.6	1.6	1.6	1.6
662	B	66	64.0	65.7	65.7	65.7	65.7	65.7	65.7	1.7	1.7	1.7	1.7	1.7	1.7
663	B	66	64.5	66.1	66.1	66.1	66.1	66.1	66.1	1.6	1.6	1.6	1.6	1.6	1.6
664	B	66	64.3	65.9	65.9	65.9	65.9	65.9	65.9	1.6	1.6	1.6	1.6	1.6	1.6
665	B	66	64.1	65.6	65.6	65.6	65.6	65.6	65.6	1.5	1.5	1.5	1.5	1.5	1.5
666	B	66	64.6	66.1	66.1	66.1	66.1	66.1	66.1	1.5	1.5	1.5	1.5	1.5	1.5
667	B	66	64.5	66.1	66.1	66.1	66.1	66.1	66.1	1.6	1.6	1.6	1.6	1.6	1.6
668	B	66	63.9	65.5	65.5	65.4	65.4	65.4	65.4	1.6	1.6	1.5	1.5	1.5	1.5
669	B	66	65.0	66.5	66.5	66.5	66.5	66.5	66.5	1.5	1.5	1.5	1.5	1.5	1.5
670	B	66	59.0	60.5	60.5	60.5	60.5	60.5	60.5	1.5	1.5	1.5	1.5	1.5	1.5
671	B	66	60.2	61.7	61.7	61.7	61.7	61.7	61.7	1.5	1.5	1.5	1.5	1.5	1.5
672	B	66	58.9	60.4	60.4	60.4	60.4	60.4	60.4	1.5	1.5	1.5	1.5	1.5	1.5
673	B	66	59.4	60.9	60.9	60.9	60.9	60.9	60.9	1.5	1.5	1.5	1.5	1.5	1.5
674	B	66	59.6	61.1	61.1	61.1	61.1	61.1	61.1	1.5	1.5	1.5	1.5	1.5	1.5

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
675	B	66	59.4	60.9	60.9	60.9	60.9	60.9	60.9	1.5	1.5	1.5	1.5	1.5	1.5
676	B	66	59.9	61.4	61.4	61.4	61.4	61.4	61.4	1.5	1.5	1.5	1.5	1.5	1.5
677	B	66	60.1	61.6	61.6	61.6	61.6	61.6	61.6	1.5	1.5	1.5	1.5	1.5	1.5
678	B	66	60.9	62.4	62.4	62.3	62.3	62.3	62.3	1.5	1.5	1.4	1.4	1.4	1.4
679	B	66	61.2	62.8	62.8	62.8	62.8	62.8	62.8	1.6	1.6	1.6	1.6	1.6	1.6
680	B	66	61.4	63.0	63.0	62.9	62.9	62.9	62.9	1.6	1.6	1.5	1.5	1.5	1.5
681	B	66	61.9	63.4	63.4	63.4	63.4	63.4	63.4	1.5	1.5	1.5	1.5	1.5	1.5
682	B	66	61.8	63.3	63.3	63.3	63.3	63.3	63.3	1.5	1.5	1.5	1.5	1.5	1.5
683	B	66	62.2	63.7	63.7	63.6	63.6	63.6	63.6	1.5	1.5	1.4	1.4	1.4	1.4
684	B	66	61.8	63.3	63.3	63.3	63.3	63.3	63.3	1.5	1.5	1.5	1.5	1.5	1.5
685	B	66	61.8	63.3	63.3	63.3	63.3	63.3	63.3	1.5	1.5	1.5	1.5	1.5	1.5
686	B	66	61.9	63.3	63.3	63.3	63.3	63.3	63.3	1.4	1.4	1.4	1.4	1.4	1.4
687	B	66	64.9	66.4	66.4	66.4	66.4	66.4	66.4	1.5	1.5	1.5	1.5	1.5	1.5
688	B	66	65.0	66.5	66.5	66.5	66.5	66.5	66.5	1.5	1.5	1.5	1.5	1.5	1.5
689	B	66	65.5	67.1	67.1	67.1	67.1	67.1	67.1	1.6	1.6	1.6	1.6	1.6	1.6
690	B	66	66.1	67.7	67.7	67.7	67.7	67.7	67.7	1.6	1.6	1.6	1.6	1.6	1.6
691	B	66	66.2	67.8	67.7	67.7	67.7	67.7	67.7	1.6	1.5	1.5	1.5	1.5	1.5
692	B	66	67.0	68.5	68.5	68.5	68.5	68.5	68.5	1.5	1.5	1.5	1.5	1.5	1.5
693	B	66	66.4	68.0	68.0	67.9	67.9	67.9	67.9	1.6	1.6	1.5	1.5	1.5	1.5
694	B	66	66.4	68.0	68.0	67.9	67.9	67.9	67.9	1.6	1.6	1.5	1.5	1.5	1.5
695	B	66	66.8	68.3	68.3	68.3	68.3	68.3	68.3	1.5	1.5	1.5	1.5	1.5	1.5
696	B	66	67.0	68.5	68.5	68.5	68.5	68.5	68.5	1.5	1.5	1.5	1.5	1.5	1.5
697	B	66	68.4	69.9	69.9	69.9	69.9	69.9	69.9	1.5	1.5	1.5	1.5	1.5	1.5
698	B	66	62.5	63.9	63.9	63.9	63.9	63.9	63.9	1.4	1.4	1.4	1.4	1.4	1.4
699	B	66	63.5	64.9	64.9	64.9	64.9	64.9	64.9	1.4	1.4	1.4	1.4	1.4	1.4
700	B	66	62.7	64.1	64.1	64.1	64.1	64.1	64.1	1.4	1.4	1.4	1.4	1.4	1.4

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
701	B	66	63.2	64.6	64.6	64.6	64.6	64.6	64.6	1.4	1.4	1.4	1.4	1.4	1.4
702	B	66	65.1	66.6	66.6	66.6	66.6	66.6	66.6	1.5	1.5	1.5	1.5	1.5	1.5
703	B	66	66.1	67.6	67.6	67.6	67.6	67.6	67.6	1.5	1.5	1.5	1.5	1.5	1.5
704	B	66	67.4	68.9	68.9	68.9	68.9	68.9	68.9	1.5	1.5	1.5	1.5	1.5	1.5
705	B	66	67.3	68.8	68.8	68.8	68.8	68.8	68.8	1.5	1.5	1.5	1.5	1.5	1.5
706	B	66	58.3	59.7	59.7	59.8	59.8	59.8	59.7	1.4	1.4	1.5	1.5	1.5	1.4
707	B	66	59.3	60.7	60.7	60.7	60.7	60.7	60.7	1.4	1.4	1.4	1.4	1.4	1.4
708	B	66	59.0	60.4	60.4	60.4	60.4	60.4	60.4	1.4	1.4	1.4	1.4	1.4	1.4
709	B	66	59.4	60.8	60.8	60.9	60.9	60.9	60.8	1.4	1.4	1.5	1.5	1.5	1.4
710	B	66	59.8	61.2	61.2	61.3	61.3	61.3	61.2	1.4	1.4	1.5	1.5	1.5	1.4
711	B	66	61.2	62.7	62.7	62.7	62.7	62.7	62.7	1.5	1.5	1.5	1.5	1.5	1.5
712	B	66	61.1	62.6	62.6	62.6	62.6	62.6	62.6	1.5	1.5	1.5	1.5	1.5	1.5
713	B	66	61.1	62.5	62.5	62.6	62.6	62.6	62.5	1.4	1.4	1.5	1.5	1.5	1.4
714	B	66	61.3	62.8	62.8	62.8	62.8	62.8	62.8	1.5	1.5	1.5	1.5	1.5	1.5
715	B	66	64.5	66.0	66.0	66.0	66.0	66.0	66.0	1.5	1.5	1.5	1.5	1.5	1.5
716	B	66	65.0	66.4	66.4	66.4	66.4	66.4	66.4	1.4	1.4	1.4	1.4	1.4	1.4
717	B	66	65.3	66.8	66.8	66.8	66.8	66.8	66.8	1.5	1.5	1.5	1.5	1.5	1.5
718	B	66	66.2	67.7	67.7	67.7	67.7	67.7	67.7	1.5	1.5	1.5	1.5	1.5	1.5
719	B	66	65.8	67.3	67.3	67.3	67.3	67.3	67.3	1.5	1.5	1.5	1.5	1.5	1.5
720	B	66	66.1	67.6	67.6	67.6	67.6	67.6	67.6	1.5	1.5	1.5	1.5	1.5	1.5
721	B	66	65.6	67.0	67.0	67.1	67.1	67.1	67.1	1.4	1.4	1.5	1.5	1.5	1.5
722	B	66	65.4	66.9	66.9	66.9	66.9	66.9	66.9	1.5	1.5	1.5	1.5	1.5	1.5
723	B	66	66.0	67.5	67.5	67.5	67.5	67.5	67.5	1.5	1.5	1.5	1.5	1.5	1.5
724	C	66	63.2	64.7	64.7	64.7	64.7	64.7	64.7	1.5	1.5	1.5	1.5	1.5	1.5
725	B	66	54.0	55.1	55.1	55.0	55.0	55.0	55.0	1.1	1.1	1.0	1.0	1.0	1.0
726	B	66	54.0	55.1	55.1	55.1	55.1	55.1	55.1	1.1	1.1	1.1	1.1	1.1	1.1

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
727	B	66	54.2	55.3	55.3	55.2	55.2	55.2	55.2	1.1	1.1	1.0	1.0	1.0	1.0
728	B	66	58.7	59.6	59.6	59.6	59.6	59.6	59.6	0.9	0.9	0.9	0.9	0.9	0.9
729	B	66	61.6	62.6	62.6	62.6	62.6	62.6	62.6	1.0	1.0	1.0	1.0	1.0	1.0
730	B	66	64.5	65.5	65.5	65.4	65.4	65.4	65.4	1.0	1.0	0.9	0.9	0.9	0.9
731	B	66	68.8	69.4	69.4	69.4	69.4	69.4	69.4	0.6	0.6	0.6	0.6	0.6	0.6
732	B	66	54.9	56.0	56.0	55.9	55.9	55.9	55.9	1.1	1.1	1.0	1.0	1.0	1.0
733	B	66	54.8	55.9	55.9	55.9	55.9	55.9	55.9	1.1	1.1	1.1	1.1	1.1	1.1
734	B	66	55.7	56.8	56.8	56.8	56.8	56.8	56.8	1.1	1.1	1.1	1.1	1.1	1.1
735	B	66	56.7	57.8	57.8	57.8	57.8	57.8	57.8	1.1	1.1	1.1	1.1	1.1	1.1
736	B	66	56.3	57.4	57.4	57.4	57.4	57.4	57.4	1.1	1.1	1.1	1.1	1.1	1.1
737	B	66	58.7	59.7	59.7	59.7	59.7	59.7	59.7	1.0	1.0	1.0	1.0	1.0	1.0
738	B	66	61.8	62.9	62.9	62.9	62.9	62.9	62.9	1.1	1.1	1.1	1.1	1.1	1.1
739	B	66	64.2	65.3	65.3	65.3	65.3	65.3	65.3	1.1	1.1	1.1	1.1	1.1	1.1
740	B	66	69.1	70.0	70.0	70.0	70.0	70.0	70.0	0.9	0.9	0.9	0.9	0.9	0.9
741	B	66	69.2	70.2	70.2	70.2	70.2	70.2	70.2	1.0	1.0	1.0	1.0	1.0	1.0
742	B	66	58.9	60.0	60.0	59.9	59.9	59.9	59.9	1.1	1.1	1.0	1.0	1.0	1.0
743	B	66	62.3	63.4	63.4	63.4	63.4	63.4	63.4	1.1	1.1	1.1	1.1	1.1	1.1
744	B	66	64.7	65.8	65.8	65.8	65.8	65.8	65.8	1.1	1.1	1.1	1.1	1.1	1.1
745	B	66	69.6	70.5	70.5	70.5	70.5	70.5	70.5	0.9	0.9	0.9	0.9	0.9	0.9
746	B	66	69.8	70.8	70.8	70.8	70.8	70.8	70.8	1.0	1.0	1.0	1.0	1.0	1.0
747	B	66	57.6	58.7	58.7	58.6	58.6	58.6	58.6	1.1	1.1	1.0	1.0	1.0	1.0
748	B	66	55.6	56.9	56.8	56.8	56.8	56.8	56.8	1.3	1.2	1.2	1.2	1.2	1.2
749	B	66	56.2	57.4	57.4	57.3	57.3	57.3	57.3	1.2	1.2	1.1	1.1	1.1	1.1
750	B	66	56.5	57.6	57.6	57.6	57.6	57.6	57.6	1.1	1.1	1.1	1.1	1.1	1.1
751	B	66	56.7	57.9	57.9	57.9	57.9	57.9	57.9	1.2	1.2	1.2	1.2	1.2	1.2
752	B	66	56.6	57.9	57.9	57.9	57.9	57.9	57.9	1.3	1.3	1.3	1.3	1.3	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA													
			2012 Existing	2035 Build						Difference between Existing/Build						
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC																
753	B	66	57.0	58.2	58.2	58.2	58.2	58.2	58.2	1.2	1.2	1.2	1.2	1.2	1.2
754	B	66	57.7	59.0	59.0	59.0	59.0	59.0	59.0	1.3	1.3	1.3	1.3	1.3	1.3
755	B	66	58.0	59.3	59.3	59.3	59.3	59.3	59.3	1.3	1.3	1.3	1.3	1.3	1.3
756	B	66	59.5	60.4	60.4	60.4	60.4	60.4	60.4	0.9	0.9	0.9	0.9	0.9	0.9
757	B	66	58.5	59.5	59.5	59.5	59.5	59.5	59.5	1.0	1.0	1.0	1.0	1.0	1.0
758	B	66	59.5	60.5	60.5	60.5	60.5	60.5	60.5	1.0	1.0	1.0	1.0	1.0	1.0
759	B	66	61.8	62.7	62.7	62.7	62.7	62.7	62.7	0.9	0.9	0.9	0.9	0.9	0.9
760	B	66	62.0	63.0	63.0	63.0	63.0	63.0	63.0	1.0	1.0	1.0	1.0	1.0	1.0
761	B	66	68.2	68.7	68.7	68.7	68.7	68.7	68.7	0.5	0.5	0.5	0.5	0.5	0.5
762	B	66	68.1	68.6	68.6	68.6	68.6	68.6	68.6	0.5	0.5	0.5	0.5	0.5	0.5
763	B	66	68.0	68.5	68.5	68.5	68.5	68.5	68.5	0.5	0.5	0.5	0.5	0.5	0.5
764	B	66	67.8	68.4	68.4	68.4	68.4	68.4	68.4	0.6	0.6	0.6	0.6	0.6	0.6
765	B	66	59.9	61.0	61.0	61.0	61.0	61.0	61.0	1.1	1.1	1.1	1.1	1.1	1.1
766	B	66	59.5	60.6	60.6	60.6	60.6	60.6	60.6	1.1	1.1	1.1	1.1	1.1	1.1
767	B	66	59.6	60.7	60.7	60.7	60.7	60.7	60.7	1.1	1.1	1.1	1.1	1.1	1.1
768	B	66	66.9	67.5	67.5	67.5	67.5	67.5	67.5	0.6	0.6	0.6	0.6	0.6	0.6
769	B	66	66.1	66.8	66.8	66.8	66.8	66.8	66.8	0.7	0.7	0.7	0.7	0.7	0.7
770	B	66	65.4	66.3	66.3	66.3	66.3	66.3	66.3	0.9	0.9	0.9	0.9	0.9	0.9
771	B	66	64.4	65.2	65.2	65.2	65.2	65.2	65.2	0.8	0.8	0.8	0.8	0.8	0.8
772	B	66	64.3	65.1	65.1	65.1	65.1	65.1	65.1	0.8	0.8	0.8	0.8	0.8	0.8
773	B	66	64.4	65.1	65.1	65.1	65.1	65.1	65.1	0.7	0.7	0.7	0.7	0.7	0.7
774	D	51	35.3	36.2	36.2	36.2	36.2	36.2	36.2	0.9	0.9	0.9	0.9	0.9	0.9
775	C	66	67.4	68.3	68.3	68.3	68.3	68.3	68.3	0.9	0.9	0.9	0.9	0.9	0.9
776	B	66	63.4	64.1	64.1	64.0	64.0	64.0	64.0	0.7	0.7	0.6	0.6	0.6	0.6
777	B	66	61.1	61.9	61.9	61.9	61.9	61.9	61.9	0.8	0.8	0.8	0.8	0.8	0.8
778	B	66	60.3	61.1	61.1	61.0	61.0	61.0	61.0	0.8	0.8	0.7	0.7	0.7	0.7

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
779	B	66	58.6	59.4	59.4	59.4	59.4	59.4	59.4	0.8	0.8	0.8	0.8	0.8	0.8
780	B	66	59.1	59.9	59.9	59.9	59.9	59.9	59.9	0.8	0.8	0.8	0.8	0.8	0.8
781	B	66	57.8	58.8	58.8	58.7	58.7	58.7	58.7	1.0	1.0	0.9	0.9	0.9	0.9
782	B	66	57.0	58.0	57.9	57.9	57.9	57.9	57.9	1.0	0.9	0.9	0.9	0.9	0.9
783	B	66	56.3	57.3	57.3	57.3	57.3	57.3	57.3	1.0	1.0	1.0	1.0	1.0	1.0
784	B	66	56.4	57.5	57.5	57.4	57.4	57.4	57.4	1.1	1.1	1.0	1.0	1.0	1.0
785	B	66	55.1	56.2	56.2	56.1	56.1	56.1	56.1	1.1	1.1	1.0	1.0	1.0	1.0
786	B	66	55.7	56.7	56.7	56.7	56.7	56.7	56.7	1.0	1.0	1.0	1.0	1.0	1.0
787	B	66	54.7	55.8	55.8	55.8	55.8	55.8	55.8	1.1	1.1	1.1	1.1	1.1	1.1
788	B	66	54.4	55.5	55.5	55.4	55.4	55.4	55.4	1.1	1.1	1.0	1.0	1.0	1.0
789	B	66	54.1	55.2	55.2	55.1	55.1	55.1	55.1	1.1	1.1	1.0	1.0	1.0	1.0
790	B	66	53.8	54.9	54.9	54.8	54.8	54.8	54.8	1.1	1.1	1.0	1.0	1.0	1.0
791	B	66	54.6	55.7	55.7	55.6	55.6	55.6	55.6	1.1	1.1	1.0	1.0	1.0	1.0
792	B	66	55.7	56.7	56.7	56.6	56.6	56.6	56.6	1.0	1.0	0.9	0.9	0.9	0.9
793	B	66	56.1	57.2	57.2	57.1	57.1	57.1	57.1	1.1	1.1	1.0	1.0	1.0	1.0
794	B	66	56.0	57.0	57.0	56.9	56.9	56.9	56.9	1.0	1.0	0.9	0.9	0.9	0.9
795	B	66	56.1	57.1	57.1	57.0	57.0	57.0	57.0	1.0	1.0	0.9	0.9	0.9	0.9
796	B	66	55.0	56.1	56.1	56.0	56.0	56.0	56.0	1.1	1.1	1.0	1.0	1.0	1.0
797	B	66	54.6	55.7	55.7	55.6	55.6	55.6	55.6	1.1	1.1	1.0	1.0	1.0	1.0
798	B	66	54.2	55.3	55.3	55.2	55.2	55.2	55.2	1.1	1.1	1.0	1.0	1.0	1.0
799	B	66	68.0	68.8	68.8	68.8	68.8	68.8	68.8	0.8	0.8	0.8	0.8	0.8	0.8
800	B	66	67.9	68.7	68.7	68.7	68.7	68.7	68.7	0.8	0.8	0.8	0.8	0.8	0.8
801	B	66	68.0	68.8	68.8	68.8	68.8	68.8	68.8	0.8	0.8	0.8	0.8	0.8	0.8
802	B	66	68.0	68.8	68.8	68.8	68.8	68.8	68.8	0.8	0.8	0.8	0.8	0.8	0.8
803	B	66	68.2	69.0	69.0	69.0	69.0	69.0	69.0	0.8	0.8	0.8	0.8	0.8	0.8
804	B	66	68.4	69.2	69.2	69.2	69.2	69.2	69.2	0.8	0.8	0.8	0.8	0.8	0.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
805	B	66	68.2	69.1	69.1	69.1	69.1	69.1	69.1	0.9	0.9	0.9	0.9	0.9	0.9
806	B	66	68.0	68.9	68.9	68.9	68.9	68.9	68.9	0.9	0.9	0.9	0.9	0.9	0.9
807	B	66	68.4	69.3	69.3	69.3	69.3	69.3	69.3	0.9	0.9	0.9	0.9	0.9	0.9
808	B	66	67.7	68.8	68.8	68.8	68.8	68.8	68.8	1.1	1.1	1.1	1.1	1.1	1.1
809	B	66	67.7	68.9	68.9	68.8	68.8	68.8	68.8	1.2	1.2	1.1	1.1	1.1	1.1
810	B	66	63.0	63.6	63.6	63.6	63.6	63.6	63.6	0.6	0.6	0.6	0.6	0.6	0.6
811	B	66	60.0	60.8	60.7	60.7	60.7	60.7	60.7	0.8	0.7	0.7	0.7	0.7	0.7
812	B	66	59.9	60.7	60.7	60.7	60.7	60.7	60.7	0.8	0.8	0.8	0.8	0.8	0.8
813	B	66	59.7	60.5	60.5	60.5	60.5	60.5	60.5	0.8	0.8	0.8	0.8	0.8	0.8
814	B	66	59.6	60.5	60.5	60.5	60.5	60.5	60.5	0.9	0.9	0.9	0.9	0.9	0.9
815	B	66	59.7	60.5	60.5	60.5	60.5	60.5	60.5	0.8	0.8	0.8	0.8	0.8	0.8
816	B	66	59.5	60.4	60.4	60.4	60.4	60.4	60.4	0.9	0.9	0.9	0.9	0.9	0.9
817	B	66	59.5	60.4	60.4	60.3	60.3	60.3	60.3	0.9	0.9	0.8	0.8	0.8	0.8
818	B	66	59.4	60.3	60.3	60.3	60.3	60.3	60.3	0.9	0.9	0.9	0.9	0.9	0.9
819	B	66	59.3	60.3	60.2	60.2	60.2	60.2	60.2	1.0	0.9	0.9	0.9	0.9	0.9
820	B	66	58.5	59.4	59.4	59.4	59.4	59.4	59.4	0.9	0.9	0.9	0.9	0.9	0.9
821	B	66	61.2	62.1	62.1	62.1	62.1	62.1	62.1	0.9	0.9	0.9	0.9	0.9	0.9
822	B	66	59.2	60.3	60.3	60.2	60.2	60.2	60.2	1.1	1.1	1.0	1.0	1.0	1.0
823	B	66	57.9	59.0	59.0	58.9	58.9	58.9	58.9	1.1	1.1	1.0	1.0	1.0	1.0
824	B	66	56.2	57.2	57.2	57.2	57.2	57.2	57.2	1.0	1.0	1.0	1.0	1.0	1.0
825	B	66	56.2	57.2	57.2	57.1	57.1	57.1	57.1	1.0	1.0	0.9	0.9	0.9	0.9
826	B	66	55.9	57.1	57.1	56.9	56.9	56.9	56.9	1.2	1.2	1.0	1.0	1.0	1.0
827	B	66	55.2	56.4	56.3	56.2	56.2	56.2	56.2	1.2	1.1	1.0	1.0	1.0	1.0
828	B	66	55.3	56.5	56.5	56.3	56.3	56.3	56.3	1.2	1.2	1.0	1.0	1.0	1.0
829	B	66	54.7	55.9	55.9	55.7	55.7	55.7	55.7	1.2	1.2	1.0	1.0	1.0	1.0
830	B	66	54.7	56.0	56.0	55.8	55.8	55.8	55.8	1.3	1.3	1.1	1.1	1.1	1.1

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
831	B	66	67.6	68.8	68.8	68.8	68.8	68.8	68.8	1.2	1.2	1.2	1.2	1.2	1.2
832	B	66	63.3	64.4	64.4	64.4	64.4	64.4	64.4	1.1	1.1	1.1	1.1	1.1	1.1
833	B	66	61.3	62.3	62.3	62.2	62.2	62.2	62.2	1.0	1.0	0.9	0.9	0.9	0.9
834	B	66	59.6	60.7	60.6	60.5	60.5	60.5	60.5	1.1	1.0	0.9	0.9	0.9	0.9
835	B	66	58.4	59.5	59.5	59.4	59.4	59.4	59.4	1.1	1.1	1.0	1.0	1.0	1.0
836	B	66	57.4	58.5	58.5	58.4	58.4	58.4	58.4	1.1	1.1	1.0	1.0	1.0	1.0
837	B	66	56.7	57.9	57.8	57.7	57.7	57.7	57.7	1.2	1.1	1.0	1.0	1.0	1.0
838	B	66	56.0	57.2	57.2	57.1	57.1	57.1	57.1	1.2	1.2	1.1	1.1	1.1	1.1
839	B	66	55.5	56.8	56.8	56.6	56.6	56.6	56.6	1.3	1.3	1.1	1.1	1.1	1.1
840	B	66	56.0	57.3	57.3	57.1	57.1	57.1	57.1	1.3	1.3	1.1	1.1	1.1	1.1
841	B	66	56.5	57.8	57.8	57.6	57.6	57.6	57.6	1.3	1.3	1.1	1.1	1.1	1.1
842	B	66	57.5	58.8	58.8	58.6	58.6	58.6	58.6	1.3	1.3	1.1	1.1	1.1	1.1
843	B	66	58.2	59.4	59.4	59.2	59.2	59.2	59.2	1.2	1.2	1.0	1.0	1.0	1.0
844	B	66	59.7	60.8	60.8	60.6	60.6	60.6	60.6	1.1	1.1	0.9	0.9	0.9	0.9
845	B	66	61.1	62.2	62.2	62.1	62.1	62.1	62.1	1.1	1.1	1.0	1.0	1.0	1.0
846	B	66	62.0	62.9	62.9	62.9	62.9	62.9	62.9	0.9	0.9	0.9	0.9	0.9	0.9
847	B	66	62.4	63.2	63.2	63.2	63.2	63.2	63.2	0.8	0.8	0.8	0.8	0.8	0.8
848	B	66	62.1	62.8	62.8	62.8	62.8	62.8	62.8	0.7	0.7	0.7	0.7	0.7	0.7
849	B	66	62.4	63.1	63.1	63.2	63.2	63.2	63.2	0.7	0.7	0.8	0.8	0.8	0.8
850	B	66	62.8	63.6	63.6	63.7	63.7	63.7	63.7	0.8	0.8	0.9	0.9	0.9	0.9
851	B	66	63.8	64.8	64.8	64.9	64.9	64.9	64.9	1.0	1.0	1.1	1.1	1.1	1.1
852	B	66	65.2	66.5	66.5	66.5	66.5	66.5	66.5	1.3	1.3	1.3	1.3	1.3	1.3
853	B	66	66.2	67.3	67.3	67.7	67.7	67.7	67.7	1.1	1.1	1.5	1.5	1.5	1.5
854	B	66	68.0	69.6	69.6	69.7	69.7	69.7	69.7	1.6	1.6	1.7	1.7	1.7	1.7
855	B	66	67.9	69.2	69.2	69.7	69.7	69.7	69.7	1.3	1.3	1.8	1.8	1.8	1.8
856	B	66	67.3	68.8	68.8	69.1	69.1	69.1	69.1	1.5	1.5	1.8	1.8	1.8	1.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA 2012 Existing	2035 Build C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	Difference between Existing/Build C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
857	B	66	67.4	69.2	69.2	69.2	69.2	69.2	69.2	1.8	1.8	1.8	1.8	1.8	1.8
858	B	66	67.4	69.2	69.2	69.3	69.3	69.3	69.3	1.8	1.8	1.9	1.9	1.9	1.9
859	B	66	67.5	69.2	69.2	69.4	69.4	69.4	69.4	1.7	1.7	1.9	1.9	1.9	1.9
860	B	66	67.0	68.8	68.8	68.9	68.9	68.9	68.9	1.8	1.8	1.9	1.9	1.9	1.9
861	B	66	65.8	67.7	67.7	67.7	67.7	67.7	67.7	1.9	1.9	1.9	1.9	1.9	1.9
862	B	66	64.7	66.5	66.5	66.5	66.5	66.5	66.5	1.8	1.8	1.8	1.8	1.8	1.8
863	B	66	62.5	64.1	64.1	64.2	64.2	64.2	64.2	1.6	1.6	1.7	1.7	1.7	1.7
864	B	66	64.1	65.8	65.8	65.8	65.8	65.8	65.8	1.7	1.7	1.7	1.7	1.7	1.7
865	B	66	63.9	65.4	65.4	65.6	65.6	65.6	65.6	1.5	1.5	1.7	1.7	1.7	1.7
866	B	66	63.7	65.1	65.1	65.4	65.4	65.4	65.4	1.4	1.4	1.7	1.7	1.7	1.7
867	B	66	61.6	62.9	62.9	63.1	63.1	63.1	63.1	1.3	1.3	1.5	1.5	1.5	1.5
868	B	66	62.7	64.0	64.0	64.2	64.2	64.2	64.2	1.3	1.3	1.5	1.5	1.5	1.5
869	B	66	63.8	65.0	65.0	65.3	65.3	65.3	65.3	1.2	1.2	1.5	1.5	1.5	1.5
870	B	66	60.0	61.2	61.2	61.4	61.4	61.4	61.4	1.2	1.2	1.4	1.4	1.4	1.4
871	B	66	59.3	60.5	60.5	60.6	60.6	60.6	60.6	1.2	1.2	1.3	1.3	1.3	1.3
872	B	66	58.8	60.1	60.1	60.0	60.0	60.0	60.0	1.3	1.3	1.2	1.2	1.2	1.2
873	B	66	58.3	59.7	59.7	59.5	59.5	59.5	59.5	1.4	1.4	1.2	1.2	1.2	1.2
874	B	66	61.7	62.6	62.6	63.0	63.0	63.0	63.0	0.9	0.9	1.3	1.3	1.3	1.3
875	B	66	60.8	61.8	61.8	62.0	62.0	62.0	62.0	1.0	1.0	1.2	1.2	1.2	1.2
876	B	66	60.1	61.2	61.2	61.2	61.2	61.2	61.2	1.1	1.1	1.1	1.1	1.1	1.1
877	B	66	59.7	60.8	60.8	60.8	60.8	60.8	60.8	1.1	1.1	1.1	1.1	1.1	1.1
878	B	66	59.1	60.2	60.2	60.2	60.2	60.2	60.2	1.1	1.1	1.1	1.1	1.1	1.1
879	B	66	57.9	59.2	59.2	59.0	59.0	59.0	59.0	1.3	1.3	1.1	1.1	1.1	1.1
880	B	66	63.3	64.9	64.9	65.1	65.1	65.1	65.1	1.6	1.6	1.8	1.8	1.8	1.8
881	B	66	63.1	63.6	63.6	63.6	63.6	63.6	63.6	0.5	0.5	0.5	0.5	0.5	0.5
882	B	66	68.4	69.2	69.2	69.2	69.2	69.2	69.2	0.8	0.8	0.8	0.8	0.8	0.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
883	B	66	68.8	69.6	69.6	69.6	69.6	69.6	69.6	0.8	0.8	0.8	0.8	0.8	0.8
884	B	66	68.8	69.5	69.5	69.5	69.5	69.5	69.5	0.7	0.7	0.7	0.7	0.7	0.7
885	B	66	70.0	70.8	70.8	70.8	70.8	70.8	70.8	0.8	0.8	0.8	0.8	0.8	0.8
886	B	66	54.0	55.1	55.1	55.1	55.1	55.1	55.1	1.1	1.1	1.1	1.1	1.1	1.1
887	B	66	54.0	55.1	55.1	55.0	55.0	55.0	55.0	1.1	1.1	1.0	1.0	1.0	1.0
888	B	66	54.7	55.8	55.8	55.7	55.7	55.7	55.7	1.1	1.1	1.0	1.0	1.0	1.0
889	B	66	54.9	55.9	55.9	55.9	55.9	55.9	55.9	1.0	1.0	1.0	1.0	1.0	1.0
890	B	66	55.6	56.7	56.7	56.6	56.7	56.6	56.6	1.1	1.1	1.0	1.1	1.0	1.0
891	B	66	55.3	56.4	56.4	56.3	56.3	56.3	56.3	1.1	1.1	1.0	1.0	1.0	1.0
892	B	66	56.3	57.4	57.4	57.3	57.3	57.3	57.3	1.1	1.1	1.0	1.0	1.0	1.0
893	B	66	56.7	57.7	57.7	57.7	57.7	57.7	57.7	1.0	1.0	1.0	1.0	1.0	1.0
894	B	66	57.4	58.4	58.4	58.4	58.4	58.4	58.4	1.0	1.0	1.0	1.0	1.0	1.0
895	B	66	57.8	58.8	58.8	58.8	58.8	58.8	58.8	1.0	1.0	1.0	1.0	1.0	1.0
896	B	66	57.9	58.9	58.9	58.9	58.9	58.9	58.9	1.0	1.0	1.0	1.0	1.0	1.0
897	B	66	59.4	60.4	60.4	60.3	60.3	60.3	60.3	1.0	1.0	0.9	0.9	0.9	0.9
898	B	66	59.5	60.5	60.5	60.5	60.5	60.5	60.5	1.0	1.0	1.0	1.0	1.0	1.0
899	B	66	60.9	61.8	61.8	61.8	61.8	61.8	61.8	0.9	0.9	0.9	0.9	0.9	0.9
900	B	66	61.2	62.1	62.1	62.1	62.1	62.1	62.1	0.9	0.9	0.9	0.9	0.9	0.9
901	B	66	63.9	64.8	64.8	64.8	64.8	64.8	64.8	0.9	0.9	0.9	0.9	0.9	0.9
902	B	66	64.0	64.9	64.9	64.9	64.9	64.9	64.9	0.9	0.9	0.9	0.9	0.9	0.9
903	B	66	70.9	72.1	72.1	72.1	72.1	72.1	72.1	1.2	1.2	1.2	1.2	1.2	1.2
904	B	66	70.7	71.9	71.9	71.9	71.9	71.9	71.9	1.2	1.2	1.2	1.2	1.2	1.2
905	B	66	70.0	71.1	71.1	71.1	71.1	71.1	71.1	1.1	1.1	1.1	1.1	1.1	1.1
906	C	66	66.1	66.9	66.9	67.0	67.0	67.0	67.0	0.8	0.8	0.9	0.9	0.9	0.9
907	C	66	63.2	64.3	64.3	64.5	64.5	64.5	64.5	1.1	1.1	1.3	1.3	1.3	1.3
908	C	66	62.3	63.3	63.3	63.6	63.6	63.6	63.6	1.0	1.0	1.3	1.3	1.3	1.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA													
			2012 Existing	2035 Build						Difference between Existing/Build						
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC																
909	B	66	61.7	64.2	63.8	63.5	63.5	63.5	63.5	2.5	2.1	1.8	1.8	1.8	1.8
910	B	66	61.7	64.1	63.8	63.4	63.4	63.4	63.4	2.4	2.1	1.7	1.7	1.7	1.7
911	B	66	61.6	64.1	63.7	63.4	63.4	63.4	63.4	2.5	2.1	1.8	1.8	1.8	1.8
912	B	66	61.6	64.0	63.7	63.3	63.3	63.3	63.3	2.4	2.1	1.7	1.7	1.7	1.7
913	B	66	61.5	63.9	63.6	63.2	63.2	63.2	63.2	2.4	2.1	1.7	1.7	1.7	1.7
914	B	66	61.4	63.9	63.5	63.2	63.2	63.2	63.2	2.5	2.1	1.8	1.8	1.8	1.8
915	B	66	61.4	63.8	63.5	63.1	63.1	63.1	63.1	2.4	2.1	1.7	1.7	1.7	1.7
916	B	66	61.3	63.7	63.4	63.0	63.0	63.0	63.0	2.4	2.1	1.7	1.7	1.7	1.7
917	B	66	61.2	63.6	63.3	62.9	62.9	62.9	62.9	2.4	2.1	1.7	1.7	1.7	1.7
918	B	66	64.1	66.7	66.4	65.9	65.9	65.9	65.9	2.6	2.3	1.8	1.8	1.8	1.8
919	B	66	63.9	66.5	66.2	65.7	65.7	65.7	65.7	2.6	2.3	1.8	1.8	1.8	1.8
920	B	66	63.6	66.2	65.8	65.4	65.4	65.4	65.4	2.6	2.2	1.8	1.8	1.8	1.8
921	B	66	62.6	65.1	64.8	64.3	64.3	64.3	64.3	2.5	2.2	1.7	1.7	1.7	1.7
922	B	66	62.4	64.9	64.7	64.2	64.2	64.2	64.2	2.5	2.3	1.8	1.8	1.8	1.8
923	B	66	62.2	64.6	64.4	63.9	63.9	63.9	63.9	2.4	2.2	1.7	1.7	1.7	1.7
924	B	66	62.1	64.6	64.4	63.8	63.8	63.8	63.8	2.5	2.3	1.7	1.7	1.7	1.7
925	B	66	67.4	70.4	69.9	69.1	69.1	69.1	69.1	3.0	2.5	1.7	1.7	1.7	1.7
926	B	66	67.5	70.5	69.9	69.3	69.3	69.3	69.3	3.0	2.4	1.8	1.8	1.8	1.8
927	B	66	67.6	70.5	69.9	69.3	69.3	69.3	69.3	2.9	2.3	1.7	1.7	1.7	1.7
928	B	66	67.7	70.6	70.0	69.4	69.4	69.4	69.4	2.9	2.3	1.7	1.7	1.7	1.7
929	B	66	67.7	70.5	70.0	69.4	69.4	69.4	69.4	2.8	2.3	1.7	1.7	1.7	1.7
930	B	66	67.7	70.6	70.1	69.5	69.5	69.5	69.5	2.9	2.4	1.8	1.8	1.8	1.8
931	B	66	67.2	70.0	69.4	68.9	68.9	68.9	68.9	2.8	2.2	1.7	1.7	1.7	1.7
932	B	66	66.8	69.5	69.0	68.6	68.6	68.6	68.6	2.7	2.2	1.8	1.8	1.8	1.8
933	B	66	66.0	68.4	68.1	67.8	67.8	67.8	67.8	2.4	2.1	1.8	1.8	1.8	1.8
934	B	66	65.7	68.1	67.8	67.5	67.5	67.5	67.5	2.4	2.1	1.8	1.8	1.8	1.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
935	B	66	65.0	67.3	67.0	66.7	66.7	66.7	66.7	2.3	2.0	1.7	1.7	1.7	1.7
936	B	66	64.7	67.0	66.7	66.5	66.5	66.5	66.5	2.3	2.0	1.8	1.8	1.8	1.8
937	B	66	64.3	66.6	66.4	66.1	66.1	66.1	66.1	2.3	2.1	1.8	1.8	1.8	1.8
938	B	66	64.1	66.4	66.2	65.9	65.9	65.9	65.9	2.3	2.1	1.8	1.8	1.8	1.8
939	B	66	64.9	67.0	66.9	66.6	66.6	66.6	66.6	2.1	2.0	1.7	1.7	1.7	1.7
940	B	66	65.3	67.3	67.2	67.0	67.0	67.0	67.0	2.0	1.9	1.7	1.7	1.7	1.7
941	B	66	68.4	70.2	70.2	70.1	70.1	70.1	70.1	1.8	1.8	1.7	1.7	1.7	1.7
942	B	66	69.4	71.2	71.2	71.1	71.1	71.1	71.1	1.8	1.8	1.7	1.7	1.7	1.7
943	B	66	67.8	69.7	69.7	69.6	69.6	69.6	69.6	1.9	1.9	1.8	1.8	1.8	1.8
944	B	66	61.7	63.8	63.7	63.4	63.4	63.4	63.4	2.1	2.0	1.7	1.7	1.7	1.7
945	B	66	61.8	63.9	63.8	63.5	63.5	63.5	63.5	2.1	2.0	1.7	1.7	1.7	1.7
946	B	66	60.9	63.0	62.9	62.6	62.6	62.6	62.6	2.1	2.0	1.7	1.7	1.7	1.7
947	B	66	60.6	62.7	62.6	62.3	62.3	62.3	62.3	2.1	2.0	1.7	1.7	1.7	1.7
948	B	66	60.5	62.5	62.4	62.2	62.2	62.2	62.2	2.0	1.9	1.7	1.7	1.7	1.7
949	B	66	60.3	62.3	62.3	62.0	62.0	62.0	62.0	2.0	2.0	1.7	1.7	1.7	1.7
950	B	66	60.3	62.2	62.2	62.1	62.1	62.1	62.1	1.9	1.9	1.8	1.8	1.8	1.8
951	B	66	59.4	61.1	61.1	61.1	61.1	61.1	61.1	1.7	1.7	1.7	1.7	1.7	1.7
952	B	66	59.1	60.8	60.8	60.7	60.7	60.7	60.7	1.7	1.7	1.6	1.6	1.6	1.6
953	B	66	65.1	67.1	67.1	67.1	67.1	67.1	67.1	2.0	2.0	2.0	2.0	2.0	2.0
954	B	66	64.1	66.4	66.3	66.4	66.4	66.4	66.4	2.3	2.2	2.3	2.3	2.3	2.3
955	B	66	64.2	66.5	66.5	66.5	66.5	66.5	66.5	2.3	2.3	2.3	2.3	2.3	2.3
956	B	66	64.7	67.0	67.0	67.1	67.1	67.1	67.1	2.3	2.3	2.4	2.4	2.4	2.4
957	B	66	64.9	67.2	67.2	67.2	67.2	67.2	67.2	2.3	2.3	2.3	2.3	2.3	2.3
958	B	66	63.3	65.2	65.2	65.2	65.2	65.2	65.2	1.9	1.9	1.9	1.9	1.9	1.9
959	B	66	63.1	65.0	65.0	64.9	64.9	64.9	64.9	1.9	1.9	1.8	1.8	1.8	1.8
960	B	66	62.9	64.8	64.8	64.8	64.8	64.8	64.8	1.9	1.9	1.9	1.9	1.9	1.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
961	B	66	62.7	64.6	64.6	64.5	64.5	64.5	64.5	1.9	1.9	1.8	1.8	1.8	1.8
962	B	66	61.4	63.3	63.3	63.2	63.2	63.2	63.2	1.9	1.9	1.8	1.8	1.8	1.8
963	B	66	61.4	63.4	63.3	63.3	63.3	63.3	63.3	2.0	1.9	1.9	1.9	1.9	1.9
964	B	66	61.5	63.5	63.4	63.4	63.4	63.4	63.4	2.0	1.9	1.9	1.9	1.9	1.9
965	B	66	61.6	63.5	63.5	63.5	63.5	63.5	63.5	1.9	1.9	1.9	1.9	1.9	1.9
966	B	66	60.7	62.3	62.3	62.4	62.4	62.4	62.4	1.6	1.6	1.7	1.7	1.7	1.7
967	B	66	60.6	62.3	62.3	62.4	62.4	62.4	62.4	1.7	1.7	1.8	1.8	1.8	1.8
968	B	66	60.9	62.6	62.6	62.7	62.7	62.7	62.7	1.7	1.7	1.8	1.8	1.8	1.8
969	B	66	61.0	62.7	62.7	62.7	62.7	62.7	62.7	1.7	1.7	1.7	1.7	1.7	1.7
970	B	66	61.2	62.9	62.9	63.0	63.0	63.0	63.0	1.7	1.7	1.8	1.8	1.8	1.8
971	B	66	61.3	63.1	63.1	63.1	63.1	63.1	63.1	1.8	1.8	1.8	1.8	1.8	1.8
972	B	66	62.3	64.0	64.0	64.1	64.1	64.1	64.1	1.7	1.7	1.8	1.8	1.8	1.8
973	B	66	61.8	63.6	63.6	63.5	63.5	63.5	63.5	1.8	1.8	1.7	1.7	1.7	1.7
974	B	66	61.4	63.3	63.2	63.1	63.1	63.1	63.2	1.9	1.8	1.7	1.7	1.7	1.8
975	B	66	60.7	62.5	62.5	62.5	62.5	62.5	62.5	1.8	1.8	1.8	1.8	1.8	1.8
976	B	66	60.7	62.4	62.4	62.4	62.4	62.4	62.4	1.7	1.7	1.7	1.7	1.7	1.7
977	B	66	60.5	62.3	62.2	62.3	62.3	62.3	62.3	1.8	1.7	1.8	1.8	1.8	1.8
978	B	66	60.6	62.5	62.5	62.4	62.4	62.4	62.4	1.9	1.9	1.8	1.8	1.8	1.8
979	B	66	60.4	62.2	62.2	62.2	62.2	62.2	62.2	1.8	1.8	1.8	1.8	1.8	1.8
980	B	66	60.3	62.1	62.1	62.1	62.1	62.1	62.1	1.8	1.8	1.8	1.8	1.8	1.8
981	B	66	60.1	61.9	61.9	61.9	61.9	61.9	61.9	1.8	1.8	1.8	1.8	1.8	1.8
982	B	66	59.3	61.1	61.0	61.1	61.1	61.1	61.1	1.8	1.7	1.8	1.8	1.8	1.8
983	B	66	59.3	61.1	61.0	61.1	61.1	61.1	61.1	1.8	1.7	1.8	1.8	1.8	1.8
984	B	66	59.3	61.0	61.0	61.1	61.1	61.1	61.1	1.7	1.7	1.8	1.8	1.8	1.8
985	B	66	59.1	60.9	60.9	60.9	60.9	60.9	60.9	1.8	1.8	1.8	1.8	1.8	1.8
986	B	66	60.6	62.6	62.6	62.6	62.6	62.6	62.6	2.0	2.0	2.0	2.0	2.0	2.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA													
			2012 Existing	2035 Build						Difference between Existing/Build						
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC																
987	B	66	60.5	62.4	62.4	62.4	62.4	62.4	62.4	1.9	1.9	1.9	1.9	1.9	1.9
988	B	66	60.4	62.2	62.2	62.3	62.3	62.3	62.3	1.8	1.8	1.9	1.9	1.9	1.9
989	B	66	60.2	62.0	62.0	62.0	62.0	62.0	62.0	1.8	1.8	1.8	1.8	1.8	1.8
990	B	66	61.5	63.7	63.5	63.2	63.2	63.2	63.2	2.2	2.0	1.7	1.7	1.7	1.7
991	B	66	60.8	63.1	62.9	62.5	62.5	62.5	62.5	2.3	2.1	1.7	1.7	1.7	1.7
992	B	66	60.6	63.0	62.8	62.4	62.4	62.4	62.4	2.4	2.2	1.8	1.8	1.8	1.8
993	B	66	60.4	62.8	62.6	62.2	62.2	62.2	62.2	2.4	2.2	1.8	1.8	1.8	1.8
994	B	66	60.9	63.4	63.2	62.7	62.7	62.7	62.7	2.5	2.3	1.8	1.8	1.8	1.8
995	B	66	61.5	64.0	63.7	63.2	63.2	63.2	63.2	2.5	2.2	1.7	1.7	1.7	1.7
996	B	66	60.5	63.0	62.7	62.2	62.2	62.2	62.2	2.5	2.2	1.7	1.7	1.7	1.7
997	B	66	65.6	67.7	67.5	67.2	67.2	67.2	67.2	2.1	1.9	1.6	1.6	1.6	1.6
998	B	66	63.4	65.8	65.5	65.2	65.2	65.2	65.2	2.4	2.1	1.8	1.8	1.8	1.8
999	B	66	63.0	65.5	65.2	64.8	64.8	64.8	64.8	2.5	2.2	1.8	1.8	1.8	1.8
1000	B	66	62.9	65.4	65.0	64.7	64.7	64.7	64.7	2.5	2.1	1.8	1.8	1.8	1.8
1001	B	66	62.7	65.3	64.9	64.5	64.5	64.5	64.5	2.6	2.2	1.8	1.8	1.8	1.8
1002	B	66	70.2	73.3	73.2	71.9	71.9	71.9	71.9	3.1	3.0	1.7	1.7	1.7	1.7
1003	B	66	67.5	70.5	70.4	69.2	69.2	69.2	69.2	3.0	2.9	1.7	1.7	1.7	1.7
1004	B	66	67.1	70.1	69.9	68.8	68.8	68.8	68.8	3.0	2.8	1.7	1.7	1.7	1.7
1005	B	66	66.5	69.5	69.2	68.3	68.3	68.3	68.3	3.0	2.7	1.8	1.8	1.8	1.8
1006	B	66	67.7	70.8	70.4	69.4	69.4	69.4	69.4	3.1	2.7	1.7	1.7	1.7	1.7
1007	B	66	66.9	70.0	69.6	68.7	68.7	68.7	68.7	3.1	2.7	1.8	1.8	1.8	1.8
1008	B	66	63.1	65.8	65.4	64.9	64.9	64.9	64.9	2.7	2.3	1.8	1.8	1.8	1.8
1009	B	66	63.1	65.7	65.3	64.9	64.9	64.9	64.9	2.6	2.2	1.8	1.8	1.8	1.8
1010	B	66	63.0	65.6	65.3	64.8	64.8	64.8	64.8	2.6	2.3	1.8	1.8	1.8	1.8
1011	B	66	63.0	65.5	65.2	64.8	64.8	64.8	64.8	2.5	2.2	1.8	1.8	1.8	1.8
1012	B	66	62.9	65.5	65.1	64.7	64.7	64.7	64.7	2.6	2.2	1.8	1.8	1.8	1.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1013	B	66	62.8	65.4	65.0	64.6	64.6	64.6	64.6	2.6	2.2	1.8	1.8	1.8	1.8
1014	B	66	62.8	65.3	65.0	64.6	64.6	64.6	64.6	2.5	2.2	1.8	1.8	1.8	1.8
1015	B	66	62.7	65.2	64.9	64.5	64.5	64.5	64.5	2.5	2.2	1.8	1.8	1.8	1.8
1016	B	66	62.6	65.2	64.8	64.4	64.4	64.4	64.4	2.6	2.2	1.8	1.8	1.8	1.8
1017	B	66	62.6	65.1	64.8	64.4	64.4	64.4	64.4	2.5	2.2	1.8	1.8	1.8	1.8
1018	B	66	62.5	65.1	64.7	64.3	64.3	64.3	64.3	2.6	2.2	1.8	1.8	1.8	1.8
1019	B	66	62.5	65.0	64.7	64.3	64.3	64.3	64.3	2.5	2.2	1.8	1.8	1.8	1.8
1020	B	66	62.4	64.9	64.6	64.2	64.2	64.2	64.2	2.5	2.2	1.8	1.8	1.8	1.8
1021	B	66	62.4	64.9	64.5	64.2	64.2	64.2	64.2	2.5	2.1	1.8	1.8	1.8	1.8
1022	B	66	62.3	64.8	64.4	64.1	64.1	64.1	64.1	2.5	2.1	1.8	1.8	1.8	1.8
1023	B	66	62.2	64.7	64.4	64.0	64.0	64.0	64.0	2.5	2.2	1.8	1.8	1.8	1.8
1024	B	66	62.2	64.7	64.3	64.0	64.0	64.0	64.0	2.5	2.1	1.8	1.8	1.8	1.8
1025	B	66	62.2	64.6	64.3	63.9	63.9	63.9	63.9	2.4	2.1	1.7	1.7	1.7	1.7
1026	B	66	62.1	64.5	64.2	63.8	63.8	63.8	63.8	2.4	2.1	1.7	1.7	1.7	1.7
1027	B	66	62.0	64.5	64.1	63.8	63.8	63.8	63.8	2.5	2.1	1.8	1.8	1.8	1.8
1028	B	66	61.8	64.2	63.9	63.5	63.5	63.5	63.5	2.4	2.1	1.7	1.7	1.7	1.7
1029	C	66	73.0	75.3	75.3	75.0	75.0	75.0	75.0	2.3	2.3	2.0	2.0	2.0	2.0
1030	B	66	64.5	66.8	66.8	66.7	66.7	66.7	66.7	2.3	2.3	2.2	2.2	2.2	2.2
1031	B	66	64.3	66.5	66.6	66.4	66.4	66.4	66.4	2.2	2.3	2.1	2.1	2.1	2.1
1032	B	66	64.7	66.8	66.8	66.7	66.7	66.7	66.7	2.1	2.1	2.0	2.0	2.0	2.0
1033	B	66	64.8	66.9	67.0	66.8	66.8	66.8	66.8	2.1	2.2	2.0	2.0	2.0	2.0
1034	B	66	65.6	67.7	67.8	67.5	67.5	67.5	67.5	2.1	2.2	1.9	1.9	1.9	1.9
1035	B	66	65.9	68.0	68.2	67.8	67.8	67.8	67.8	2.1	2.3	1.9	1.9	1.9	1.9
1036	B	66	66.7	68.8	69.1	68.6	68.6	68.6	68.6	2.1	2.4	1.9	1.9	1.9	1.9
1037	B	66	67.1	69.2	69.6	69.0	69.0	69.0	69.0	2.1	2.5	1.9	1.9	1.9	1.9
1038	B	66	66.8	68.5	68.7	68.8	68.8	68.8	68.8	1.7	1.9	2.0	2.0	2.0	2.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1039	D	51	48.2	50.7	51.3	50.1	50.1	50.1	50.1	2.5	3.1	1.9	1.9	1.9	1.9
1040	B	66	71.0	74.3	75.2	72.9	72.9	72.9	72.9	3.3	4.2	1.9	1.9	1.9	1.9
1041	B	66	67.7	70.9	71.7	69.5	69.5	69.5	69.5	3.2	4.0	1.8	1.8	1.8	1.8
1042	B	66	66.0	68.9	69.4	67.9	67.9	67.9	67.9	2.9	3.4	1.9	1.9	1.9	1.9
1043	B	66	64.5	67.1	67.3	66.3	66.3	66.3	66.3	2.6	2.8	1.8	1.8	1.8	1.8
1044	B	66	63.9	66.4	66.6	65.8	65.8	65.8	65.8	2.5	2.7	1.9	1.9	1.9	1.9
1045	B	66	63.1	65.5	65.5	64.9	64.9	64.9	64.9	2.4	2.4	1.8	1.8	1.8	1.8
1046	B	66	62.5	64.8	64.8	64.3	64.3	64.3	64.3	2.3	2.3	1.8	1.8	1.8	1.8
1047	B	66	61.9	64.2	64.2	63.7	63.7	63.7	63.7	2.3	2.3	1.8	1.8	1.8	1.8
1048	B	66	61.4	63.7	63.8	63.2	63.2	63.2	63.2	2.3	2.4	1.8	1.8	1.8	1.8
1049	B	66	60.7	63.0	63.0	62.6	62.6	62.6	62.6	2.3	2.3	1.9	1.9	1.9	1.9
1050	B	66	60.3	62.5	62.5	62.3	62.3	62.3	62.3	2.2	2.2	2.0	2.0	2.0	2.0
1051	B	66	60.1	62.4	62.4	62.3	62.3	62.3	62.3	2.3	2.3	2.2	2.2	2.2	2.2
1052	B	66	61.2	63.8	63.8	63.7	63.7	63.7	63.7	2.6	2.6	2.5	2.5	2.5	2.5
1053	B	66	69.2	72.5	72.9	71.0	71.0	71.0	71.0	3.3	3.7	1.8	1.8	1.8	1.8
1054	B	66	66.3	69.2	69.5	68.1	68.1	68.1	68.1	2.9	3.2	1.8	1.8	1.8	1.8
1055	B	66	64.7	67.4	67.6	66.6	66.6	66.6	66.6	2.7	2.9	1.9	1.9	1.9	1.9
1056	B	66	63.6	66.1	66.2	65.4	65.4	65.4	65.4	2.5	2.6	1.8	1.8	1.8	1.8
1057	B	66	62.8	65.2	65.1	64.6	64.6	64.6	64.6	2.4	2.3	1.8	1.8	1.8	1.8
1058	B	66	62.0	64.4	64.4	63.8	63.8	63.8	63.8	2.4	2.4	1.8	1.8	1.8	1.8
1059	B	66	61.5	63.8	63.9	63.3	63.3	63.3	63.3	2.3	2.4	1.8	1.8	1.8	1.8
1060	B	66	61.1	63.5	63.5	62.9	62.9	62.9	62.9	2.4	2.4	1.8	1.8	1.8	1.8
1061	B	66	60.5	62.9	62.9	62.3	62.3	62.3	62.3	2.4	2.4	1.8	1.8	1.8	1.8
1062	B	66	59.9	62.2	62.3	61.7	61.7	61.7	61.7	2.3	2.4	1.8	1.8	1.8	1.8
1063	B	66	59.3	61.5	61.6	61.2	61.2	61.2	61.2	2.2	2.3	1.9	1.9	1.9	1.9
1064	B	66	58.9	61.0	61.0	60.9	60.9	60.9	60.9	2.1	2.1	2.0	2.0	2.0	2.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1065	B	66	58.1	60.3	60.2	60.2	60.2	60.2	60.2	2.2	2.1	2.1	2.1	2.1	2.1
1066	B	66	58.4	60.7	60.6	60.6	60.6	60.6	60.6	2.3	2.2	2.2	2.2	2.2	2.2
1067	B	66	60.0	62.5	62.5	62.5	62.5	62.5	62.5	2.5	2.5	2.5	2.5	2.5	2.5
1068	B	66	59.6	61.9	61.9	61.9	61.9	61.9	61.9	2.3	2.3	2.3	2.3	2.3	2.3
1069	B	66	62.1	64.3	64.3	64.3	64.3	64.3	64.3	2.2	2.2	2.2	2.2	2.2	2.2
1070	B	66	60.5	62.4	62.4	62.3	62.3	62.3	62.3	1.9	1.9	1.8	1.8	1.8	1.8
1071	B	66	60.6	62.6	62.6	62.5	62.5	62.5	62.5	2.0	2.0	1.9	1.9	1.9	1.9
1072	B	66	61.1	63.1	63.0	62.9	62.9	62.9	62.9	2.0	1.9	1.8	1.8	1.8	1.8
1073	B	66	61.3	63.2	63.3	63.0	63.0	63.0	63.0	1.9	2.0	1.7	1.7	1.7	1.7
1074	B	66	61.7	63.8	63.8	63.4	63.4	63.4	63.4	2.1	2.1	1.7	1.7	1.7	1.7
1075	B	66	62.1	64.2	64.2	63.8	63.8	63.8	63.8	2.1	2.1	1.7	1.7	1.7	1.7
1076	B	66	62.3	64.5	64.5	64.0	64.0	64.0	64.0	2.2	2.2	1.7	1.7	1.7	1.7
1077	B	66	62.5	64.9	64.9	64.2	64.2	64.2	64.2	2.4	2.4	1.7	1.7	1.7	1.7
1078	B	66	63.1	65.4	65.4	64.8	64.8	64.8	64.8	2.3	2.3	1.7	1.7	1.7	1.7
1079	B	66	63.7	66.0	66.0	65.4	65.4	65.4	65.4	2.3	2.3	1.7	1.7	1.7	1.7
1080	B	66	64.4	66.6	66.6	66.1	66.1	66.1	66.1	2.2	2.2	1.7	1.7	1.7	1.7
1081	B	66	65.5	68.0	68.0	67.3	67.3	67.3	67.3	2.5	2.5	1.8	1.8	1.8	1.8
1082	B	66	66.6	69.4	69.6	68.4	68.4	68.4	68.4	2.8	3.0	1.8	1.8	1.8	1.8
1083	B	66	69.3	72.5	72.7	71.1	71.1	71.1	71.1	3.2	3.4	1.8	1.8	1.8	1.8
1084	B	66	71.1	74.2	74.3	73.0	73.0	73.0	73.0	3.1	3.2	1.9	1.9	1.9	1.9
1085	B	66	68.2	71.5	71.5	70.0	70.0	70.0	70.0	3.3	3.3	1.8	1.8	1.8	1.8
1086	B	66	65.9	68.3	68.3	67.6	67.6	67.6	67.6	2.4	2.4	1.7	1.7	1.7	1.7
1087	B	66	65.1	67.3	67.2	66.7	66.7	66.7	66.7	2.2	2.1	1.6	1.6	1.6	1.6
1088	B	66	63.9	66.1	66.1	65.5	65.5	65.5	65.5	2.2	2.2	1.6	1.6	1.6	1.6
1089	B	66	63.3	65.5	65.5	64.9	64.9	64.9	64.9	2.2	2.2	1.6	1.6	1.6	1.6
1090	B	66	62.9	65.0	65.0	64.5	64.5	64.5	64.5	2.1	2.1	1.6	1.6	1.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1091	B	66	62.3	64.3	64.3	63.9	63.9	63.9	63.9	2.0	2.0	1.6	1.6	1.6	1.6
1092	B	66	60.8	62.7	62.7	62.4	62.4	62.4	62.4	1.9	1.9	1.6	1.6	1.6	1.6
1093	B	66	61.2	62.9	62.9	62.8	62.8	62.8	62.8	1.7	1.7	1.6	1.6	1.6	1.6
1094	B	66	60.7	62.4	62.3	62.3	62.3	62.3	62.3	1.7	1.6	1.6	1.6	1.6	1.6
1095	B	66	60.7	62.3	62.3	62.3	62.3	62.3	62.3	1.6	1.6	1.6	1.6	1.6	1.6
1096	B	66	60.8	62.5	62.4	62.4	62.4	62.4	62.4	1.7	1.6	1.6	1.6	1.6	1.6
1097	B	66	60.3	62.3	62.2	62.2	62.2	62.2	62.2	2.0	1.9	1.9	1.9	1.9	1.9
1098	B	66	61.3	63.4	63.4	63.3	63.3	63.3	63.3	2.1	2.1	2.0	2.0	2.0	2.0
1099	B	66	63.3	65.6	65.6	65.5	65.5	65.5	65.5	2.3	2.3	2.2	2.2	2.2	2.2
1100	B	66	71.9	74.9	74.9	73.7	73.7	73.7	73.7	3.0	3.0	1.8	1.8	1.8	1.8
1101	B	66	67.2	70.5	70.5	69.0	69.0	69.0	69.0	3.3	3.3	1.8	1.8	1.8	1.8
1102	B	66	65.0	67.5	67.4	66.7	66.7	66.7	66.7	2.5	2.4	1.7	1.7	1.7	1.7
1103	B	66	62.1	64.7	64.7	63.8	63.8	63.8	63.8	2.6	2.6	1.7	1.7	1.7	1.7
1104	B	66	61.0	63.6	63.6	62.8	62.8	62.8	62.8	2.6	2.6	1.8	1.8	1.8	1.8
1105	B	66	60.1	62.5	62.5	61.9	61.9	61.9	61.9	2.4	2.4	1.8	1.8	1.8	1.8
1106	B	66	59.1	61.3	61.3	60.9	60.9	60.9	60.9	2.2	2.2	1.8	1.8	1.8	1.8
1107	B	66	58.2	60.5	60.5	60.0	60.0	60.0	60.0	2.3	2.3	1.8	1.8	1.8	1.8
1108	B	66	57.6	59.8	59.8	59.4	59.4	59.4	59.4	2.2	2.2	1.8	1.8	1.8	1.8
1109	B	66	57.1	59.2	59.2	58.9	58.9	58.9	58.9	2.1	2.1	1.8	1.8	1.8	1.8
1110	B	66	57.0	59.0	58.9	58.9	58.9	58.9	58.9	2.0	1.9	1.9	1.9	1.9	1.9
1111	B	66	56.3	58.3	58.3	58.2	58.2	58.2	58.2	2.0	2.0	1.9	1.9	1.9	1.9
1112	B	66	56.9	59.1	59.0	59.0	59.0	59.0	59.0	2.2	2.1	2.1	2.1	2.1	2.1
1113	B	66	55.8	57.9	57.9	57.8	57.8	57.8	57.8	2.1	2.1	2.0	2.0	2.0	2.0
1114	B	66	54.8	57.0	57.0	56.8	56.8	56.8	56.8	2.2	2.2	2.0	2.0	2.0	2.0
1115	B	66	56.7	59.0	58.9	58.9	58.9	58.9	58.9	2.3	2.2	2.2	2.2	2.2	2.2
1116	B	66	55.5	57.8	57.7	57.6	57.6	57.6	57.6	2.3	2.2	2.1	2.1	2.1	2.1

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1117	B	66	54.8	57.0	56.9	56.8	56.8	56.8	56.8	2.2	2.1	2.0	2.0	2.0	2.0
1118	B	66	54.3	56.4	56.4	56.2	56.2	56.2	56.2	2.1	2.1	1.9	1.9	1.9	1.9
1119	B	66	54.0	56.2	56.1	55.9	55.9	55.9	55.9	2.2	2.1	1.9	1.9	1.9	1.9
1120	B	66	54.7	56.8	56.8	56.7	56.7	56.7	56.7	2.1	2.1	2.0	2.0	2.0	2.0
1121	B	66	54.3	56.5	56.5	56.2	56.2	56.2	56.2	2.2	2.2	1.9	1.9	1.9	1.9
1122	B	66	54.4	56.5	56.5	56.3	56.3	56.3	56.3	2.1	2.1	1.9	1.9	1.9	1.9
1123	B	66	55.4	57.5	57.5	57.3	57.3	57.3	57.3	2.1	2.1	1.9	1.9	1.9	1.9
1124	B	66	56.4	58.5	58.5	58.3	58.3	58.3	58.3	2.1	2.1	1.9	1.9	1.9	1.9
1125	B	66	56.8	59.0	59.0	58.6	58.6	58.6	58.6	2.2	2.2	1.8	1.8	1.8	1.8
1126	B	66	57.7	59.9	59.9	59.5	59.5	59.5	59.5	2.2	2.2	1.8	1.8	1.8	1.8
1127	B	66	55.6	57.7	57.6	57.4	57.4	57.4	57.4	2.1	2.0	1.8	1.8	1.8	1.8
1128	B	66	55.8	57.9	57.9	57.7	57.7	57.7	57.7	2.1	2.1	1.9	1.9	1.9	1.9
1129	B	66	57.5	60.1	60.0	59.3	59.3	59.3	59.3	2.6	2.5	1.8	1.8	1.8	1.8
1130	B	66	57.5	59.8	59.8	59.3	59.3	59.3	59.3	2.3	2.3	1.8	1.8	1.8	1.8
1131	B	66	70.7	74.1	74.1	72.6	72.6	72.6	72.6	3.4	3.4	1.9	1.9	1.9	1.9
1132	B	66	67.5	70.8	70.8	69.4	69.4	69.4	69.4	3.3	3.3	1.9	1.9	1.9	1.9
1133	B	66	65.3	67.8	67.8	67.1	67.1	67.1	67.1	2.5	2.5	1.8	1.8	1.8	1.8
1134	B	66	63.7	66.2	66.2	65.5	65.5	65.5	65.5	2.5	2.5	1.8	1.8	1.8	1.8
1135	B	66	62.5	65.1	65.1	64.3	64.3	64.3	64.3	2.6	2.6	1.8	1.8	1.8	1.8
1136	B	66	61.3	64.0	64.0	63.0	63.0	63.0	63.0	2.7	2.7	1.7	1.7	1.7	1.7
1137	B	66	59.7	62.3	62.3	61.5	61.5	61.5	61.5	2.6	2.6	1.8	1.8	1.8	1.8
1138	B	66	59.6	62.1	62.1	61.4	61.4	61.4	61.4	2.5	2.5	1.8	1.8	1.8	1.8
1139	B	66	59.1	61.9	61.9	60.9	60.9	60.9	60.9	2.8	2.8	1.8	1.8	1.8	1.8
1140	B	66	70.3	73.5	73.5	72.3	72.3	72.3	72.3	3.2	3.2	2.0	2.0	2.0	2.0
1141	B	66	67.0	70.0	70.0	69.0	69.0	69.0	69.0	3.0	3.0	2.0	2.0	2.0	2.0
1142	B	66	64.8	67.4	67.4	66.7	66.7	66.7	66.7	2.6	2.6	1.9	1.9	1.9	1.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA													
			2012 Existing	2035 Build						Difference between Existing/Build						
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC																
1143	B	66	63.2	65.5	65.5	65.1	65.1	65.1	65.1	2.3	2.3	1.9	1.9	1.9	1.9
1144	B	66	61.2	63.4	63.4	63.1	63.1	63.1	63.1	2.2	2.2	1.9	1.9	1.9	1.9
1145	B	66	60.1	62.3	62.3	62.0	62.0	62.0	62.0	2.2	2.2	1.9	1.9	1.9	1.9
1146	B	66	66.1	68.2	68.2	68.0	68.0	68.0	68.0	2.1	2.1	1.9	1.9	1.9	1.9
1147	B	66	66.1	68.2	68.2	68.0	68.0	68.0	68.0	2.1	2.1	1.9	1.9	1.9	1.9
1148	B	66	66.5	68.7	68.7	68.4	68.4	68.4	68.4	2.2	2.2	1.9	1.9	1.9	1.9
1149	B	66	66.3	68.9	68.9	68.2	68.2	68.2	68.2	2.6	2.6	1.9	1.9	1.9	1.9
1150	B	66	67.0	69.6	69.6	68.9	68.9	68.9	68.9	2.6	2.6	1.9	1.9	1.9	1.9
1151	B	66	66.8	69.5	69.5	68.7	68.7	68.7	68.7	2.7	2.7	1.9	1.9	1.9	1.9
1152	B	66	67.1	69.9	69.9	68.9	68.9	68.9	68.9	2.8	2.8	1.8	1.8	1.8	1.8
1153	B	66	67.1	70.3	70.3	69.0	69.0	69.0	69.0	3.2	3.2	1.9	1.9	1.9	1.9
1154	B	66	67.0	70.1	70.1	68.8	68.8	68.8	68.8	3.1	3.1	1.8	1.8	1.8	1.8
1155	B	66	67.9	71.3	71.3	69.7	69.7	69.7	69.7	3.4	3.4	1.8	1.8	1.8	1.8
1156	B	66	67.0	70.0	70.0	68.9	68.9	68.9	68.9	3.0	3.0	1.9	1.9	1.9	1.9
1157	B	66	66.4	68.8	68.8	68.3	68.3	68.3	68.3	2.4	2.4	1.9	1.9	1.9	1.9
1158	B	66	66.1	68.4	68.4	68.0	68.0	68.0	68.0	2.3	2.3	1.9	1.9	1.9	1.9
1159	B	66	66.6	69.0	69.0	68.5	68.5	68.5	68.5	2.4	2.4	1.9	1.9	1.9	1.9
1160	B	66	66.1	68.6	68.6	68.0	68.0	68.0	68.0	2.5	2.5	1.9	1.9	1.9	1.9
1161	B	66	66.6	69.0	69.0	68.5	68.5	68.5	68.5	2.4	2.4	1.9	1.9	1.9	1.9
1162	B	66	66.3	69.2	69.2	68.2	68.2	68.2	68.2	2.9	2.9	1.9	1.9	1.9	1.9
1163	B	66	66.1	69.0	69.0	68.0	68.0	68.0	68.0	2.9	2.9	1.9	1.9	1.9	1.9
1164	B	66	66.2	69.0	69.0	68.1	68.1	68.1	68.1	2.8	2.8	1.9	1.9	1.9	1.9
1165	B	66	66.4	69.3	69.3	68.2	68.2	68.2	68.2	2.9	2.9	1.8	1.8	1.8	1.8
1166	B	66	67.0	70.4	70.4	68.9	68.9	68.9	68.9	3.4	3.4	1.9	1.9	1.9	1.9
1167	B	66	62.2	64.1	64.1	64.1	64.1	64.1	64.1	1.9	1.9	1.9	1.9	1.9	1.9
1168	B	66	62.2	64.3	64.3	64.1	64.1	64.1	64.1	2.1	2.1	1.9	1.9	1.9	1.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1169	B	66	62.4	64.4	64.3	64.2	64.2	64.2	64.2	2.0	1.9	1.8	1.8	1.8	1.8
1170	B	66	62.2	64.6	64.6	64.1	64.1	64.1	64.1	2.4	2.4	1.9	1.9	1.9	1.9
1171	B	66	62.3	64.7	64.7	64.1	64.1	64.1	64.1	2.4	2.4	1.8	1.8	1.8	1.8
1172	B	66	62.5	65.0	65.0	64.3	64.3	64.3	64.3	2.5	2.5	1.8	1.8	1.8	1.8
1173	B	66	62.6	65.2	65.2	64.3	64.3	64.3	64.3	2.6	2.6	1.7	1.7	1.7	1.7
1174	B	66	62.6	65.0	65.0	64.4	64.4	64.4	64.4	2.4	2.4	1.8	1.8	1.8	1.8
1175	B	66	62.5	65.2	65.2	64.3	64.3	64.3	64.3	2.7	2.7	1.8	1.8	1.8	1.8
1176	B	66	62.4	64.9	64.9	64.2	64.2	64.2	64.2	2.5	2.5	1.8	1.8	1.8	1.8
1177	B	66	62.6	64.9	64.9	64.4	64.4	64.4	64.4	2.3	2.3	1.8	1.8	1.8	1.8
1178	B	66	62.5	64.6	64.6	64.3	64.3	64.3	64.3	2.1	2.1	1.8	1.8	1.8	1.8
1179	B	66	62.3	64.6	64.6	64.1	64.1	64.1	64.1	2.3	2.3	1.8	1.8	1.8	1.8
1180	B	66	62.2	64.6	64.6	64.0	64.0	64.0	64.0	2.4	2.4	1.8	1.8	1.8	1.8
1181	B	66	62.2	64.7	64.7	64.0	64.0	64.0	64.0	2.5	2.5	1.8	1.8	1.8	1.8
1182	B	66	62.1	64.6	64.6	63.9	63.9	63.9	63.9	2.5	2.5	1.8	1.8	1.8	1.8
1183	B	66	62.3	65.2	65.2	64.1	64.1	64.1	64.1	2.9	2.9	1.8	1.8	1.8	1.8
1184	B	66	62.3	65.4	65.4	64.1	64.1	64.1	64.1	3.1	3.1	1.8	1.8	1.8	1.8
1185	B	66	62.7	65.4	65.4	64.5	64.5	64.5	64.5	2.7	2.7	1.8	1.8	1.8	1.8
1186	B	66	62.5	65.4	65.4	64.3	64.3	64.3	64.3	2.9	2.9	1.8	1.8	1.8	1.8
1187	B	66	60.4	62.5	62.5	62.2	62.2	62.2	62.2	2.1	2.1	1.8	1.8	1.8	1.8
1188	B	66	66.7	70.2	70.2	68.6	68.6	68.6	68.6	3.5	3.5	1.9	1.9	1.9	1.9
1189	B	66	66.3	69.7	69.7	68.2	68.2	68.2	68.2	3.4	3.4	1.9	1.9	1.9	1.9
1190	B	66	66.9	70.4	70.4	68.7	68.7	68.7	68.7	3.5	3.5	1.8	1.8	1.8	1.8
1191	B	66	66.7	70.1	70.1	68.5	68.5	68.5	68.5	3.4	3.4	1.8	1.8	1.8	1.8
1192	B	66	67.1	70.6	70.6	69.0	69.0	69.0	69.0	3.5	3.5	1.9	1.9	1.9	1.9
1193	B	66	66.9	70.3	70.3	68.7	68.7	68.7	68.7	3.4	3.4	1.8	1.8	1.8	1.8
1194	B	66	67.1	70.7	70.7	69.0	69.0	69.0	69.0	3.6	3.6	1.9	1.9	1.9	1.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1195	B	66	67.0	70.6	70.6	68.9	68.9	68.9	68.9	3.6	3.6	1.9	1.9	1.9	1.9
1196	B	66	66.8	70.3	70.3	68.6	68.6	68.6	68.6	3.5	3.5	1.8	1.8	1.8	1.8
1197	B	66	67.5	70.9	70.9	69.4	69.4	69.4	69.4	3.4	3.4	1.9	1.9	1.9	1.9
1198	B	66	61.7	65.0	65.0	63.5	63.5	63.5	63.5	3.3	3.3	1.8	1.8	1.8	1.8
1199	B	66	62.7	65.7	65.7	64.5	64.5	64.5	64.5	3.0	3.0	1.8	1.8	1.8	1.8
1200	B	66	62.9	65.7	65.7	64.6	64.6	64.6	64.6	2.8	2.8	1.7	1.7	1.7	1.7
1201	B	66	62.7	65.5	65.5	64.5	64.5	64.5	64.5	2.8	2.8	1.8	1.8	1.8	1.8
1202	B	66	59.6	62.9	62.9	61.3	61.3	61.3	61.3	3.3	3.3	1.7	1.7	1.7	1.7
1203	B	66	59.2	62.4	62.4	61.0	61.0	61.0	61.0	3.2	3.2	1.8	1.8	1.8	1.8
1204	B	66	58.4	61.7	61.7	60.2	60.2	60.2	60.2	3.3	3.3	1.8	1.8	1.8	1.8
1205	B	66	58.5	61.9	61.9	60.2	60.2	60.2	60.2	3.4	3.4	1.7	1.7	1.7	1.7
1206	B	66	63.3	66.0	66.0	65.0	65.0	65.0	65.0	2.7	2.7	1.7	1.7	1.7	1.7
1207	B	66	61.0	64.0	64.0	62.7	62.7	62.7	62.7	3.0	3.0	1.7	1.7	1.7	1.7
1208	B	66	63.2	65.8	65.8	65.0	65.0	65.0	65.0	2.6	2.6	1.8	1.8	1.8	1.8
1209	B	66	63.1	65.7	65.7	64.9	64.9	64.9	64.9	2.6	2.6	1.8	1.8	1.8	1.8
1210	B	66	63.6	66.2	66.2	65.5	65.5	65.5	65.5	2.6	2.6	1.9	1.9	1.9	1.9
1211	B	66	59.8	62.9	62.9	61.6	61.6	61.6	61.6	3.1	3.1	1.8	1.8	1.8	1.8
1212	B	66	58.2	61.5	61.5	60.0	60.0	60.0	60.0	3.3	3.3	1.8	1.8	1.8	1.8
1213	B	66	58.4	61.7	61.7	60.3	60.3	60.3	60.3	3.3	3.3	1.9	1.9	1.9	1.9
1214	B	66	58.3	61.5	61.5	60.2	60.2	60.2	60.2	3.2	3.2	1.9	1.9	1.9	1.9
1215	B	66	61.2	64.0	64.0	63.2	63.2	63.2	63.2	2.8	2.8	2.0	2.0	2.0	2.0
1216	B	66	65.3	67.1	67.0	66.7	66.7	66.7	66.7	1.8	1.7	1.4	1.4	1.4	1.4
1217	B	66	65.6	67.5	67.4	67.1	67.1	67.1	67.1	1.9	1.8	1.5	1.5	1.5	1.5
1218	B	66	62.9	65.3	65.3	64.7	64.7	64.7	64.7	2.4	2.4	1.8	1.8	1.8	1.8
1219	B	66	62.3	65.0	64.9	64.1	64.1	64.1	64.1	2.7	2.6	1.8	1.8	1.8	1.8
1220	B	66	62.0	64.8	64.7	63.8	63.8	63.8	63.8	2.8	2.7	1.8	1.8	1.8	1.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1221	B	66	61.7	64.5	64.5	63.5	63.5	63.5	63.5	2.8	2.8	1.8	1.8	1.8	1.8
1222	B	66	61.1	64.1	64.1	62.9	62.9	62.9	62.9	3.0	3.0	1.8	1.8	1.8	1.8
1223	B	66	67.9	70.7	70.6	69.4	69.4	69.4	69.4	2.8	2.7	1.5	1.5	1.5	1.5
1224	B	66	66.5	69.6	69.6	68.3	68.3	68.3	68.3	3.1	3.1	1.8	1.8	1.8	1.8
1225	B	66	66.6	69.8	69.8	68.4	68.4	68.4	68.4	3.2	3.2	1.8	1.8	1.8	1.8
1226	B	66	66.3	69.4	69.4	68.1	68.1	68.1	68.1	3.1	3.1	1.8	1.8	1.8	1.8
1227	B	66	66.2	69.1	69.1	68.0	68.0	68.0	68.0	2.9	2.9	1.8	1.8	1.8	1.8
1228	B	66	66.4	69.3	69.4	68.2	68.2	68.2	68.2	2.9	3.0	1.8	1.8	1.8	1.8
1229	B	66	66.4	69.2	69.3	68.2	68.2	68.2	68.2	2.8	2.9	1.8	1.8	1.8	1.8
1230	B	66	66.2	69.0	69.0	68.0	68.0	68.0	68.0	2.8	2.8	1.8	1.8	1.8	1.8
1231	B	66	67.5	70.3	70.3	69.3	69.3	69.3	69.3	2.8	2.8	1.8	1.8	1.8	1.8
1232	B	66	67.0	69.9	69.9	68.8	68.8	68.8	68.8	2.9	2.9	1.8	1.8	1.8	1.8
1233	B	66	66.9	69.9	69.9	68.7	68.7	68.7	68.7	3.0	3.0	1.8	1.8	1.8	1.8
1234	B	66	67.4	70.8	70.9	69.2	69.2	69.2	69.2	3.4	3.5	1.8	1.8	1.8	1.8
1235	B	66	62.2	65.3	65.3	64.0	64.0	64.0	64.0	3.1	3.1	1.8	1.8	1.8	1.8
1236	B	66	62.2	65.4	65.4	64.1	64.1	64.1	64.1	3.2	3.2	1.9	1.9	1.9	1.9
1237	B	66	62.2	65.3	65.3	64.1	64.1	64.1	64.1	3.1	3.1	1.9	1.9	1.9	1.9
1238	B	66	62.3	65.3	65.3	64.2	64.2	64.2	64.2	3.0	3.0	1.9	1.9	1.9	1.9
1239	B	66	67.3	70.8	70.8	69.1	69.1	69.1	69.1	3.5	3.5	1.8	1.8	1.8	1.8
1240	B	66	65.8	68.7	68.7	67.6	67.6	67.6	67.6	2.9	2.9	1.8	1.8	1.8	1.8
1241	B	66	65.9	68.8	68.8	67.7	67.7	67.7	67.7	2.9	2.9	1.8	1.8	1.8	1.8
1242	B	66	65.7	68.6	68.6	67.6	67.6	67.6	67.6	2.9	2.9	1.9	1.9	1.9	1.9
1243	B	66	65.7	68.7	68.7	67.6	67.6	67.6	67.6	3.0	3.0	1.9	1.9	1.9	1.9
1244	B	66	66.1	69.2	69.2	67.9	67.9	67.9	67.9	3.1	3.1	1.8	1.8	1.8	1.8
1245	B	66	66.2	69.3	69.3	68.0	68.0	68.0	68.0	3.1	3.1	1.8	1.8	1.8	1.8
1246	B	66	66.4	69.7	69.7	68.2	68.2	68.2	68.2	3.3	3.3	1.8	1.8	1.8	1.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA													
			2012 Existing	2035 Build						Difference between Existing/Build						
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC																
1247	B	66	65.9	69.0	69.0	67.7	67.7	67.7	67.7	3.1	3.1	1.8	1.8	1.8	1.8
1248	B	66	66.2	69.4	69.4	68.0	68.0	68.0	68.0	3.2	3.2	1.8	1.8	1.8	1.8
1249	B	66	65.7	68.6	68.6	67.5	67.5	67.5	67.5	2.9	2.9	1.8	1.8	1.8	1.8
1250	B	66	66.0	69.1	69.1	67.8	67.8	67.8	67.8	3.1	3.1	1.8	1.8	1.8	1.8
1251	B	66	66.0	68.9	68.9	67.8	67.8	67.8	67.8	2.9	2.9	1.8	1.8	1.8	1.8
1252	B	66	65.4	68.3	68.3	67.2	67.2	67.2	67.2	2.9	2.9	1.8	1.8	1.8	1.8
1253	B	66	65.4	68.3	68.3	67.2	67.2	67.2	67.2	2.9	2.9	1.8	1.8	1.8	1.8
1254	B	66	66.9	69.6	69.5	68.7	68.7	68.7	68.7	2.7	2.6	1.8	1.8	1.8	1.8
1255	B	66	65.8	68.3	68.3	67.6	67.6	67.6	67.6	2.5	2.5	1.8	1.8	1.8	1.8
1256	B	66	66.0	68.4	68.4	67.7	67.7	67.7	67.7	2.4	2.4	1.7	1.7	1.7	1.7
1257	B	66	66.6	69.0	69.0	68.3	68.3	68.3	68.3	2.4	2.4	1.7	1.7	1.7	1.7
1258	B	66	62.2	65.3	65.3	64.1	64.1	64.1	64.1	3.1	3.1	1.9	1.9	1.9	1.9
1259	B	66	62.2	65.2	65.2	64.0	64.0	64.0	64.0	3.0	3.0	1.8	1.8	1.8	1.8
1260	B	66	62.1	65.3	65.3	63.9	63.9	63.9	63.9	3.2	3.2	1.8	1.8	1.8	1.8
1261	B	66	62.0	65.3	65.3	63.9	63.9	63.9	63.9	3.3	3.3	1.9	1.9	1.9	1.9
1262	B	66	62.0	65.2	65.2	63.8	63.8	63.8	63.8	3.2	3.2	1.8	1.8	1.8	1.8
1263	B	66	61.9	65.2	65.2	63.8	63.8	63.8	63.8	3.3	3.3	1.9	1.9	1.9	1.9
1264	B	66	62.0	65.3	65.3	63.8	63.8	63.8	63.8	3.3	3.3	1.8	1.8	1.8	1.8
1265	B	66	61.9	65.2	65.2	63.7	63.7	63.7	63.7	3.3	3.3	1.8	1.8	1.8	1.8
1266	B	66	61.9	65.2	65.2	63.7	63.7	63.7	63.7	3.3	3.3	1.8	1.8	1.8	1.8
1267	B	66	61.8	65.1	65.1	63.6	63.6	63.6	63.6	3.3	3.3	1.8	1.8	1.8	1.8
1268	B	66	61.8	65.1	65.1	63.7	63.7	63.7	63.7	3.3	3.3	1.9	1.9	1.9	1.9
1269	B	66	61.7	65.0	65.0	63.5	63.5	63.5	63.5	3.3	3.3	1.8	1.8	1.8	1.8
1270	B	66	61.8	65.1	65.1	63.6	63.6	63.6	63.6	3.3	3.3	1.8	1.8	1.8	1.8
1271	B	66	62.1	65.0	65.0	64.0	64.0	64.0	64.0	2.9	2.9	1.9	1.9	1.9	1.9
1272	B	66	62.1	65.0	65.0	64.0	64.0	64.0	64.0	2.9	2.9	1.9	1.9	1.9	1.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1273	B	66	62.3	65.1	65.1	64.2	64.2	64.2	64.2	2.8	2.8	1.9	1.9	1.9	1.9
1274	B	66	62.5	65.1	65.1	64.3	64.3	64.3	64.3	2.6	2.6	1.8	1.8	1.8	1.8
1275	C	66	59.0	61.8	61.8	60.8	60.8	60.8	60.8	2.8	2.8	1.8	1.8	1.8	1.8
1276	B	66	72.1	74.5	74.5	73.8	73.8	73.8	73.8	2.4	2.4	1.7	1.7	1.7	1.7
1277	B	66	66.0	68.3	68.3	67.8	67.8	67.8	67.8	2.3	2.3	1.8	1.8	1.8	1.8
1278	B	66	66.4	68.9	68.9	68.3	68.3	68.3	68.3	2.5	2.5	1.9	1.9	1.9	1.9
1279	B	66	71.0	73.3	73.3	72.8	72.8	72.8	72.8	2.3	2.3	1.8	1.8	1.8	1.8
1280	B	66	68.8	71.4	71.4	70.8	70.8	70.8	70.8	2.6	2.6	2.0	2.0	2.0	2.0
1281	B	66	67.0	69.5	69.5	69.2	69.2	69.2	69.2	2.5	2.5	2.2	2.2	2.2	2.2
1282	B	66	64.6	67.2	67.2	66.9	66.9	66.9	66.9	2.6	2.6	2.3	2.3	2.3	2.3
1283	B	66	64.8	67.5	67.5	67.2	67.2	67.2	67.2	2.7	2.7	2.4	2.4	2.4	2.4
1284	B	66	66.7	69.3	69.3	69.2	69.2	69.2	69.2	2.6	2.6	2.5	2.5	2.5	2.5
1285	B	66	62.7	65.3	65.3	65.0	65.0	65.0	65.0	2.6	2.6	2.3	2.3	2.3	2.3
1286	B	66	61.1	63.8	63.8	63.2	63.2	63.2	63.2	2.7	2.7	2.1	2.1	2.1	2.1
1287	B	66	62.4	64.9	64.9	64.4	64.4	64.4	64.4	2.5	2.5	2.0	2.0	2.0	2.0
1288	B	66	62.3	64.8	64.8	64.3	64.3	64.3	64.3	2.5	2.5	2.0	2.0	2.0	2.0
1289	B	66	62.0	64.5	64.5	63.9	63.9	63.9	63.9	2.5	2.5	1.9	1.9	1.9	1.9
1290	B	66	60.3	63.0	63.0	62.2	62.2	62.2	62.2	2.7	2.7	1.9	1.9	1.9	1.9
1291	B	66	59.7	62.6	62.6	61.6	61.6	61.6	61.6	2.9	2.9	1.9	1.9	1.9	1.9
1292	B	66	59.2	61.9	61.9	61.1	61.1	61.1	61.1	2.7	2.7	1.9	1.9	1.9	1.9
1293	B	66	73.5	75.6	75.6	75.5	75.5	75.5	75.5	2.1	2.1	2.0	2.0	2.0	2.0
1294	B	66	69.3	71.7	71.7	71.3	71.3	71.3	71.3	2.4	2.4	2.0	2.0	2.0	2.0
1295	B	66	68.2	70.5	70.5	70.1	70.1	70.1	70.1	2.3	2.3	1.9	1.9	1.9	1.9
1296	B	66	68.5	70.5	70.5	70.4	70.4	70.4	70.4	2.0	2.0	1.9	1.9	1.9	1.9
1297	B	66	68.5	70.5	70.5	70.4	70.4	70.4	70.4	2.0	2.0	1.9	1.9	1.9	1.9
1298	B	66	69.3	71.2	71.2	71.2	71.2	71.2	71.2	1.9	1.9	1.9	1.9	1.9	1.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1299	B	66	68.8	70.6	70.6	70.6	70.6	70.6	70.6	1.8	1.8	1.8	1.8	1.8	1.8
1300	B	66	70.2	72.0	72.0	72.1	72.1	72.1	72.1	1.8	1.8	1.9	1.9	1.9	1.9
1301	B	66	70.1	71.8	71.8	71.9	71.9	71.9	71.9	1.7	1.7	1.8	1.8	1.8	1.8
1302	B	66	66.9	68.7	68.7	68.7	68.7	68.7	68.7	1.8	1.8	1.8	1.8	1.8	1.8
1303	B	66	67.0	68.7	68.7	68.7	68.7	68.7	68.7	1.7	1.7	1.7	1.7	1.7	1.7
1304	B	66	67.6	70.2	70.2	69.7	69.7	69.7	69.7	2.6	2.6	2.1	2.1	2.1	2.1
1305	B	66	64.2	66.5	66.5	66.2	66.2	66.2	66.2	2.3	2.3	2.0	2.0	2.0	2.0
1306	B	66	63.6	66.0	66.0	65.7	65.7	65.7	65.7	2.4	2.4	2.1	2.1	2.1	2.1
1307	B	66	62.5	65.0	65.0	64.7	64.7	64.7	64.7	2.5	2.5	2.2	2.2	2.2	2.2
1308	B	66	62.0	64.6	64.6	64.2	64.2	64.2	64.2	2.6	2.6	2.2	2.2	2.2	2.2
1309	B	66	62.0	64.6	64.6	64.2	64.2	64.2	64.2	2.6	2.6	2.2	2.2	2.2	2.2
1310	B	66	63.9	65.9	65.9	65.7	65.7	65.7	65.7	2.0	2.0	1.8	1.8	1.8	1.8
1311	B	66	64.1	66.1	66.1	65.9	65.9	65.9	65.9	2.0	2.0	1.8	1.8	1.8	1.8
1312	B	66	64.3	66.3	66.3	66.1	66.1	66.1	66.1	2.0	2.0	1.8	1.8	1.8	1.8
1313	B	66	64.4	66.3	66.3	66.1	66.1	66.1	66.1	1.9	1.9	1.7	1.7	1.7	1.7
1314	B	66	63.8	65.7	65.7	65.6	65.6	65.6	65.6	1.9	1.9	1.8	1.8	1.8	1.8
1315	B	66	64.0	65.7	65.7	65.6	65.6	65.6	65.6	1.7	1.7	1.6	1.6	1.6	1.6
1316	B	66	64.3	66.0	66.0	65.8	65.8	65.8	65.8	1.7	1.7	1.5	1.5	1.5	1.5
1317	B	66	62.1	63.7	63.7	63.6	63.6	63.6	63.6	1.6	1.6	1.5	1.5	1.5	1.5
1318	B	66	61.0	62.9	62.9	62.7	62.7	62.7	62.7	1.9	1.9	1.7	1.7	1.7	1.7
1319	B	66	60.5	62.5	62.5	62.2	62.2	62.2	62.2	2.0	2.0	1.7	1.7	1.7	1.7
1320	B	66	61.1	63.2	63.2	62.8	62.8	62.8	62.8	2.1	2.1	1.7	1.7	1.7	1.7
1321	E	71	68.3	69.9	69.9	69.8	69.8	69.8	69.8	1.6	1.6	1.5	1.5	1.5	1.5
1322	B	66	61.8	63.4	63.4	63.2	63.2	63.2	63.2	1.6	1.6	1.4	1.4	1.4	1.4
1323	B	66	61.5	63.1	63.1	62.9	62.9	62.9	62.9	1.6	1.6	1.4	1.4	1.4	1.4
1324	B	66	61.2	62.9	62.9	62.6	62.6	62.6	62.6	1.7	1.7	1.4	1.4	1.4	1.4

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1325	B	66	60.9	62.6	62.6	62.3	62.3	62.3	62.3	1.7	1.7	1.4	1.4	1.4	1.4
1326	B	66	60.6	62.4	62.4	62.1	62.1	62.1	62.1	1.8	1.8	1.5	1.5	1.5	1.5
1327	B	66	60.4	62.1	62.1	61.9	61.9	61.9	61.9	1.7	1.7	1.5	1.5	1.5	1.5
1328	B	66	60.1	61.9	61.9	61.6	61.6	61.6	61.6	1.8	1.8	1.5	1.5	1.5	1.5
1329	B	66	59.9	61.7	61.7	61.4	61.4	61.4	61.4	1.8	1.8	1.5	1.5	1.5	1.5
1330	B	66	59.2	61.3	61.3	60.9	60.9	60.9	60.9	2.1	2.1	1.7	1.7	1.7	1.7
1331	B	66	59.8	62.0	62.0	61.6	61.6	61.6	61.6	2.2	2.2	1.8	1.8	1.8	1.8
1332	B	66	59.8	62.1	62.1	61.7	61.7	61.7	61.7	2.3	2.3	1.9	1.9	1.9	1.9
1333	B	66	63.3	64.9	64.9	64.7	64.7	64.7	64.7	1.6	1.6	1.4	1.4	1.4	1.4
1334	B	66	62.7	64.3	64.3	64.2	64.2	64.2	64.2	1.6	1.6	1.5	1.5	1.5	1.5
1335	B	66	62.2	63.9	63.9	63.7	63.7	63.7	63.7	1.7	1.7	1.5	1.5	1.5	1.5
1336	B	66	61.7	63.6	63.6	63.3	63.3	63.3	63.3	1.9	1.9	1.6	1.6	1.6	1.6
1337	B	66	61.4	63.4	63.4	63.0	63.0	63.0	63.0	2.0	2.0	1.6	1.6	1.6	1.6
1338	B	66	61.3	63.3	63.3	63.1	63.1	63.1	63.1	2.0	2.0	1.8	1.8	1.8	1.8
1339	B	66	61.5	63.5	63.5	63.3	63.3	63.3	63.3	2.0	2.0	1.8	1.8	1.8	1.8
1340	B	66	61.9	64.0	64.0	63.7	63.7	63.7	63.7	2.1	2.1	1.8	1.8	1.8	1.8
1341	B	66	62.4	64.7	64.7	64.3	64.3	64.3	64.3	2.3	2.3	1.9	1.9	1.9	1.9
1342	B	66	66.5	69.1	69.1	69.1	69.1	69.1	69.1	2.6	2.6	2.6	2.6	2.6	2.6
1343	B	66	63.4	66.0	66.0	65.8	65.8	65.8	65.8	2.6	2.6	2.4	2.4	2.4	2.4
1344	B	66	63.9	66.5	66.5	66.3	66.3	66.3	66.3	2.6	2.6	2.4	2.4	2.4	2.4
1345	B	66	64.0	66.6	66.6	66.4	66.4	66.4	66.4	2.6	2.6	2.4	2.4	2.4	2.4
1346	B	66	65.9	68.6	68.6	68.4	68.4	68.4	68.4	2.7	2.7	2.5	2.5	2.5	2.5
1347	B	66	65.1	67.7	67.7	67.4	67.4	67.4	67.4	2.6	2.6	2.3	2.3	2.3	2.3
1348	B	66	65.7	67.5	67.5	67.3	67.3	67.3	67.3	1.8	1.8	1.6	1.6	1.6	1.6
1349	B	66	65.7	67.6	67.6	67.3	67.3	67.3	67.3	1.9	1.9	1.6	1.6	1.6	1.6
1350	B	66	65.4	67.4	67.4	67.1	67.1	67.1	67.1	2.0	2.0	1.7	1.7	1.7	1.7

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1351	B	66	65.4	67.4	67.4	67.2	67.2	67.2	67.2	2.0	2.0	1.8	1.8	1.8	1.8
1352	B	66	65.4	67.4	67.4	67.1	67.1	67.1	67.1	2.0	2.0	1.7	1.7	1.7	1.7
1353	B	66	66.1	68.2	68.2	67.8	67.8	67.8	67.8	2.1	2.1	1.7	1.7	1.7	1.7
1354	B	66	65.8	67.9	67.9	67.6	67.6	67.6	67.6	2.1	2.1	1.8	1.8	1.8	1.8
1355	B	66	66.2	68.3	68.3	68.0	68.0	68.0	68.0	2.1	2.1	1.8	1.8	1.8	1.8
1356	B	66	65.8	68.1	68.1	67.6	67.6	67.6	67.6	2.3	2.3	1.8	1.8	1.8	1.8
1357	B	66	67.3	69.9	69.9	69.5	69.5	69.5	69.5	2.6	2.6	2.2	2.2	2.2	2.2
1358	B	66	68.2	70.9	70.9	70.4	70.4	70.4	70.4	2.7	2.7	2.2	2.2	2.2	2.2
1359	B	66	70.4	72.8	72.8	72.3	72.3	72.3	72.3	2.4	2.4	1.9	1.9	1.9	1.9
1360	C	66	55.6	56.6	56.6	56.6	56.6	56.6	56.6	1.0	1.0	1.0	1.0	1.0	1.0
1361	B	66	61.2	62.5	62.5	62.4	62.4	62.4	62.4	1.3	1.3	1.2	1.2	1.2	1.2
1362	B	66	60.9	62.2	62.2	62.1	62.1	62.1	62.1	1.3	1.3	1.2	1.2	1.2	1.2
1363	B	66	60.1	61.4	61.4	61.4	61.4	61.4	61.4	1.3	1.3	1.3	1.3	1.3	1.3
1364	B	66	59.4	60.8	60.8	60.7	60.7	60.7	60.7	1.4	1.4	1.3	1.3	1.3	1.3
1365	B	66	60.5	61.9	61.9	61.9	61.9	61.9	61.9	1.4	1.4	1.4	1.4	1.4	1.4
1366	B	66	59.1	60.4	60.4	60.4	60.4	60.4	60.4	1.3	1.3	1.3	1.3	1.3	1.3
1367	B	66	58.9	60.4	60.4	60.3	60.3	60.3	60.3	1.5	1.5	1.4	1.4	1.4	1.4
1368	B	66	60.0	61.4	61.4	61.4	61.4	61.4	61.4	1.4	1.4	1.4	1.4	1.4	1.4
1369	B	66	59.2	60.4	60.4	60.4	60.4	60.4	60.4	1.2	1.2	1.2	1.2	1.2	1.2
1370	B	66	58.1	59.4	59.4	59.4	59.4	59.4	59.4	1.3	1.3	1.3	1.3	1.3	1.3
1371	B	66	57.5	58.8	58.8	58.7	58.7	58.7	58.7	1.3	1.3	1.2	1.2	1.2	1.2
1372	B	66	58.5	59.7	59.7	59.7	59.7	59.7	59.7	1.2	1.2	1.2	1.2	1.2	1.2
1373	B	66	57.8	59.0	59.0	59.0	59.0	59.0	59.0	1.2	1.2	1.2	1.2	1.2	1.2
1374	B	66	57.2	58.5	58.5	58.4	58.4	58.4	58.4	1.3	1.3	1.2	1.2	1.2	1.2
1375	B	66	56.8	58.2	58.2	58.1	58.1	58.1	58.1	1.4	1.4	1.3	1.3	1.3	1.3
1376	B	66	57.5	58.8	58.8	58.7	58.7	58.7	58.7	1.3	1.3	1.2	1.2	1.2	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1377	B	66	57.0	58.3	58.3	58.3	58.3	58.3	58.3	1.3	1.3	1.3	1.3	1.3	1.3
1378	B	66	56.6	57.9	57.9	57.9	57.9	57.9	57.9	1.3	1.3	1.3	1.3	1.3	1.3
1379	B	66	57.2	58.5	58.5	58.5	58.5	58.5	58.5	1.3	1.3	1.3	1.3	1.3	1.3
1380	B	66	56.7	58.0	58.0	57.9	57.9	57.9	57.9	1.3	1.3	1.2	1.2	1.2	1.2
1381	B	66	56.0	57.4	57.4	57.3	57.3	57.3	57.3	1.4	1.4	1.3	1.3	1.3	1.3
1382	B	66	60.8	61.9	61.9	61.8	61.8	61.8	61.8	1.1	1.1	1.0	1.0	1.0	1.0
1383	B	66	56.7	58.0	58.0	57.9	57.9	57.9	57.9	1.3	1.3	1.2	1.2	1.2	1.2
1384	B	66	56.5	57.7	57.7	57.7	57.7	57.7	57.7	1.2	1.2	1.2	1.2	1.2	1.2
1385	B	66	56.0	57.3	57.3	57.2	57.2	57.2	57.2	1.3	1.3	1.2	1.2	1.2	1.2
1386	B	66	55.9	57.2	57.2	57.1	57.1	57.1	57.1	1.3	1.3	1.2	1.2	1.2	1.2
1387	B	66	55.4	56.8	56.8	56.7	56.7	56.7	56.7	1.4	1.4	1.3	1.3	1.3	1.3
1388	B	66	55.3	56.7	56.7	56.6	56.6	56.6	56.6	1.4	1.4	1.3	1.3	1.3	1.3
1389	B	66	59.5	60.5	60.5	60.5	60.5	60.5	60.5	1.0	1.0	1.0	1.0	1.0	1.0
1390	B	66	55.8	57.1	57.1	57.1	57.1	57.1	57.1	1.3	1.3	1.3	1.3	1.3	1.3
1391	B	66	55.2	56.4	56.4	56.3	56.3	56.3	56.3	1.2	1.2	1.1	1.1	1.1	1.1
1392	B	66	54.4	55.7	55.7	55.6	55.6	55.6	55.6	1.3	1.3	1.2	1.2	1.2	1.2
1393	B	66	54.0	55.2	55.2	55.2	55.2	55.2	55.2	1.2	1.2	1.2	1.2	1.2	1.2
1394	B	66	53.8	55.1	55.1	55.0	55.0	55.0	55.0	1.3	1.3	1.2	1.2	1.2	1.2
1395	B	66	53.1	54.3	54.3	54.2	54.2	54.2	54.2	1.2	1.2	1.1	1.1	1.1	1.1
1396	B	66	53.9	55.1	55.1	55.1	55.1	55.1	55.1	1.2	1.2	1.2	1.2	1.2	1.2
1397	B	66	54.4	55.6	55.6	55.5	55.5	55.5	55.5	1.2	1.2	1.1	1.1	1.1	1.1
1398	B	66	54.9	56.1	56.1	56.1	56.1	56.1	56.1	1.2	1.2	1.2	1.2	1.2	1.2
1399	B	66	54.3	55.4	55.4	55.4	55.4	55.4	55.4	1.1	1.1	1.1	1.1	1.1	1.1
1400	B	66	53.6	54.8	54.8	54.7	54.7	54.7	54.7	1.2	1.2	1.1	1.1	1.1	1.1
1401	B	66	53.2	54.4	54.4	54.4	54.4	54.4	54.4	1.2	1.2	1.2	1.2	1.2	1.2
1402	B	66	52.8	54.1	54.1	54.0	54.0	54.0	54.0	1.3	1.3	1.2	1.2	1.2	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1403	B	66	54.0	55.2	55.2	55.1	55.1	55.1	55.1	1.2	1.2	1.1	1.1	1.1	1.1
1404	B	66	53.9	55.1	55.1	55.0	55.0	55.0	55.0	1.2	1.2	1.1	1.1	1.1	1.1
1405	B	66	54.0	55.1	55.1	55.0	55.0	55.0	55.0	1.1	1.1	1.0	1.0	1.0	1.0
1406	B	66	53.9	55.1	55.1	55.0	55.0	55.0	55.0	1.2	1.2	1.1	1.1	1.1	1.1
1407	B	66	53.8	54.9	54.9	54.9	54.9	54.9	54.9	1.1	1.1	1.1	1.1	1.1	1.1
1408	B	66	52.3	53.5	53.5	53.4	53.4	53.4	53.4	1.2	1.2	1.1	1.1	1.1	1.1
1409	B	66	52.4	53.6	53.6	53.5	53.5	53.5	53.5	1.2	1.2	1.1	1.1	1.1	1.1
1410	B	66	58.5	59.5	59.5	59.5	59.5	59.5	59.5	1.0	1.0	1.0	1.0	1.0	1.0
1411	B	66	57.1	58.1	58.1	58.1	58.1	58.1	58.1	1.0	1.0	1.0	1.0	1.0	1.0
1412	B	66	56.0	57.1	57.1	57.1	57.1	57.1	57.1	1.1	1.1	1.1	1.1	1.1	1.1
1413	B	66	56.0	57.1	57.1	57.1	57.1	57.1	57.1	1.1	1.1	1.1	1.1	1.1	1.1
1414	B	66	57.4	58.4	58.4	58.4	58.4	58.4	58.4	1.0	1.0	1.0	1.0	1.0	1.0
1415	B	66	56.3	57.3	57.3	57.3	57.3	57.3	57.3	1.0	1.0	1.0	1.0	1.0	1.0
1416	B	66	58.7	59.7	59.7	59.7	59.7	59.7	59.7	1.0	1.0	1.0	1.0	1.0	1.0
1417	B	66	57.6	58.6	58.6	58.6	58.6	58.6	58.6	1.0	1.0	1.0	1.0	1.0	1.0
1418	B	66	56.6	57.7	57.7	57.6	57.6	57.6	57.6	1.1	1.1	1.0	1.0	1.0	1.0
1419	B	66	53.9	55.0	55.0	55.0	55.0	55.0	55.0	1.1	1.1	1.1	1.1	1.1	1.1
1420	B	66	52.9	54.1	54.1	54.0	54.0	54.0	54.0	1.2	1.2	1.1	1.1	1.1	1.1
1421	B	66	52.2	53.4	53.4	53.4	53.4	53.4	53.4	1.2	1.2	1.2	1.2	1.2	1.2
1422	B	66	54.0	55.1	55.1	55.1	55.1	55.1	55.1	1.1	1.1	1.1	1.1	1.1	1.1
1423	B	66	54.0	55.1	55.1	55.0	55.0	55.0	55.0	1.1	1.1	1.0	1.0	1.0	1.0
1424	B	66	52.4	53.7	53.6	53.6	53.6	53.6	53.6	1.3	1.2	1.2	1.2	1.2	1.2
1425	B	66	54.4	55.6	55.6	55.5	55.5	55.5	55.5	1.2	1.2	1.1	1.1	1.1	1.1
1426	B	66	53.6	54.9	54.9	54.8	54.8	54.8	54.8	1.3	1.3	1.2	1.2	1.2	1.2
1427	B	66	53.1	54.3	54.3	54.2	54.2	54.2	54.2	1.2	1.2	1.1	1.1	1.1	1.1
1428	B	66	52.4	53.7	53.7	53.6	53.6	53.6	53.6	1.3	1.3	1.2	1.2	1.2	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA													
			2012 Existing	2035 Build						Difference between Existing/Build						
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC																
1429	B	66	52.5	53.7	53.7	53.6	53.6	53.6	53.6	1.2	1.2	1.1	1.1	1.1	1.1
1430	B	66	53.2	54.5	54.5	54.4	54.4	54.4	54.4	1.3	1.3	1.2	1.2	1.2	1.2
1431	B	66	54.2	55.3	55.3	55.3	55.3	55.3	55.3	1.1	1.1	1.1	1.1	1.1	1.1
1432	B	66	60.9	61.9	61.9	61.8	61.8	61.8	61.8	1.0	1.0	0.9	0.9	0.9	0.9
1433	B	66	59.0	60.0	60.0	60.0	60.0	60.0	60.0	1.0	1.0	1.0	1.0	1.0	1.0
1434	B	66	56.7	57.7	57.7	57.7	57.7	57.7	57.7	1.0	1.0	1.0	1.0	1.0	1.0
1435	B	66	54.1	55.2	55.2	55.2	55.2	55.2	55.2	1.1	1.1	1.1	1.1	1.1	1.1
1436	B	66	54.0	55.1	55.1	55.1	55.1	55.1	55.1	1.1	1.1	1.1	1.1	1.1	1.1
1437	B	66	53.4	54.5	54.5	54.5	54.5	54.5	54.5	1.1	1.1	1.1	1.1	1.1	1.1
1438	B	66	52.7	53.8	53.8	53.8	53.8	53.8	53.7	1.1	1.1	1.1	1.1	1.1	1.0
1439	B	66	52.0	53.1	53.1	53.0	53.0	53.0	53.0	1.1	1.1	1.0	1.0	1.0	1.0
1440	B	66	51.9	53.0	53.0	52.9	52.9	52.9	52.9	1.1	1.1	1.0	1.0	1.0	1.0
1441	B	66	52.7	53.8	53.8	53.7	53.7	53.7	53.7	1.1	1.1	1.0	1.0	1.0	1.0
1442	B	66	52.1	53.2	53.2	53.1	53.1	53.1	53.1	1.1	1.1	1.0	1.0	1.0	1.0
1443	B	66	52.8	53.8	53.8	53.8	53.8	53.8	53.8	1.0	1.0	1.0	1.0	1.0	1.0
1444	B	66	52.3	53.3	53.3	53.3	53.3	53.3	53.3	1.0	1.0	1.0	1.0	1.0	1.0
1445	B	66	53.6	54.6	54.6	54.5	54.5	54.5	54.5	1.0	1.0	0.9	0.9	0.9	0.9
1446	B	66	53.0	54.0	54.0	54.0	54.0	54.0	54.0	1.0	1.0	1.0	1.0	1.0	1.0
1447	B	66	52.3	53.3	53.3	53.3	53.3	53.3	53.3	1.0	1.0	1.0	1.0	1.0	1.0
1448	C	66	63.4	64.5	64.5	64.4	64.4	64.4	64.4	1.1	1.1	1.0	1.0	1.0	1.0
1449	D	51	47.1	48.0	48.0	48.0	48.0	48.0	48.0	0.9	0.9	0.9	0.9	0.9	0.9
1450	B	66	68.0	69.6	69.6	69.4	69.4	69.4	69.4	1.6	1.6	1.4	1.4	1.4	1.4
1451	B	66	67.9	69.6	69.6	69.4	69.4	69.4	69.4	1.7	1.7	1.5	1.5	1.5	1.5
1452	B	66	67.8	69.6	69.6	69.4	69.4	69.4	69.4	1.8	1.8	1.6	1.6	1.6	1.6
1453	B	66	68.4	70.1	70.1	70.0	70.0	70.0	70.0	1.7	1.7	1.6	1.6	1.6	1.6
1454	B	66	68.4	70.1	70.1	70.1	70.1	70.1	70.1	1.7	1.7	1.7	1.7	1.7	1.7

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1455	B	66	63.0	64.5	64.5	64.2	64.2	64.2	64.2	1.5	1.5	1.2	1.2	1.2	1.2
1456	B	66	62.8	64.4	64.4	64.2	64.2	64.2	64.2	1.6	1.6	1.4	1.4	1.4	1.4
1457	B	66	62.5	64.2	64.2	64.0	64.0	64.0	63.9	1.7	1.7	1.5	1.5	1.5	1.4
1458	B	66	62.7	64.4	64.4	64.2	64.2	64.2	64.2	1.7	1.7	1.5	1.5	1.5	1.5
1459	B	66	62.8	64.6	64.6	64.4	64.4	64.4	64.4	1.8	1.8	1.6	1.6	1.6	1.6
1460	B	66	59.7	61.3	61.3	61.1	61.1	61.1	61.1	1.6	1.6	1.4	1.4	1.4	1.4
1461	B	66	59.9	61.4	61.4	61.2	61.2	61.2	61.2	1.5	1.5	1.3	1.3	1.3	1.3
1462	B	66	60.4	61.9	61.9	61.7	61.7	61.7	61.7	1.5	1.5	1.3	1.3	1.3	1.3
1463	B	66	61.1	62.4	62.4	62.3	62.3	62.3	62.3	1.3	1.3	1.2	1.2	1.2	1.2
1464	B	66	62.0	63.3	63.3	63.2	63.2	63.2	63.2	1.3	1.3	1.2	1.2	1.2	1.2
1465	B	66	64.2	65.3	65.3	65.2	65.2	65.2	65.2	1.1	1.1	1.0	1.0	1.0	1.0
1466	B	66	62.4	63.6	63.6	63.5	63.5	63.5	63.5	1.2	1.2	1.1	1.1	1.1	1.1
1467	B	66	61.1	62.3	62.3	62.2	62.2	62.2	62.2	1.2	1.2	1.1	1.1	1.1	1.1
1468	B	66	60.0	61.4	61.4	61.2	61.2	61.2	61.2	1.4	1.4	1.2	1.2	1.2	1.2
1469	B	66	59.1	60.5	60.5	60.3	60.3	60.3	60.3	1.4	1.4	1.2	1.2	1.2	1.2
1470	B	66	62.7	63.8	63.8	63.7	63.7	63.7	63.7	1.1	1.1	1.0	1.0	1.0	1.0
1471	B	66	61.1	62.2	62.2	62.2	62.2	62.2	62.2	1.1	1.1	1.1	1.1	1.1	1.1
1472	B	66	59.7	60.9	60.9	60.8	60.8	60.8	60.8	1.2	1.2	1.1	1.1	1.1	1.1
1473	B	66	58.8	60.0	60.0	59.9	59.9	59.9	59.9	1.2	1.2	1.1	1.1	1.1	1.1
1474	B	66	58.0	59.4	59.4	59.2	59.2	59.2	59.2	1.4	1.4	1.2	1.2	1.2	1.2
1475	B	66	61.5	62.6	62.6	62.5	62.5	62.5	62.5	1.1	1.1	1.0	1.0	1.0	1.0
1476	B	66	59.9	61.1	61.1	61.1	61.1	61.1	61.1	1.2	1.2	1.2	1.2	1.2	1.2
1477	B	66	58.5	59.7	59.7	59.7	59.7	59.7	59.7	1.2	1.2	1.2	1.2	1.2	1.2
1478	B	66	57.8	59.0	59.0	58.9	58.9	58.9	58.9	1.2	1.2	1.1	1.1	1.1	1.1
1479	B	66	57.0	58.3	58.3	58.2	58.2	58.2	58.2	1.3	1.3	1.2	1.2	1.2	1.2
1480	B	66	60.4	61.5	61.5	61.5	61.5	61.5	61.5	1.1	1.1	1.1	1.1	1.1	1.1

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1481	B	66	59.0	60.2	60.2	60.1	60.1	60.1	60.1	1.2	1.2	1.1	1.1	1.1	1.1
1482	B	66	57.9	59.0	59.0	59.0	59.0	59.0	59.0	1.1	1.1	1.1	1.1	1.1	1.1
1483	B	66	57.0	58.3	58.3	58.2	58.2	58.2	58.2	1.3	1.3	1.2	1.2	1.2	1.2
1484	B	66	56.2	57.5	57.5	57.4	57.4	57.4	57.4	1.3	1.3	1.2	1.2	1.2	1.2
1485	B	66	57.2	58.3	58.3	58.3	58.3	58.3	58.3	1.1	1.1	1.1	1.1	1.1	1.1
1486	B	66	59.8	60.8	60.8	60.8	60.8	60.8	60.8	1.0	1.0	1.0	1.0	1.0	1.0
1487	B	66	57.8	58.8	58.8	58.8	58.8	58.8	58.8	1.0	1.0	1.0	1.0	1.0	1.0
1488	B	66	59.8	60.8	60.8	60.8	60.8	60.8	60.8	1.0	1.0	1.0	1.0	1.0	1.0
1489	B	66	57.5	58.6	58.6	58.6	58.6	58.6	58.6	1.1	1.1	1.1	1.1	1.1	1.1
1490	B	66	56.8	57.8	57.8	57.9	57.9	57.9	57.9	1.0	1.0	1.1	1.1	1.1	1.1
1491	B	66	56.7	57.8	57.8	57.8	57.8	57.8	57.8	1.1	1.1	1.1	1.1	1.1	1.1
1492	B	66	56.6	57.7	57.7	57.7	57.7	57.7	57.7	1.1	1.1	1.1	1.1	1.1	1.1
1493	B	66	56.5	57.6	57.6	57.6	57.6	57.6	57.6	1.1	1.1	1.1	1.1	1.1	1.1
1494	B	66	53.6	54.7	54.7	54.8	54.8	54.8	54.8	1.1	1.1	1.2	1.2	1.2	1.2
1495	B	66	53.4	54.5	54.5	54.6	54.6	54.6	54.6	1.1	1.1	1.2	1.2	1.2	1.2
1496	B	66	53.4	54.5	54.5	54.5	54.5	54.5	54.5	1.1	1.1	1.1	1.1	1.1	1.1
1497	B	66	53.5	54.7	54.7	54.7	54.7	54.7	54.7	1.2	1.2	1.2	1.2	1.2	1.2
1498	B	66	53.0	54.3	54.3	54.2	54.2	54.2	54.2	1.3	1.3	1.2	1.2	1.2	1.2
1499	B	66	53.0	54.1	54.1	54.2	54.2	54.2	54.1	1.1	1.1	1.2	1.2	1.2	1.1
1500	B	66	52.9	54.1	54.1	54.2	54.2	54.2	54.2	1.2	1.2	1.3	1.3	1.3	1.3
1501	B	66	64.2	65.2	65.2	65.2	65.2	65.2	65.2	1.0	1.0	1.0	1.0	1.0	1.0
1502	B	66	60.4	61.4	61.4	61.4	61.4	61.4	61.4	1.0	1.0	1.0	1.0	1.0	1.0
1503	B	66	58.2	59.3	59.3	59.2	59.2	59.2	59.2	1.1	1.1	1.0	1.0	1.0	1.0
1504	B	66	56.8	57.9	57.9	57.9	57.9	57.9	57.9	1.1	1.1	1.1	1.1	1.1	1.1
1505	B	66	56.2	57.3	57.3	57.2	57.2	57.2	57.2	1.1	1.1	1.0	1.0	1.0	1.0
1506	B	66	64.2	65.2	65.2	65.1	65.1	65.1	65.1	1.0	1.0	0.9	0.9	0.9	0.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1507	B	66	60.6	61.6	61.6	61.6	61.6	61.6	61.6	1.0	1.0	1.0	1.0	1.0	1.0
1508	B	66	58.5	59.5	59.5	59.5	59.5	59.5	59.5	1.0	1.0	1.0	1.0	1.0	1.0
1509	B	66	57.0	58.0	58.0	58.1	58.1	58.1	58.1	1.0	1.0	1.1	1.1	1.1	1.1
1510	B	66	56.1	57.1	57.1	57.2	57.2	57.2	57.2	1.0	1.0	1.1	1.1	1.1	1.1
1511	B	66	54.0	55.1	55.1	55.1	55.1	55.1	55.1	1.1	1.1	1.1	1.1	1.1	1.1
1512	B	66	53.4	54.5	54.5	54.6	54.6	54.6	54.6	1.1	1.1	1.2	1.2	1.2	1.2
1513	B	66	52.9	54.0	54.0	54.1	54.1	54.1	54.1	1.1	1.1	1.2	1.2	1.2	1.2
1514	B	66	53.7	54.9	54.9	54.8	54.8	54.8	54.8	1.2	1.2	1.1	1.1	1.1	1.1
1515	B	66	53.8	55.0	55.0	54.9	54.9	54.9	54.9	1.2	1.2	1.1	1.1	1.1	1.1
1516	B	66	53.9	55.0	55.0	55.0	55.0	55.0	55.0	1.1	1.1	1.1	1.1	1.1	1.1
1517	B	66	60.3	61.3	61.3	61.3	61.3	61.3	61.3	1.0	1.0	1.0	1.0	1.0	1.0
1518	B	66	58.4	59.3	59.3	59.4	59.4	59.4	59.4	0.9	0.9	1.0	1.0	1.0	1.0
1519	B	66	58.8	59.8	59.8	59.8	59.8	59.8	59.8	1.0	1.0	1.0	1.0	1.0	1.0
1520	B	66	57.4	58.4	58.4	58.4	58.4	58.4	58.4	1.0	1.0	1.0	1.0	1.0	1.0
1521	B	66	57.3	58.3	58.3	58.3	58.3	58.3	58.3	1.0	1.0	1.0	1.0	1.0	1.0
1522	B	66	56.2	57.3	57.3	57.3	57.3	57.3	57.3	1.1	1.1	1.1	1.1	1.1	1.1
1523	B	66	56.3	57.3	57.3	57.3	57.3	57.3	57.3	1.0	1.0	1.0	1.0	1.0	1.0
1524	B	66	53.8	54.9	54.9	54.9	54.9	54.9	54.9	1.1	1.1	1.1	1.1	1.1	1.1
1525	B	66	53.9	55.0	55.0	55.0	55.0	55.0	55.0	1.1	1.1	1.1	1.1	1.1	1.1
1526	B	66	53.9	55.0	55.0	55.0	55.0	55.0	55.0	1.1	1.1	1.1	1.1	1.1	1.1
1527	B	66	53.9	55.0	55.0	55.0	55.0	55.0	55.0	1.1	1.1	1.1	1.1	1.1	1.1
1528	B	66	54.0	55.1	55.1	55.1	55.1	55.1	55.1	1.1	1.1	1.1	1.1	1.1	1.1
1529	B	66	52.7	53.8	53.8	53.8	53.8	53.8	53.8	1.1	1.1	1.1	1.1	1.1	1.1
1530	B	66	52.6	53.7	53.7	53.7	53.7	53.7	53.7	1.1	1.1	1.1	1.1	1.1	1.1
1531	B	66	54.1	55.2	55.2	55.2	55.2	55.2	55.2	1.1	1.1	1.1	1.1	1.1	1.1
1532	B	66	54.2	55.2	55.2	55.2	55.2	55.2	55.2	1.0	1.0	1.0	1.0	1.0	1.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1533	B	66	54.1	55.2	55.2	55.2	55.2	55.2	55.2	1.1	1.1	1.1	1.1	1.1	1.1
1534	B	66	54.2	55.3	55.3	55.3	55.3	55.3	55.3	1.1	1.1	1.1	1.1	1.1	1.1
1535	B	66	54.3	55.4	55.4	55.4	55.4	55.4	55.4	1.1	1.1	1.1	1.1	1.1	1.1
1536	B	66	53.4	54.4	54.4	54.5	54.5	54.5	54.5	1.0	1.0	1.1	1.1	1.1	1.1
1537	B	66	54.4	55.5	55.5	55.5	55.5	55.5	55.5	1.1	1.1	1.1	1.1	1.1	1.1
1538	B	66	54.5	55.5	55.5	55.5	55.5	55.5	55.5	1.0	1.0	1.0	1.0	1.0	1.0
1539	B	66	54.4	55.4	55.4	55.4	55.4	55.4	55.4	1.0	1.0	1.0	1.0	1.0	1.0
1540	B	66	53.0	54.1	54.1	54.1	54.1	54.1	54.1	1.1	1.1	1.1	1.1	1.1	1.1
1541	B	66	53.2	54.3	54.3	54.2	54.2	54.2	54.2	1.1	1.1	1.0	1.0	1.0	1.0
1542	B	66	58.4	59.3	59.3	59.3	59.3	59.3	59.3	0.9	0.9	0.9	0.9	0.9	0.9
1543	B	66	57.5	58.5	58.5	58.5	58.5	58.5	58.5	1.0	1.0	1.0	1.0	1.0	1.0
1544	B	66	57.3	58.2	58.2	58.2	58.2	58.2	58.2	0.9	0.9	0.9	0.9	0.9	0.9
1545	B	66	56.9	57.9	57.9	57.9	57.9	57.9	57.9	1.0	1.0	1.0	1.0	1.0	1.0
1546	B	66	56.9	57.9	57.9	57.9	57.9	57.9	57.9	1.0	1.0	1.0	1.0	1.0	1.0
1547	B	66	56.6	57.6	57.6	57.6	57.6	57.6	57.6	1.0	1.0	1.0	1.0	1.0	1.0
1548	B	66	56.7	57.7	57.7	57.7	57.7	57.7	57.7	1.0	1.0	1.0	1.0	1.0	1.0
1549	B	66	57.6	58.6	58.6	58.6	58.6	58.6	58.6	1.0	1.0	1.0	1.0	1.0	1.0
1550	B	66	53.9	55.0	55.0	54.9	54.9	54.9	54.9	1.1	1.1	1.0	1.0	1.0	1.0
1551	B	66	53.9	54.9	54.9	54.9	54.9	54.9	54.9	1.0	1.0	1.0	1.0	1.0	1.0
1552	B	66	53.8	54.9	54.9	54.9	54.9	54.9	54.8	1.1	1.1	1.1	1.1	1.1	1.0
1553	B	66	53.8	54.8	54.8	54.8	54.8	54.8	54.8	1.0	1.0	1.0	1.0	1.0	1.0
1554	B	66	53.8	54.8	54.8	54.8	54.8	54.8	54.8	1.0	1.0	1.0	1.0	1.0	1.0
1555	D	51	40.9	42.5	42.5	42.5	42.5	42.5	42.5	1.6	1.6	1.6	1.6	1.6	1.6
1556	B	66	56.2	57.9	57.9	57.8	57.8	57.8	57.8	1.7	1.7	1.6	1.6	1.6	1.6
1557	B	66	56.2	57.9	57.9	57.8	57.8	57.8	57.8	1.7	1.7	1.6	1.6	1.6	1.6
1558	B	66	56.2	57.9	57.9	57.8	57.8	57.8	57.8	1.7	1.7	1.6	1.6	1.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1559	B	66	56.3	58.0	58.0	57.9	57.9	57.9	57.9	1.7	1.7	1.6	1.6	1.6	1.6
1560	B	66	56.3	57.9	57.9	57.9	57.9	57.9	57.9	1.6	1.6	1.6	1.6	1.6	1.6
1561	B	66	56.4	58.0	58.0	58.0	58.0	58.0	58.0	1.6	1.6	1.6	1.6	1.6	1.6
1562	B	66	58.6	60.3	60.2	60.2	60.2	60.2	60.2	1.7	1.6	1.6	1.6	1.6	1.6
1563	B	66	57.9	59.5	59.5	59.5	59.5	59.5	59.5	1.6	1.6	1.6	1.6	1.6	1.6
1564	B	66	57.2	58.9	58.9	58.8	58.8	58.8	58.8	1.7	1.7	1.6	1.6	1.6	1.6
1565	B	66	56.6	58.2	58.2	58.2	58.2	58.2	58.2	1.6	1.6	1.6	1.6	1.6	1.6
1566	B	66	58.7	60.3	60.3	60.3	60.3	60.3	60.3	1.6	1.6	1.6	1.6	1.6	1.6
1567	B	66	58.0	59.6	59.6	59.6	59.6	59.6	59.6	1.6	1.6	1.6	1.6	1.6	1.6
1568	B	66	57.3	58.9	58.9	58.9	58.9	58.9	58.9	1.6	1.6	1.6	1.6	1.6	1.6
1569	B	66	56.6	58.3	58.3	58.2	58.2	58.2	58.2	1.7	1.7	1.6	1.6	1.6	1.6
1570	B	66	58.6	60.2	60.2	60.1	60.1	60.1	60.2	1.6	1.6	1.5	1.5	1.5	1.6
1571	B	66	57.8	59.4	59.4	59.4	59.4	59.4	59.4	1.6	1.6	1.6	1.6	1.6	1.6
1572	B	66	57.2	58.8	58.8	58.8	58.8	58.8	58.8	1.6	1.6	1.6	1.6	1.6	1.6
1573	B	66	56.6	58.2	58.2	58.2	58.2	58.2	58.2	1.6	1.6	1.6	1.6	1.6	1.6
1574	B	66	58.7	60.3	60.3	60.3	60.3	60.3	60.3	1.6	1.6	1.6	1.6	1.6	1.6
1575	B	66	58.0	59.6	59.6	59.6	59.6	59.6	59.6	1.6	1.6	1.6	1.6	1.6	1.6
1576	B	66	57.4	59.0	59.0	59.0	59.0	59.0	59.0	1.6	1.6	1.6	1.6	1.6	1.6
1577	B	66	56.7	58.4	58.4	58.4	58.4	58.4	58.4	1.7	1.7	1.7	1.7	1.7	1.7
1578	B	66	58.4	60.1	60.1	60.1	60.1	60.1	60.1	1.7	1.7	1.7	1.7	1.7	1.7
1579	B	66	55.1	56.7	56.7	56.7	56.7	56.7	56.7	1.6	1.6	1.6	1.6	1.6	1.6
1580	B	66	56.0	57.6	57.6	57.6	57.6	57.6	57.6	1.6	1.6	1.6	1.6	1.6	1.6
1581	B	66	56.8	58.4	58.4	58.4	58.4	58.4	58.4	1.6	1.6	1.6	1.6	1.6	1.6
1582	B	66	55.5	57.2	57.2	57.1	57.1	57.1	57.1	1.7	1.7	1.6	1.6	1.6	1.6
1583	B	66	59.3	60.9	60.9	60.9	60.9	60.9	60.9	1.6	1.6	1.6	1.6	1.6	1.6
1584	B	66	57.9	59.5	59.5	59.5	59.5	59.5	59.5	1.6	1.6	1.6	1.6	1.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1585	B	66	56.8	58.5	58.5	58.4	58.4	58.4	58.4	1.7	1.7	1.6	1.6	1.6	1.6
1586	B	66	56.0	57.7	57.7	57.6	57.6	57.6	57.6	1.7	1.7	1.6	1.6	1.6	1.6
1587	B	66	55.4	57.0	57.0	57.0	57.0	57.0	57.0	1.6	1.6	1.6	1.6	1.6	1.6
1588	B	66	62.1	63.6	63.6	63.6	63.6	63.6	63.6	1.5	1.5	1.5	1.5	1.5	1.5
1589	B	66	61.2	62.8	62.8	62.8	62.8	62.8	62.8	1.6	1.6	1.6	1.6	1.6	1.6
1590	B	66	60.5	62.1	62.1	62.1	62.1	62.1	62.1	1.6	1.6	1.6	1.6	1.6	1.6
1591	B	66	59.9	61.5	61.5	61.5	61.5	61.5	61.5	1.6	1.6	1.6	1.6	1.6	1.6
1592	B	66	60.8	62.3	62.3	62.3	62.3	62.3	62.3	1.5	1.5	1.5	1.5	1.5	1.5
1593	B	66	60.2	61.8	61.8	61.8	61.8	61.8	61.8	1.6	1.6	1.6	1.6	1.6	1.6
1594	B	66	59.6	61.2	61.2	61.2	61.2	61.2	61.2	1.6	1.6	1.6	1.6	1.6	1.6
1595	B	66	58.7	60.3	60.3	60.3	60.3	60.3	60.3	1.6	1.6	1.6	1.6	1.6	1.6
1596	B	66	56.8	58.4	58.4	58.4	58.4	58.4	58.4	1.6	1.6	1.6	1.6	1.6	1.6
1597	B	66	55.9	57.5	57.5	57.5	57.5	57.5	57.5	1.6	1.6	1.6	1.6	1.6	1.6
1598	B	66	56.1	57.7	57.7	57.7	57.7	57.7	57.7	1.6	1.6	1.6	1.6	1.6	1.6
1599	B	66	56.7	58.3	58.3	58.3	58.3	58.3	58.3	1.6	1.6	1.6	1.6	1.6	1.6
1600	B	66	58.1	59.6	59.6	59.6	59.6	59.6	59.6	1.5	1.5	1.5	1.5	1.5	1.5
1601	B	66	57.8	59.4	59.4	59.4	59.4	59.4	59.4	1.6	1.6	1.6	1.6	1.6	1.6
1602	B	66	57.7	59.3	59.3	59.3	59.3	59.3	59.3	1.6	1.6	1.6	1.6	1.6	1.6
1603	B	66	57.5	59.1	59.1	59.1	59.1	59.1	59.1	1.6	1.6	1.6	1.6	1.6	1.6
1604	B	66	59.4	61.0	61.0	61.0	61.0	61.0	61.0	1.6	1.6	1.6	1.6	1.6	1.6
1605	B	66	59.2	60.7	60.7	60.7	60.7	60.7	60.7	1.5	1.5	1.5	1.5	1.5	1.5
1606	B	66	58.9	60.4	60.4	60.4	60.4	60.4	60.4	1.5	1.5	1.5	1.5	1.5	1.5
1607	B	66	58.7	60.3	60.3	60.3	60.3	60.3	60.3	1.6	1.6	1.6	1.6	1.6	1.6
1608	C	66	56.7	58.4	58.4	58.3	58.3	58.3	58.3	1.7	1.7	1.6	1.6	1.6	1.6
1609	B	66	62.3	63.8	63.8	63.7	63.7	63.7	63.7	1.5	1.5	1.4	1.4	1.4	1.4
1610	B	66	61.8	63.4	63.4	63.2	63.2	63.2	63.2	1.6	1.6	1.4	1.4	1.4	1.4

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1611	B	66	61.4	62.9	62.9	62.8	62.8	62.8	62.8	1.5	1.5	1.4	1.4	1.4	1.4
1612	B	66	61.0	62.6	62.6	62.5	62.5	62.5	62.5	1.6	1.6	1.5	1.5	1.5	1.5
1613	B	66	62.5	64.0	64.0	63.8	63.8	63.8	63.8	1.5	1.5	1.3	1.3	1.3	1.3
1614	B	66	62.2	63.7	63.7	63.6	63.6	63.6	63.6	1.5	1.5	1.4	1.4	1.4	1.4
1615	B	66	61.7	63.2	63.2	63.1	63.1	63.1	63.1	1.5	1.5	1.4	1.4	1.4	1.4
1616	B	66	61.2	62.9	62.9	62.7	62.7	62.7	62.7	1.7	1.7	1.5	1.5	1.5	1.5
1617	B	66	54.9	56.6	56.6	56.6	56.6	56.6	56.6	1.7	1.7	1.7	1.7	1.7	1.7
1618	B	66	55.7	57.4	57.4	57.4	57.4	57.4	57.4	1.7	1.7	1.7	1.7	1.7	1.7
1619	B	66	56.7	58.4	58.4	58.4	58.4	58.4	58.4	1.7	1.7	1.7	1.7	1.7	1.7
1620	B	66	58.1	59.9	59.9	59.9	59.9	59.9	59.9	1.8	1.8	1.8	1.8	1.8	1.8
1621	B	66	59.7	61.5	61.5	61.5	61.5	61.5	61.5	1.8	1.8	1.8	1.8	1.8	1.8
1622	B	66	60.3	62.1	62.1	62.1	62.1	62.1	62.1	1.8	1.8	1.8	1.8	1.8	1.8
1623	B	66	60.8	62.6	62.6	62.5	62.5	62.5	62.5	1.8	1.8	1.7	1.7	1.7	1.7
1624	B	66	60.6	62.3	62.3	62.3	62.3	62.3	62.3	1.7	1.7	1.7	1.7	1.7	1.7
1625	B	66	60.5	62.2	62.2	62.2	62.2	62.2	62.2	1.7	1.7	1.7	1.7	1.7	1.7
1626	B	66	60.8	62.5	62.5	62.5	62.5	62.5	62.5	1.7	1.7	1.7	1.7	1.7	1.7
1627	B	66	60.7	62.4	62.4	62.4	62.4	62.4	62.4	1.7	1.7	1.7	1.7	1.7	1.7
1628	B	66	60.8	62.5	62.5	62.5	62.5	62.5	62.5	1.7	1.7	1.7	1.7	1.7	1.7
1629	B	66	61.2	62.9	62.9	62.9	62.9	62.9	62.9	1.7	1.7	1.7	1.7	1.7	1.7
1630	B	66	61.1	62.8	62.8	62.8	62.8	62.8	62.8	1.7	1.7	1.7	1.7	1.7	1.7
1631	B	66	61.4	63.1	63.1	63.1	63.1	63.1	63.1	1.7	1.7	1.7	1.7	1.7	1.7
1632	B	66	61.4	63.0	63.0	63.0	63.0	63.0	63.0	1.6	1.6	1.6	1.6	1.6	1.6
1633	B	66	61.5	63.1	63.1	63.1	63.1	63.1	63.1	1.6	1.6	1.6	1.6	1.6	1.6
1634	B	66	61.8	63.4	63.4	63.4	63.4	63.4	63.4	1.6	1.6	1.6	1.6	1.6	1.6
1635	B	66	61.9	63.5	63.5	63.5	63.5	63.5	63.5	1.6	1.6	1.6	1.6	1.6	1.6
1636	B	66	62.1	63.7	63.7	63.7	63.7	63.7	63.7	1.6	1.6	1.6	1.6	1.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1637	B	66	54.6	56.3	56.3	56.3	56.3	56.3	56.3	1.7	1.7	1.7	1.7	1.7	1.7
1638	B	66	55.6	57.3	57.3	57.3	57.3	57.3	57.3	1.7	1.7	1.7	1.7	1.7	1.7
1639	B	66	56.6	58.4	58.4	58.3	58.3	58.3	58.3	1.8	1.8	1.7	1.7	1.7	1.7
1640	B	66	56.6	58.4	58.4	58.3	58.3	58.3	58.3	1.8	1.8	1.7	1.7	1.7	1.7
1641	B	66	56.6	58.3	58.3	58.3	58.3	58.3	58.3	1.7	1.7	1.7	1.7	1.7	1.7
1642	B	66	56.7	58.4	58.4	58.4	58.4	58.4	58.4	1.7	1.7	1.7	1.7	1.7	1.7
1643	B	66	56.9	58.6	58.6	58.6	58.6	58.6	58.6	1.7	1.7	1.7	1.7	1.7	1.7
1644	B	66	56.0	57.7	57.7	57.7	57.7	57.7	57.7	1.7	1.7	1.7	1.7	1.7	1.7
1645	B	66	55.0	56.7	56.7	56.7	56.7	56.7	56.6	1.7	1.7	1.7	1.7	1.7	1.6
1646	B	66	57.4	59.1	59.1	59.1	59.1	59.1	59.1	1.7	1.7	1.7	1.7	1.7	1.7
1647	B	66	56.1	57.8	57.8	57.8	57.8	57.8	57.8	1.7	1.7	1.7	1.7	1.7	1.7
1648	B	66	55.1	56.8	56.8	56.8	56.8	56.8	56.8	1.7	1.7	1.7	1.7	1.7	1.7
1649	B	66	57.7	59.3	59.3	59.3	59.3	59.3	59.3	1.6	1.6	1.6	1.6	1.6	1.6
1650	B	66	56.4	58.0	58.0	58.0	58.0	58.0	58.0	1.6	1.6	1.6	1.6	1.6	1.6
1651	B	66	55.6	57.3	57.3	57.3	57.3	57.3	57.3	1.7	1.7	1.7	1.7	1.7	1.7
1652	B	66	64.8	66.4	66.4	66.4	66.4	66.4	66.4	1.6	1.6	1.6	1.6	1.6	1.6
1653	B	66	65.4	67.0	67.0	67.0	67.0	67.0	67.0	1.6	1.6	1.6	1.6	1.6	1.6
1654	B	66	62.4	64.0	64.0	64.0	64.0	64.0	64.0	1.6	1.6	1.6	1.6	1.6	1.6
1655	B	66	62.9	64.5	64.5	64.5	64.5	64.5	64.5	1.6	1.6	1.6	1.6	1.6	1.6
1656	B	66	60.4	62.1	62.1	62.1	62.1	62.1	62.1	1.7	1.7	1.7	1.7	1.7	1.7
1657	B	66	61.0	62.6	62.6	62.6	62.6	62.6	62.6	1.6	1.6	1.6	1.6	1.6	1.6
1658	B	66	59.1	60.7	60.7	60.7	60.7	60.7	60.7	1.6	1.6	1.6	1.6	1.6	1.6
1659	B	66	59.5	61.2	61.2	61.2	61.2	61.2	61.2	1.7	1.7	1.7	1.7	1.7	1.7
1660	B	66	58.7	60.4	60.4	60.4	60.4	60.4	60.4	1.7	1.7	1.7	1.7	1.7	1.7
1661	B	66	57.6	59.2	59.2	59.2	59.2	59.2	59.2	1.6	1.6	1.6	1.6	1.6	1.6
1662	B	66	56.5	58.2	58.2	58.2	58.2	58.2	58.2	1.7	1.7	1.7	1.7	1.7	1.7

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1663	B	66	58.2	59.9	59.9	59.8	59.8	59.8	59.8	1.7	1.7	1.6	1.6	1.6	1.6
1664	B	66	57.2	58.8	58.8	58.8	58.8	58.8	58.8	1.6	1.6	1.6	1.6	1.6	1.6
1665	B	66	56.3	57.9	57.9	57.9	57.9	57.9	57.9	1.6	1.6	1.6	1.6	1.6	1.6
1666	B	66	65.7	67.3	67.3	67.3	67.3	67.3	67.3	1.6	1.6	1.6	1.6	1.6	1.6
1667	B	66	67.0	68.6	68.6	68.6	68.6	68.6	68.6	1.6	1.6	1.6	1.6	1.6	1.6
1668	B	66	68.2	69.8	69.8	69.8	69.8	69.8	69.8	1.6	1.6	1.6	1.6	1.6	1.6
1669	B	66	66.0	67.6	67.6	67.6	67.6	67.6	67.6	1.6	1.6	1.6	1.6	1.6	1.6
1670	B	66	66.9	68.5	68.5	68.5	68.5	68.5	68.5	1.6	1.6	1.6	1.6	1.6	1.6
1671	B	66	68.2	69.8	69.8	69.8	69.8	69.8	69.8	1.6	1.6	1.6	1.6	1.6	1.6
1672	B	66	69.7	71.3	71.3	71.3	71.3	71.3	71.3	1.6	1.6	1.6	1.6	1.6	1.6
1673	B	66	63.1	64.7	64.7	64.7	64.7	64.7	64.7	1.6	1.6	1.6	1.6	1.6	1.6
1674	B	66	62.3	64.0	64.0	63.9	63.9	63.9	64.0	1.7	1.7	1.6	1.6	1.6	1.7
1675	B	66	61.6	63.2	63.2	63.2	63.2	63.2	63.2	1.6	1.6	1.6	1.6	1.6	1.6
1676	B	66	61.0	62.7	62.7	62.7	62.7	62.7	62.7	1.7	1.7	1.7	1.7	1.7	1.7
1677	B	66	63.1	64.7	64.7	64.7	64.7	64.7	64.7	1.6	1.6	1.6	1.6	1.6	1.6
1678	B	66	62.4	64.0	64.0	64.0	64.0	64.0	64.0	1.6	1.6	1.6	1.6	1.6	1.6
1679	B	66	61.6	63.3	63.3	63.3	63.3	63.3	63.3	1.7	1.7	1.7	1.7	1.7	1.7
1680	B	66	61.0	62.7	62.7	62.7	62.7	62.7	62.7	1.7	1.7	1.7	1.7	1.7	1.7
1681	B	66	66.1	67.8	67.8	67.7	67.7	67.7	67.7	1.7	1.7	1.6	1.6	1.6	1.6
1682	B	66	65.4	67.1	67.1	67.1	67.1	67.1	67.1	1.7	1.7	1.7	1.7	1.7	1.7
1683	B	66	64.5	66.1	66.1	66.1	66.1	66.1	66.1	1.6	1.6	1.6	1.6	1.6	1.6
1684	B	66	64.0	65.6	65.6	65.6	65.6	65.6	65.6	1.6	1.6	1.6	1.6	1.6	1.6
1685	B	66	67.7	69.3	69.3	69.3	69.3	69.3	69.3	1.6	1.6	1.6	1.6	1.6	1.6
1686	B	66	67.0	68.6	68.6	68.6	68.6	68.6	68.6	1.6	1.6	1.6	1.6	1.6	1.6
1687	B	66	65.8	67.4	67.4	67.4	67.4	67.4	67.4	1.6	1.6	1.6	1.6	1.6	1.6
1688	B	66	65.2	66.8	66.8	66.8	66.8	66.8	66.8	1.6	1.6	1.6	1.6	1.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1689	B	66	62.1	63.8	63.8	63.8	63.8	63.8	63.8	1.7	1.7	1.7	1.7	1.7	1.7
1690	B	66	61.7	63.5	63.5	63.4	63.4	63.4	63.5	1.8	1.8	1.7	1.7	1.7	1.8
1691	B	66	61.2	62.9	62.9	62.9	62.9	62.9	62.9	1.7	1.7	1.7	1.7	1.7	1.7
1692	B	66	60.8	62.6	62.6	62.5	62.5	62.5	62.5	1.8	1.8	1.7	1.7	1.7	1.7
1693	B	66	62.8	64.5	64.5	64.5	64.5	64.5	64.5	1.7	1.7	1.7	1.7	1.7	1.7
1694	B	66	62.5	64.2	64.2	64.2	64.2	64.2	64.2	1.7	1.7	1.7	1.7	1.7	1.7
1695	B	66	61.9	63.6	63.6	63.6	63.6	63.6	63.6	1.7	1.7	1.7	1.7	1.7	1.7
1696	B	66	61.5	63.3	63.3	63.3	63.3	63.3	63.3	1.8	1.8	1.8	1.8	1.8	1.8
1697	B	66	61.4	63.2	63.2	63.1	63.1	63.1	63.1	1.8	1.8	1.7	1.7	1.7	1.7
1698	B	66	60.8	62.6	62.6	62.6	62.6	62.6	62.6	1.8	1.8	1.8	1.8	1.8	1.8
1699	B	66	61.8	63.6	63.6	63.6	63.6	63.6	63.6	1.8	1.8	1.8	1.8	1.8	1.8
1700	B	66	61.3	63.1	63.1	63.1	63.1	63.1	63.1	1.8	1.8	1.8	1.8	1.8	1.8
1701	B	66	65.8	67.3	67.3	67.3	67.3	67.3	67.3	1.5	1.5	1.5	1.5	1.5	1.5
1702	B	66	64.0	65.6	65.6	65.6	65.6	65.6	65.6	1.6	1.6	1.6	1.6	1.6	1.6
1703	B	66	61.9	63.6	63.6	63.5	63.5	63.5	63.5	1.7	1.7	1.6	1.6	1.6	1.6
1704	B	66	61.0	62.6	62.6	62.6	62.6	62.6	62.6	1.6	1.6	1.6	1.6	1.6	1.6
1705	B	66	59.8	61.5	61.5	61.5	61.5	61.5	61.5	1.7	1.7	1.7	1.7	1.7	1.7
1706	B	66	59.9	61.6	61.6	61.6	61.6	61.6	61.6	1.7	1.7	1.7	1.7	1.7	1.7
1707	B	66	60.2	61.9	61.9	61.9	61.9	61.9	61.9	1.7	1.7	1.7	1.7	1.7	1.7
1708	B	66	60.6	62.2	62.2	62.1	62.1	62.1	62.1	1.6	1.6	1.5	1.5	1.5	1.5
1709	B	66	65.5	67.0	67.0	67.0	67.0	67.0	67.0	1.5	1.5	1.5	1.5	1.5	1.5
1710	B	66	64.1	65.7	65.7	65.7	65.7	65.7	65.7	1.6	1.6	1.6	1.6	1.6	1.6
1711	B	66	62.4	64.0	64.0	64.0	64.0	64.0	64.0	1.6	1.6	1.6	1.6	1.6	1.6
1712	B	66	61.5	63.1	63.1	63.1	63.1	63.1	63.1	1.6	1.6	1.6	1.6	1.6	1.6
1713	B	66	60.7	62.4	62.4	62.3	62.3	62.3	62.3	1.7	1.7	1.6	1.6	1.6	1.6
1714	B	66	60.7	62.4	62.4	62.3	62.3	62.3	62.3	1.7	1.7	1.6	1.6	1.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1715	B	66	60.6	62.2	62.2	62.2	62.2	62.2	62.2	1.6	1.6	1.6	1.6	1.6	1.6
1716	B	66	60.7	62.3	62.3	62.3	62.3	62.3	62.3	1.6	1.6	1.6	1.6	1.6	1.6
1717	B	66	60.4	62.6	62.6	62.6	62.6	62.6	62.6	2.2	2.2	2.2	2.2	2.2	2.2
1718	B	66	60.3	62.5	62.5	62.5	62.5	62.5	62.4	2.2	2.2	2.2	2.2	2.2	2.1
1719	B	66	60.1	62.2	62.2	62.2	62.2	62.2	62.2	2.1	2.1	2.1	2.1	2.1	2.1
1720	B	66	60.2	62.3	62.3	62.3	62.3	62.3	62.3	2.1	2.1	2.1	2.1	2.1	2.1
1721	B	66	60.0	62.2	62.2	62.1	62.1	62.1	62.1	2.2	2.2	2.1	2.1	2.1	2.1
1722	B	66	60.0	62.1	62.1	62.1	62.1	62.1	62.1	2.1	2.1	2.1	2.1	2.1	2.1
1723	B	66	60.0	62.1	62.1	62.1	62.1	62.1	62.1	2.1	2.1	2.1	2.1	2.1	2.1
1724	B	66	59.9	62.0	62.0	62.0	62.0	62.0	62.0	2.1	2.1	2.1	2.1	2.1	2.1
1725	B	66	59.8	61.9	61.9	61.9	61.9	61.9	61.9	2.1	2.1	2.1	2.1	2.1	2.1
1726	B	66	59.7	61.8	61.8	61.8	61.8	61.8	61.8	2.1	2.1	2.1	2.1	2.1	2.1
1727	B	66	59.6	61.6	61.6	61.6	61.6	61.6	61.6	2.0	2.0	2.0	2.0	2.0	2.0
1728	B	66	59.5	61.5	61.5	61.5	61.5	61.5	61.5	2.0	2.0	2.0	2.0	2.0	2.0
1729	B	66	59.3	61.4	61.4	61.3	61.3	61.3	61.3	2.1	2.1	2.0	2.0	2.0	2.0
1730	B	66	59.3	61.4	61.4	61.4	61.4	61.4	61.4	2.1	2.1	2.1	2.1	2.1	2.1
1731	B	66	59.9	62.0	62.0	62.0	62.0	62.0	62.0	2.1	2.1	2.1	2.1	2.1	2.1
1732	B	66	61.8	64.1	64.1	64.1	64.1	64.1	64.0	2.3	2.3	2.3	2.3	2.3	2.2
1733	B	66	62.3	64.5	64.5	64.5	64.5	64.5	64.4	2.2	2.2	2.2	2.2	2.2	2.1
1734	B	66	62.4	64.6	64.6	64.6	64.6	64.6	64.5	2.2	2.2	2.2	2.2	2.2	2.1
1735	B	66	71.3	73.2	73.2	73.1	73.1	73.1	73.1	1.9	1.9	1.8	1.8	1.8	1.8
1736	B	66	68.2	70.0	70.0	70.0	70.0	70.0	70.0	1.8	1.8	1.8	1.8	1.8	1.8
1737	B	66	70.0	71.9	71.9	71.9	71.9	71.9	71.9	1.9	1.9	1.9	1.9	1.9	1.9
1738	B	66	65.8	67.6	67.6	67.5	67.5	67.5	67.5	1.8	1.8	1.7	1.7	1.7	1.7
1739	B	66	65.9	67.7	67.7	67.6	67.6	67.6	67.6	1.8	1.8	1.7	1.7	1.7	1.7
1740	B	66	64.4	66.2	66.2	66.1	66.1	66.1	66.1	1.8	1.8	1.7	1.7	1.7	1.7

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1741	B	66	64.4	66.3	66.3	66.1	66.1	66.1	66.1	1.9	1.9	1.7	1.7	1.7	1.7
1742	B	66	62.8	64.6	64.6	64.4	64.4	64.4	64.4	1.8	1.8	1.6	1.6	1.6	1.6
1743	B	66	63.0	64.9	64.9	64.7	64.7	64.7	64.7	1.9	1.9	1.7	1.7	1.7	1.7
1744	B	66	61.7	63.5	63.5	63.3	63.3	63.3	63.3	1.8	1.8	1.6	1.6	1.6	1.6
1745	B	66	61.9	63.7	63.7	63.5	63.5	63.5	63.5	1.8	1.8	1.6	1.6	1.6	1.6
1746	B	66	60.6	62.4	62.4	62.2	62.2	62.2	62.2	1.8	1.8	1.6	1.6	1.6	1.6
1747	B	66	60.6	62.4	62.4	62.2	62.2	62.2	62.2	1.8	1.8	1.6	1.6	1.6	1.6
1748	B	66	59.3	61.1	61.1	60.9	60.9	60.9	60.9	1.8	1.8	1.6	1.6	1.6	1.6
1749	B	66	59.4	61.2	61.2	61.0	61.0	61.0	61.0	1.8	1.8	1.6	1.6	1.6	1.6
1750	B	66	59.3	61.1	61.1	60.9	60.9	60.9	60.9	1.8	1.8	1.6	1.6	1.6	1.6
1751	B	66	59.4	61.2	61.2	61.0	61.0	61.0	61.0	1.8	1.8	1.6	1.6	1.6	1.6
1752	B	66	66.7	68.6	68.6	68.5	68.5	68.5	68.5	1.9	1.9	1.8	1.8	1.8	1.8
1753	B	66	71.8	73.8	73.8	73.8	73.8	73.8	73.8	2.0	2.0	2.0	2.0	2.0	2.0
1754	B	66	69.1	71.0	71.0	71.0	71.0	71.0	71.0	1.9	1.9	1.9	1.9	1.9	1.9
1755	B	66	66.9	68.8	68.8	68.8	68.8	68.8	68.8	1.9	1.9	1.9	1.9	1.9	1.9
1756	B	66	65.4	67.3	67.3	67.2	67.2	67.2	67.2	1.9	1.9	1.8	1.8	1.8	1.8
1757	B	66	65.2	67.1	67.1	67.0	67.0	67.0	67.0	1.9	1.9	1.8	1.8	1.8	1.8
1758	B	66	64.3	66.2	66.2	66.1	66.1	66.1	66.1	1.9	1.9	1.8	1.8	1.8	1.8
1759	B	66	63.2	65.0	65.0	64.9	64.9	64.9	64.9	1.8	1.8	1.7	1.7	1.7	1.7
1760	B	66	62.6	64.5	64.5	64.4	64.4	64.4	64.4	1.9	1.9	1.8	1.8	1.8	1.8
1761	B	66	62.0	63.8	63.8	63.7	63.7	63.7	63.7	1.8	1.8	1.7	1.7	1.7	1.7
1762	B	66	61.6	63.4	63.4	63.3	63.3	63.3	63.3	1.8	1.8	1.7	1.7	1.7	1.7
1763	B	66	60.5	62.4	62.4	62.2	62.2	62.2	62.2	1.9	1.9	1.7	1.7	1.7	1.7
1764	B	66	59.6	61.4	61.4	61.2	61.2	61.2	61.2	1.8	1.8	1.6	1.6	1.6	1.6
1765	B	66	59.4	61.3	61.3	61.1	61.1	61.1	61.1	1.9	1.9	1.7	1.7	1.7	1.7
1766	B	66	59.3	61.2	61.2	61.0	61.0	61.0	61.0	1.9	1.9	1.7	1.7	1.7	1.7

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1767	B	66	69.3	71.3	71.3	71.2	71.2	71.2	71.2	2.0	2.0	1.9	1.9	1.9	1.9
1768	B	66	66.3	68.1	68.1	68.1	68.1	68.1	68.1	1.8	1.8	1.8	1.8	1.8	1.8
1769	B	66	64.7	66.6	66.6	66.5	66.5	66.5	66.5	1.9	1.9	1.8	1.8	1.8	1.8
1770	B	66	63.6	65.4	65.4	65.4	65.4	65.4	65.4	1.8	1.8	1.8	1.8	1.8	1.8
1771	B	66	62.2	64.0	64.0	63.9	63.9	63.9	63.9	1.8	1.8	1.7	1.7	1.7	1.7
1772	B	66	61.3	63.1	63.1	63.0	63.0	63.0	63.0	1.8	1.8	1.7	1.7	1.7	1.7
1773	B	66	59.4	61.1	61.1	61.0	61.0	61.0	61.0	1.7	1.7	1.6	1.6	1.6	1.6
1774	B	66	59.8	61.5	61.5	61.4	61.4	61.4	61.4	1.7	1.7	1.6	1.6	1.6	1.6
1775	B	66	65.2	66.7	66.7	66.6	66.6	66.6	66.6	1.5	1.5	1.4	1.4	1.4	1.4
1776	B	66	64.6	66.0	66.0	66.0	66.0	66.0	66.0	1.4	1.4	1.4	1.4	1.4	1.4
1777	B	66	64.1	65.5	65.5	65.5	65.5	65.5	65.5	1.4	1.4	1.4	1.4	1.4	1.4
1778	B	66	61.8	63.2	63.2	63.2	63.2	63.2	63.2	1.4	1.4	1.4	1.4	1.4	1.4
1779	B	66	62.5	63.8	63.8	63.8	63.8	63.8	63.8	1.3	1.3	1.3	1.3	1.3	1.3
1780	B	66	68.9	70.8	70.8	70.7	70.7	70.7	70.7	1.9	1.9	1.8	1.8	1.8	1.8
1781	B	66	69.2	71.0	71.0	70.9	70.9	70.9	70.9	1.8	1.8	1.7	1.7	1.7	1.7
1782	B	66	69.5	71.3	71.3	71.2	71.2	71.2	71.2	1.8	1.8	1.7	1.7	1.7	1.7
1783	B	66	69.5	71.4	71.4	71.3	71.3	71.3	71.3	1.9	1.9	1.8	1.8	1.8	1.8
1784	B	66	69.6	71.5	71.5	71.4	71.4	71.4	71.4	1.9	1.9	1.8	1.8	1.8	1.8
1785	B	66	69.6	71.5	71.5	71.4	71.4	71.4	71.4	1.9	1.9	1.8	1.8	1.8	1.8
1786	B	66	69.7	71.6	71.6	71.5	71.5	71.5	71.5	1.9	1.9	1.8	1.8	1.8	1.8
1787	B	66	69.8	71.7	71.7	71.6	71.6	71.6	71.6	1.9	1.9	1.8	1.8	1.8	1.8
1788	B	66	65.9	67.8	67.8	67.7	67.7	67.7	67.7	1.9	1.9	1.8	1.8	1.8	1.8
1789	B	66	66.1	68.0	68.0	67.9	67.9	67.9	67.9	1.9	1.9	1.8	1.8	1.8	1.8
1790	B	66	66.2	68.2	68.2	68.0	68.0	68.0	68.0	2.0	2.0	1.8	1.8	1.8	1.8
1791	B	66	66.4	68.3	68.3	68.1	68.1	68.1	68.1	1.9	1.9	1.7	1.7	1.7	1.7
1792	B	66	63.5	65.4	65.4	65.3	65.3	65.3	65.3	1.9	1.9	1.8	1.8	1.8	1.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1793	B	66	63.5	65.5	65.5	65.3	65.3	65.3	65.3	2.0	2.0	1.8	1.8	1.8	1.8
1794	B	66	63.6	65.6	65.6	65.5	65.5	65.5	65.5	2.0	2.0	1.9	1.9	1.9	1.9
1795	B	66	63.7	65.7	65.7	65.6	65.6	65.6	65.6	2.0	2.0	1.9	1.9	1.9	1.9
1796	B	66	62.1	64.0	64.0	63.8	63.8	63.8	63.8	1.9	1.9	1.7	1.7	1.7	1.7
1797	B	66	62.2	64.1	64.1	63.9	63.9	63.9	63.9	1.9	1.9	1.7	1.7	1.7	1.7
1798	B	66	62.3	64.2	64.2	64.0	64.0	64.0	64.0	1.9	1.9	1.7	1.7	1.7	1.7
1799	B	66	62.3	64.3	64.3	64.1	64.1	64.1	64.1	2.0	2.0	1.8	1.8	1.8	1.8
1800	B	66	66.5	68.4	68.4	68.3	68.3	68.3	68.3	1.9	1.9	1.8	1.8	1.8	1.8
1801	B	66	66.4	68.3	68.3	68.2	68.2	68.2	68.2	1.9	1.9	1.8	1.8	1.8	1.8
1802	B	66	66.6	68.5	68.5	68.4	68.4	68.4	68.4	1.9	1.9	1.8	1.8	1.8	1.8
1803	B	66	66.7	68.6	68.6	68.5	68.5	68.5	68.5	1.9	1.9	1.8	1.8	1.8	1.8
1804	B	66	69.3	71.2	71.2	71.1	71.1	71.1	71.1	1.9	1.9	1.8	1.8	1.8	1.8
1805	B	66	68.5	70.3	70.3	70.2	70.2	70.2	70.2	1.8	1.8	1.7	1.7	1.7	1.7
1806	B	66	66.9	68.7	68.7	68.6	68.6	68.6	68.6	1.8	1.8	1.7	1.7	1.7	1.7
1807	B	66	66.1	68.0	68.0	67.9	67.9	67.9	67.9	1.9	1.9	1.8	1.8	1.8	1.8
1808	B	66	69.3	71.2	71.2	71.1	71.1	71.1	71.1	1.9	1.9	1.8	1.8	1.8	1.8
1809	B	66	68.3	70.1	70.1	70.0	70.0	70.0	70.0	1.8	1.8	1.7	1.7	1.7	1.7
1810	B	66	66.9	68.8	68.8	68.7	68.7	68.7	68.7	1.9	1.9	1.8	1.8	1.8	1.8
1811	B	66	66.0	67.9	67.9	67.8	67.8	67.8	67.8	1.9	1.9	1.8	1.8	1.8	1.8
1812	B	66	64.4	66.4	66.4	66.2	66.2	66.2	66.2	2.0	2.0	1.8	1.8	1.8	1.8
1813	B	66	64.3	66.3	66.3	66.2	66.2	66.2	66.2	2.0	2.0	1.9	1.9	1.9	1.9
1814	B	66	64.2	66.2	66.2	66.0	66.0	66.0	66.0	2.0	2.0	1.8	1.8	1.8	1.8
1815	B	66	64.0	66.0	66.0	65.9	65.9	65.9	65.9	2.0	2.0	1.9	1.9	1.9	1.9
1816	B	66	62.9	64.8	64.8	64.7	64.7	64.7	64.7	1.9	1.9	1.8	1.8	1.8	1.8
1817	B	66	62.9	64.8	64.8	64.7	64.7	64.7	64.7	1.9	1.9	1.8	1.8	1.8	1.8
1818	B	66	62.7	64.7	64.7	64.5	64.5	64.5	64.5	2.0	2.0	1.8	1.8	1.8	1.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1819	B	66	62.5	64.5	64.5	64.3	64.3	64.3	64.3	2.0	2.0	1.8	1.8	1.8	1.8
1820	B	66	60.0	61.9	61.9	61.7	61.7	61.7	61.7	1.9	1.9	1.7	1.7	1.7	1.7
1821	B	66	60.0	61.9	61.9	61.7	61.7	61.7	61.7	1.9	1.9	1.7	1.7	1.7	1.7
1822	B	66	60.2	62.1	62.1	61.9	61.9	61.9	61.9	1.9	1.9	1.7	1.7	1.7	1.7
1823	B	66	60.2	62.1	62.1	61.9	61.9	61.9	61.9	1.9	1.9	1.7	1.7	1.7	1.7
1824	B	66	62.8	64.4	64.4	64.3	64.3	64.3	64.3	1.6	1.6	1.5	1.5	1.5	1.5
1825	B	66	61.7	63.2	63.2	63.2	63.2	63.2	63.2	1.5	1.5	1.5	1.5	1.5	1.5
1826	B	66	60.6	62.2	62.2	62.1	62.1	62.1	62.1	1.6	1.6	1.5	1.5	1.5	1.5
1827	B	66	59.1	60.8	60.8	60.7	60.7	60.7	60.7	1.7	1.7	1.6	1.6	1.6	1.6
1828	B	66	58.5	60.1	60.1	60.1	60.1	60.1	60.1	1.6	1.6	1.6	1.6	1.6	1.6
1829	B	66	61.1	62.7	62.7	62.7	62.7	62.7	62.7	1.6	1.6	1.6	1.6	1.6	1.6
1830	B	66	60.3	61.9	61.9	61.9	61.9	61.9	61.9	1.6	1.6	1.6	1.6	1.6	1.6
1831	B	66	61.4	63.6	63.6	63.6	63.6	63.6	63.6	2.2	2.2	2.2	2.2	2.2	2.2
1832	B	66	61.9	64.1	64.1	64.1	64.1	64.1	64.1	2.2	2.2	2.2	2.2	2.2	2.2
1833	B	66	61.8	63.9	63.9	63.9	63.9	63.9	63.9	2.1	2.1	2.1	2.1	2.1	2.1
1834	B	66	61.9	64.1	64.1	64.1	64.1	64.1	64.1	2.2	2.2	2.2	2.2	2.2	2.2
1835	B	66	62.2	64.3	64.3	64.3	64.3	64.3	64.3	2.1	2.1	2.1	2.1	2.1	2.1
1836	B	66	62.1	64.3	64.3	64.3	64.3	64.3	64.3	2.2	2.2	2.2	2.2	2.2	2.2
1837	B	66	62.6	64.8	64.8	64.8	64.8	64.8	64.8	2.2	2.2	2.2	2.2	2.2	2.2
1838	B	66	62.7	64.9	64.9	64.9	64.9	64.9	64.9	2.2	2.2	2.2	2.2	2.2	2.2
1839	B	66	62.8	65.0	65.0	65.0	65.0	65.0	65.0	2.2	2.2	2.2	2.2	2.2	2.2
1840	B	66	62.7	64.9	64.9	64.9	64.9	64.9	64.9	2.2	2.2	2.2	2.2	2.2	2.2
1841	B	66	62.7	64.9	64.9	64.9	64.9	64.9	64.9	2.2	2.2	2.2	2.2	2.2	2.2
1842	B	66	62.7	64.9	64.9	64.9	64.9	64.9	64.9	2.2	2.2	2.2	2.2	2.2	2.2
1843	B	66	62.4	64.7	64.7	64.7	64.7	64.7	64.7	2.3	2.3	2.3	2.3	2.3	2.3
1844	B	66	62.5	64.7	64.7	64.7	64.7	64.7	64.7	2.2	2.2	2.2	2.2	2.2	2.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1845	B	66	62.4	64.6	64.6	64.6	64.6	64.6	64.6	2.2	2.2	2.2	2.2	2.2	2.2
1846	B	66	61.4	63.0	63.0	63.0	63.0	63.0	63.2	1.6	1.6	1.6	1.6	1.6	1.8
1847	B	66	61.8	63.4	63.4	63.4	63.4	63.4	63.6	1.6	1.6	1.6	1.6	1.6	1.8
1848	B	66	63.0	64.6	64.6	64.6	64.6	64.6	64.8	1.6	1.6	1.6	1.6	1.6	1.8
1849	B	66	63.6	65.2	65.2	65.2	65.2	65.2	65.3	1.6	1.6	1.6	1.6	1.6	1.7
1850	B	66	61.3	62.9	62.9	62.9	62.9	62.9	63.1	1.6	1.6	1.6	1.6	1.6	1.8
1851	B	66	61.7	63.3	63.3	63.3	63.3	63.3	63.5	1.6	1.6	1.6	1.6	1.6	1.8
1852	B	66	63.0	64.6	64.6	64.6	64.6	64.6	64.8	1.6	1.6	1.6	1.6	1.6	1.8
1853	B	66	63.6	65.2	65.2	65.2	65.2	65.2	65.4	1.6	1.6	1.6	1.6	1.6	1.8
1854	B	66	62.2	63.8	63.8	63.8	63.8	63.8	63.9	1.6	1.6	1.6	1.6	1.6	1.7
1855	B	66	61.1	62.8	62.8	62.8	62.8	62.8	62.9	1.7	1.7	1.7	1.7	1.7	1.8
1856	B	66	61.0	62.7	62.7	62.7	62.7	62.7	62.9	1.7	1.7	1.7	1.7	1.7	1.9
1857	B	66	61.0	62.7	62.7	62.7	62.7	62.7	62.9	1.7	1.7	1.7	1.7	1.7	1.9
1858	B	66	60.9	62.6	62.6	62.6	62.6	62.6	62.7	1.7	1.7	1.7	1.7	1.7	1.8
1859	B	66	62.4	64.0	64.0	64.0	64.0	64.0	64.2	1.6	1.6	1.6	1.6	1.6	1.8
1860	B	66	62.2	63.9	63.9	63.9	63.9	63.9	64.0	1.7	1.7	1.7	1.7	1.7	1.8
1861	B	66	62.3	63.9	63.9	63.9	63.9	63.9	64.0	1.6	1.6	1.6	1.6	1.6	1.7
1862	B	66	62.2	63.8	63.8	63.8	63.8	63.8	63.9	1.6	1.6	1.6	1.6	1.6	1.7
1863	B	66	63.3	64.9	64.9	64.9	64.9	64.9	65.0	1.6	1.6	1.6	1.6	1.6	1.7
1864	B	66	64.0	65.6	65.6	65.6	65.6	65.6	65.7	1.6	1.6	1.6	1.6	1.6	1.7
1865	B	66	65.8	67.3	67.3	67.3	67.3	67.3	67.4	1.5	1.5	1.5	1.5	1.5	1.6
1866	B	66	66.8	68.3	68.3	68.3	68.3	68.3	68.4	1.5	1.5	1.5	1.5	1.5	1.6
1867	B	66	63.4	65.0	65.0	65.0	65.0	65.0	65.2	1.6	1.6	1.6	1.6	1.6	1.8
1868	B	66	64.1	65.7	65.7	65.7	65.7	65.7	65.8	1.6	1.6	1.6	1.6	1.6	1.7
1869	B	66	65.8	67.4	67.4	67.4	67.4	67.4	67.5	1.6	1.6	1.6	1.6	1.6	1.7
1870	B	66	66.8	68.3	68.3	68.3	68.3	68.3	68.4	1.5	1.5	1.5	1.5	1.5	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1871	B	66	64.9	66.5	66.5	66.5	66.5	66.5	66.6	1.6	1.6	1.6	1.6	1.6	1.7
1872	B	66	64.9	66.5	66.5	66.5	66.5	66.5	66.6	1.6	1.6	1.6	1.6	1.6	1.7
1873	B	66	64.8	66.4	66.4	66.3	66.3	66.3	66.4	1.6	1.6	1.5	1.5	1.5	1.6
1874	B	66	64.8	66.3	66.3	66.3	66.3	66.3	66.4	1.5	1.5	1.5	1.5	1.5	1.6
1875	B	66	67.2	68.7	68.7	68.7	68.7	68.7	68.7	1.5	1.5	1.5	1.5	1.5	1.5
1876	B	66	67.0	68.5	68.5	68.5	68.5	68.5	68.6	1.5	1.5	1.5	1.5	1.5	1.6
1877	B	66	67.0	68.6	68.6	68.5	68.5	68.5	68.6	1.6	1.6	1.5	1.5	1.5	1.6
1878	B	66	67.0	68.5	68.5	68.5	68.5	68.5	68.6	1.5	1.5	1.5	1.5	1.5	1.6
1879	B	66	63.5	65.1	65.1	65.1	65.1	65.1	65.2	1.6	1.6	1.6	1.6	1.6	1.7
1880	B	66	60.7	62.3	62.3	62.3	62.3	62.3	62.4	1.6	1.6	1.6	1.6	1.6	1.7
1881	B	66	61.1	62.7	62.7	62.7	62.7	62.7	62.8	1.6	1.6	1.6	1.6	1.6	1.7
1882	B	66	62.5	64.0	64.0	64.0	64.0	64.0	64.1	1.5	1.5	1.5	1.5	1.5	1.6
1883	B	66	63.1	64.6	64.6	64.6	64.6	64.6	64.7	1.5	1.5	1.5	1.5	1.5	1.6
1884	B	66	60.8	62.4	62.4	62.4	62.4	62.4	62.5	1.6	1.6	1.6	1.6	1.6	1.7
1885	B	66	61.3	62.9	62.9	62.9	62.9	62.9	62.9	1.6	1.6	1.6	1.6	1.6	1.6
1886	B	66	62.6	64.2	64.2	64.2	64.2	64.2	64.2	1.6	1.6	1.6	1.6	1.6	1.6
1887	B	66	63.4	64.9	64.9	64.9	64.9	64.9	65.0	1.5	1.5	1.5	1.5	1.5	1.6
1888	B	66	60.7	62.3	62.3	62.3	62.3	62.3	62.3	1.6	1.6	1.6	1.6	1.6	1.6
1889	B	66	61.1	62.7	62.7	62.7	62.7	62.7	62.8	1.6	1.6	1.6	1.6	1.6	1.7
1890	B	66	62.7	64.3	64.3	64.3	64.3	64.3	64.3	1.6	1.6	1.6	1.6	1.6	1.6
1891	B	66	63.3	64.8	64.8	64.8	64.8	64.8	64.9	1.5	1.5	1.5	1.5	1.5	1.6
1892	B	66	60.7	62.3	62.3	62.3	62.3	62.3	62.3	1.6	1.6	1.6	1.6	1.6	1.6
1893	B	66	61.2	62.8	62.8	62.8	62.8	62.8	62.8	1.6	1.6	1.6	1.6	1.6	1.6
1894	B	66	62.6	64.2	64.2	64.2	64.2	64.2	64.2	1.6	1.6	1.6	1.6	1.6	1.6
1895	B	66	63.2	64.7	64.7	64.7	64.7	64.7	64.7	1.5	1.5	1.5	1.5	1.5	1.5
1896	B	66	64.1	65.7	65.7	65.7	65.7	65.7	65.7	1.6	1.6	1.6	1.6	1.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1897	B	66	64.0	65.5	65.5	65.5	65.5	65.5	65.5	1.5	1.5	1.5	1.5	1.5	1.5
1898	B	66	64.1	65.6	65.6	65.6	65.6	65.6	65.7	1.5	1.5	1.5	1.5	1.5	1.6
1899	B	66	64.2	65.7	65.7	65.7	65.7	65.7	65.7	1.5	1.5	1.5	1.5	1.5	1.5
1900	B	66	66.2	67.8	67.8	67.8	67.8	67.8	67.8	1.6	1.6	1.6	1.6	1.6	1.6
1901	B	66	66.3	67.9	67.9	67.9	67.9	67.9	67.9	1.6	1.6	1.6	1.6	1.6	1.6
1902	B	66	66.5	68.0	68.0	68.0	68.0	68.0	68.0	1.5	1.5	1.5	1.5	1.5	1.5
1903	B	66	66.5	68.1	68.1	68.1	68.1	68.1	68.1	1.6	1.6	1.6	1.6	1.6	1.6
1904	B	66	61.3	62.9	62.9	62.8	62.8	62.8	62.9	1.6	1.6	1.5	1.5	1.5	1.6
1905	B	66	62.3	63.8	63.8	63.8	63.8	63.8	63.9	1.5	1.5	1.5	1.5	1.5	1.6
1906	B	66	63.0	64.6	64.6	64.5	64.5	64.5	64.6	1.6	1.6	1.5	1.5	1.5	1.6
1907	B	66	63.7	65.3	65.3	65.3	65.3	65.3	65.3	1.6	1.6	1.6	1.6	1.6	1.6
1908	B	66	61.3	62.9	62.9	62.8	62.8	62.8	62.9	1.6	1.6	1.5	1.5	1.5	1.6
1909	B	66	62.0	63.5	63.5	63.5	63.5	63.5	63.6	1.5	1.5	1.5	1.5	1.5	1.6
1910	B	66	62.7	64.3	64.3	64.3	64.3	64.3	64.3	1.6	1.6	1.6	1.6	1.6	1.6
1911	B	66	63.8	65.4	65.4	65.4	65.4	65.4	65.4	1.6	1.6	1.6	1.6	1.6	1.6
1912	B	66	61.3	62.9	62.9	62.9	62.9	62.9	62.9	1.6	1.6	1.6	1.6	1.6	1.6
1913	B	66	62.2	63.8	63.8	63.8	63.8	63.8	63.8	1.6	1.6	1.6	1.6	1.6	1.6
1914	B	66	63.0	64.5	64.5	64.5	64.5	64.5	64.6	1.5	1.5	1.5	1.5	1.5	1.6
1915	B	66	63.7	65.2	65.2	65.2	65.2	65.2	65.3	1.5	1.5	1.5	1.5	1.5	1.6
1916	B	66	61.2	62.9	62.9	62.8	62.8	62.8	62.9	1.7	1.7	1.6	1.6	1.6	1.7
1917	B	66	61.8	63.4	63.4	63.4	63.4	63.4	63.4	1.6	1.6	1.6	1.6	1.6	1.6
1918	B	66	62.4	64.0	64.0	64.0	64.0	64.0	64.0	1.6	1.6	1.6	1.6	1.6	1.6
1919	B	66	63.7	65.2	65.2	65.2	65.2	65.2	65.2	1.5	1.5	1.5	1.5	1.5	1.5
1920	B	66	68.7	70.3	70.3	70.3	70.3	70.3	70.3	1.6	1.6	1.6	1.6	1.6	1.6
1921	B	66	64.7	66.3	66.3	66.3	66.3	66.3	66.3	1.6	1.6	1.6	1.6	1.6	1.6
1922	B	66	58.9	61.3	61.3	61.3	61.3	61.3	61.2	2.4	2.4	2.4	2.4	2.4	2.3

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1923	B	66	58.6	60.9	60.9	60.9	60.9	60.9	60.8	2.3	2.3	2.3	2.3	2.3	2.2
1924	B	66	58.8	61.4	61.4	61.4	61.4	61.4	61.3	2.6	2.6	2.6	2.6	2.6	2.5
1925	B	66	57.8	60.3	60.3	60.3	60.3	60.3	60.2	2.5	2.5	2.5	2.5	2.5	2.4
1926	B	66	57.4	60.0	60.0	60.0	60.0	60.0	59.9	2.6	2.6	2.6	2.6	2.6	2.5
1927	B	66	57.1	59.7	59.7	59.7	59.7	59.7	59.6	2.6	2.6	2.6	2.6	2.6	2.5
1928	B	66	56.7	59.2	59.2	59.2	59.2	59.2	59.1	2.5	2.5	2.5	2.5	2.5	2.4
1929	B	66	56.1	58.7	58.7	58.7	58.7	58.7	58.6	2.6	2.6	2.6	2.6	2.6	2.5
1930	B	66	55.6	58.1	58.1	58.1	58.1	58.1	58.1	2.5	2.5	2.5	2.5	2.5	2.5
1931	B	66	55.4	57.9	57.9	57.9	57.9	57.9	57.8	2.5	2.5	2.5	2.5	2.5	2.4
1932	B	66	54.9	57.5	57.5	57.5	57.5	57.5	57.4	2.6	2.6	2.6	2.6	2.6	2.5
1933	B	66	54.7	57.2	57.2	57.2	57.2	57.2	57.1	2.5	2.5	2.5	2.5	2.5	2.4
1934	B	66	56.4	59.4	59.4	59.4	59.4	59.4	59.4	3.0	3.0	3.0	3.0	3.0	3.0
1935	B	66	56.4	59.3	59.3	59.3	59.3	59.3	59.3	2.9	2.9	2.9	2.9	2.9	2.9
1936	B	66	56.2	59.2	59.2	59.2	59.2	59.2	59.2	3.0	3.0	3.0	3.0	3.0	3.0
1937	B	66	56.1	59.1	59.1	59.1	59.1	59.1	59.0	3.0	3.0	3.0	3.0	3.0	2.9
1938	B	66	56.2	59.1	59.1	59.1	59.1	59.1	59.1	2.9	2.9	2.9	2.9	2.9	2.9
1939	B	66	56.1	59.1	59.1	59.1	59.1	59.1	59.1	3.0	3.0	3.0	3.0	3.0	3.0
1940	B	66	56.0	59.0	59.0	59.0	59.0	59.0	59.0	3.0	3.0	3.0	3.0	3.0	3.0
1941	B	66	55.8	58.9	58.9	58.9	58.9	58.9	58.9	3.1	3.1	3.1	3.1	3.1	3.1
1942	B	66	56.0	59.0	59.0	59.0	59.0	59.0	59.0	3.0	3.0	3.0	3.0	3.0	3.0
1943	B	66	56.2	59.2	59.2	59.2	59.2	59.2	59.2	3.0	3.0	3.0	3.0	3.0	3.0
1944	B	66	55.8	58.8	58.8	58.8	58.8	58.8	58.8	3.0	3.0	3.0	3.0	3.0	3.0
1945	B	66	55.9	59.0	59.0	59.0	59.0	59.0	59.0	3.1	3.1	3.1	3.1	3.1	3.1
1946	B	66	55.7	58.8	58.8	58.8	58.8	58.8	58.8	3.1	3.1	3.1	3.1	3.1	3.1
1947	B	66	55.8	59.0	59.0	59.0	59.0	59.0	59.0	3.2	3.2	3.2	3.2	3.2	3.2
1948	B	66	56.2	59.4	59.4	59.4	59.4	59.4	59.4	3.2	3.2	3.2	3.2	3.2	3.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1949	B	66	53.7	56.6	56.6	56.6	56.6	56.6	56.6	2.9	2.9	2.9	2.9	2.9	2.9
1950	B	66	52.7	55.5	55.5	55.5	55.5	55.5	55.5	2.8	2.8	2.8	2.8	2.8	2.8
1951	B	66	52.8	55.7	55.7	55.7	55.7	55.7	55.6	2.9	2.9	2.9	2.9	2.9	2.8
1952	B	66	52.6	55.4	55.4	55.4	55.4	55.4	55.4	2.8	2.8	2.8	2.8	2.8	2.8
1953	B	66	52.8	55.7	55.7	55.7	55.7	55.7	55.7	2.9	2.9	2.9	2.9	2.9	2.9
1954	B	66	52.6	55.4	55.4	55.4	55.4	55.4	55.4	2.8	2.8	2.8	2.8	2.8	2.8
1955	B	66	52.7	55.6	55.6	55.6	55.6	55.6	55.6	2.9	2.9	2.9	2.9	2.9	2.9
1956	B	66	52.8	55.7	55.7	55.7	55.7	55.7	55.7	2.9	2.9	2.9	2.9	2.9	2.9
1957	B	66	52.9	55.8	55.8	55.8	55.8	55.8	55.8	2.9	2.9	2.9	2.9	2.9	2.9
1958	B	66	52.8	55.7	55.7	55.7	55.7	55.7	55.7	2.9	2.9	2.9	2.9	2.9	2.9
1959	B	66	52.7	55.7	55.7	55.7	55.7	55.7	55.7	3.0	3.0	3.0	3.0	3.0	3.0
1960	B	66	52.7	55.7	55.7	55.7	55.7	55.7	55.7	3.0	3.0	3.0	3.0	3.0	3.0
1961	B	66	52.6	55.6	55.6	55.6	55.6	55.6	55.6	3.0	3.0	3.0	3.0	3.0	3.0
1962	B	66	52.5	55.5	55.5	55.5	55.5	55.5	55.5	3.0	3.0	3.0	3.0	3.0	3.0
1963	B	66	52.7	55.6	55.6	55.6	55.6	55.6	55.6	2.9	2.9	2.9	2.9	2.9	2.9
1964	B	66	52.5	55.5	55.5	55.5	55.5	55.5	55.5	3.0	3.0	3.0	3.0	3.0	3.0
1965	B	66	57.3	60.5	60.5	60.5	60.5	60.5	60.5	3.2	3.2	3.2	3.2	3.2	3.2
1966	B	66	58.1	61.2	61.2	61.2	61.2	61.2	61.2	3.1	3.1	3.1	3.1	3.1	3.1
1967	B	66	58.1	61.2	61.2	61.2	61.2	61.2	61.2	3.1	3.1	3.1	3.1	3.1	3.1
1968	B	66	57.5	60.7	60.7	60.7	60.7	60.7	60.7	3.2	3.2	3.2	3.2	3.2	3.2
1969	B	66	63.6	67.0	67.0	67.0	67.0	67.0	67.0	3.4	3.4	3.4	3.4	3.4	3.4
1970	B	66	57.8	60.9	60.9	60.9	60.9	60.9	60.9	3.1	3.1	3.1	3.1	3.1	3.1
1971	B	66	58.3	61.5	61.5	61.5	61.5	61.5	61.5	3.2	3.2	3.2	3.2	3.2	3.2
1972	B	66	57.8	61.0	61.0	61.0	61.0	61.0	61.0	3.2	3.2	3.2	3.2	3.2	3.2
1973	B	66	58.4	61.6	61.6	61.6	61.6	61.6	61.6	3.2	3.2	3.2	3.2	3.2	3.2
1974	B	66	58.4	61.6	61.6	61.6	61.6	61.6	61.6	3.2	3.2	3.2	3.2	3.2	3.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
1975	B	66	58.5	61.7	61.7	61.7	61.7	61.7	61.7	3.2	3.2	3.2	3.2	3.2	3.2
1976	B	66	57.8	61.1	61.1	61.1	61.1	61.1	61.0	3.3	3.3	3.3	3.3	3.3	3.2
1977	B	66	53.8	56.9	56.9	56.9	56.9	56.9	56.9	3.1	3.1	3.1	3.1	3.1	3.1
1978	B	66	53.8	56.9	56.9	56.9	56.9	56.9	56.9	3.1	3.1	3.1	3.1	3.1	3.1
1979	B	66	53.9	57.0	57.0	56.9	56.9	56.9	56.9	3.1	3.1	3.0	3.0	3.0	3.0
1980	B	66	53.6	56.7	56.7	56.7	56.7	56.7	56.7	3.1	3.1	3.1	3.1	3.1	3.1
1981	B	66	53.9	57.0	57.0	57.0	57.0	57.0	57.0	3.1	3.1	3.1	3.1	3.1	3.1
1982	B	66	53.7	56.8	56.8	56.8	56.8	56.8	56.8	3.1	3.1	3.1	3.1	3.1	3.1
1983	B	66	53.9	57.0	57.0	57.0	57.0	57.0	57.0	3.1	3.1	3.1	3.1	3.1	3.1
1984	B	66	54.0	57.1	57.1	57.1	57.1	57.1	57.1	3.1	3.1	3.1	3.1	3.1	3.1
1985	B	66	53.9	57.0	57.0	57.0	57.0	57.0	57.0	3.1	3.1	3.1	3.1	3.1	3.1
1986	B	66	54.0	57.1	57.1	57.1	57.1	57.1	57.1	3.1	3.1	3.1	3.1	3.1	3.1
1987	B	66	52.1	55.1	55.1	55.1	55.1	55.1	55.1	3.0	3.0	3.0	3.0	3.0	3.0
1988	B	66	52.1	55.1	55.1	55.1	55.1	55.1	55.1	3.0	3.0	3.0	3.0	3.0	3.0
1989	B	66	52.1	55.1	55.1	55.1	55.1	55.1	55.1	3.0	3.0	3.0	3.0	3.0	3.0
1990	B	66	52.1	55.1	55.1	55.1	55.1	55.1	55.1	3.0	3.0	3.0	3.0	3.0	3.0
1991	B	66	52.1	55.2	55.2	55.2	55.2	55.2	55.2	3.1	3.1	3.1	3.1	3.1	3.1
1992	B	66	51.9	54.9	54.9	54.9	54.9	54.9	54.9	3.0	3.0	3.0	3.0	3.0	3.0
1993	B	66	52.0	55.0	55.0	55.0	55.0	55.0	55.0	3.0	3.0	3.0	3.0	3.0	3.0
1994	B	66	52.2	55.3	55.3	55.3	55.3	55.3	55.3	3.1	3.1	3.1	3.1	3.1	3.1
1995	B	66	52.3	55.4	55.4	55.4	55.4	55.4	55.4	3.1	3.1	3.1	3.1	3.1	3.1
1996	B	66	52.1	55.2	55.2	55.2	55.2	55.2	55.2	3.1	3.1	3.1	3.1	3.1	3.1
1997	B	66	53.1	56.2	56.2	56.2	56.2	56.2	56.2	3.1	3.1	3.1	3.1	3.1	3.1
1998	B	66	65.9	69.4	69.4	69.4	69.4	69.4	69.4	3.5	3.5	3.5	3.5	3.5	3.5
1999	B	66	66.0	69.5	69.5	69.5	69.5	69.5	69.5	3.5	3.5	3.5	3.5	3.5	3.5
2000	B	66	67.0	70.5	70.5	70.5	70.5	70.5	70.5	3.5	3.5	3.5	3.5	3.5	3.5

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
2001	B	66	67.0	70.5	70.5	70.5	70.5	70.5	70.5	3.5	3.5	3.5	3.5	3.5	3.5
2002	B	66	67.0	70.5	70.5	70.5	70.5	70.5	70.5	3.5	3.5	3.5	3.5	3.5	3.5
2003	B	66	67.6	71.2	71.2	71.2	71.2	71.2	71.2	3.6	3.6	3.6	3.6	3.6	3.6
2004	B	66	65.0	68.1	68.1	68.1	68.1	68.1	68.1	3.1	3.1	3.1	3.1	3.1	3.1
2005	B	66	62.5	65.7	65.7	65.7	65.7	65.7	65.7	3.2	3.2	3.2	3.2	3.2	3.2
2006	B	66	59.5	62.7	62.7	62.7	62.7	62.7	62.7	3.2	3.2	3.2	3.2	3.2	3.2
2007	B	66	58.4	61.5	61.5	61.5	61.5	61.5	61.5	3.1	3.1	3.1	3.1	3.1	3.1
2008	B	66	65.1	68.2	68.2	68.2	68.2	68.2	68.2	3.1	3.1	3.1	3.1	3.1	3.1
2009	B	66	62.8	66.0	66.0	66.0	66.0	66.0	66.0	3.2	3.2	3.2	3.2	3.2	3.2
2010	B	66	59.3	62.5	62.5	62.5	62.5	62.5	62.5	3.2	3.2	3.2	3.2	3.2	3.2
2011	B	66	58.3	61.5	61.5	61.5	61.5	61.5	61.5	3.2	3.2	3.2	3.2	3.2	3.2
2012	B	66	66.6	69.7	69.7	69.7	69.7	69.7	69.7	3.1	3.1	3.1	3.1	3.1	3.1
2013	B	66	60.4	63.7	63.7	63.7	63.7	63.7	63.7	3.3	3.3	3.3	3.3	3.3	3.3
2014	B	66	58.1	61.3	61.3	61.3	61.3	61.3	61.3	3.2	3.2	3.2	3.2	3.2	3.2
2015	B	66	55.5	58.6	58.6	58.5	58.5	58.5	58.5	3.1	3.1	3.0	3.0	3.0	3.0
2016	B	66	54.6	57.6	57.6	57.5	57.5	57.5	57.5	3.0	3.0	2.9	2.9	2.9	2.9
2017	B	66	53.6	56.5	56.5	56.5	56.5	56.5	56.5	2.9	2.9	2.9	2.9	2.9	2.9
2018	B	66	52.5	55.3	55.3	55.3	55.3	55.3	55.2	2.8	2.8	2.8	2.8	2.8	2.7
2019	B	66	58.4	61.6	61.6	61.6	61.6	61.6	61.6	3.2	3.2	3.2	3.2	3.2	3.2
2020	B	66	56.4	59.6	59.6	59.6	59.6	59.6	59.6	3.2	3.2	3.2	3.2	3.2	3.2
2021	B	66	55.2	58.3	58.3	58.2	58.2	58.2	58.2	3.1	3.1	3.0	3.0	3.0	3.0
2022	B	66	59.1	62.4	62.4	62.4	62.4	62.4	62.4	3.3	3.3	3.3	3.3	3.3	3.3
2023	B	66	56.6	59.9	59.9	59.9	59.9	59.9	59.9	3.3	3.3	3.3	3.3	3.3	3.3
2024	B	66	55.1	58.3	58.3	58.3	58.3	58.3	58.3	3.2	3.2	3.2	3.2	3.2	3.2
2025	B	66	53.1	56.0	56.0	56.0	56.0	56.0	56.0	2.9	2.9	2.9	2.9	2.9	2.9
2026	B	66	53.1	56.0	56.0	56.0	56.0	56.0	56.0	2.9	2.9	2.9	2.9	2.9	2.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
2027	B	66	53.2	56.1	56.1	56.1	56.1	56.1	56.1	2.9	2.9	2.9	2.9	2.9	2.9
2028	B	66	52.7	55.5	55.5	55.5	55.5	55.5	55.5	2.8	2.8	2.8	2.8	2.8	2.8
2029	B	66	51.9	54.6	54.6	54.6	54.6	54.6	54.6	2.7	2.7	2.7	2.7	2.7	2.7
2030	B	66	52.0	54.9	54.9	54.9	54.9	54.9	54.9	2.9	2.9	2.9	2.9	2.9	2.9
2031	B	66	51.7	54.4	54.4	54.4	54.4	54.4	54.4	2.7	2.7	2.7	2.7	2.7	2.7
2032	B	66	58.1	61.4	61.4	61.4	61.4	61.4	61.4	3.3	3.3	3.3	3.3	3.3	3.3
2033	B	66	62.9	66.2	66.2	66.2	66.2	66.2	66.2	3.3	3.3	3.3	3.3	3.3	3.3
2034	B	66	58.7	62.1	62.1	62.1	62.1	62.1	62.1	3.4	3.4	3.4	3.4	3.4	3.4
2035	B	66	55.0	58.2	58.2	58.2	58.2	58.2	58.2	3.2	3.2	3.2	3.2	3.2	3.2
2036	B	66	53.1	56.2	56.2	56.2	56.2	56.2	56.2	3.1	3.1	3.1	3.1	3.1	3.1
2037	B	66	52.8	55.8	55.8	55.8	55.8	55.8	55.8	3.0	3.0	3.0	3.0	3.0	3.0
2038	B	66	53.0	56.1	56.1	56.1	56.1	56.1	56.1	3.1	3.1	3.1	3.1	3.1	3.1
2039	B	66	51.4	54.3	54.3	54.3	54.3	54.3	54.3	2.9	2.9	2.9	2.9	2.9	2.9
2040	B	66	51.9	54.9	54.9	54.8	54.8	54.8	54.8	3.0	3.0	2.9	2.9	2.9	2.9
2041	B	66	51.4	54.3	54.3	54.3	54.3	54.3	54.3	2.9	2.9	2.9	2.9	2.9	2.9
2042	B	66	63.4	66.7	66.7	66.7	66.7	66.7	66.7	3.3	3.3	3.3	3.3	3.3	3.3
2043	B	66	60.5	64.0	64.0	64.0	64.0	64.0	64.0	3.5	3.5	3.5	3.5	3.5	3.5
2044	B	66	58.7	62.1	62.1	62.1	62.1	62.1	62.1	3.4	3.4	3.4	3.4	3.4	3.4
2045	B	66	56.5	59.9	59.9	59.9	59.9	59.9	59.9	3.4	3.4	3.4	3.4	3.4	3.4
2046	B	66	55.6	59.0	59.0	59.0	59.0	59.0	59.0	3.4	3.4	3.4	3.4	3.4	3.4
2047	B	66	60.3	63.7	63.7	63.7	63.7	63.7	63.7	3.4	3.4	3.4	3.4	3.4	3.4
2048	B	66	58.7	62.1	62.1	62.1	62.1	62.1	62.1	3.4	3.4	3.4	3.4	3.4	3.4
2049	B	66	57.1	60.5	60.5	60.5	60.5	60.5	60.5	3.4	3.4	3.4	3.4	3.4	3.4
2050	B	66	55.7	59.1	59.1	59.1	59.1	59.1	59.1	3.4	3.4	3.4	3.4	3.4	3.4
2051	B	66	52.8	56.0	56.0	56.0	56.0	56.0	56.0	3.2	3.2	3.2	3.2	3.2	3.2
2052	B	66	52.9	56.1	56.1	56.1	56.1	56.1	56.1	3.2	3.2	3.2	3.2	3.2	3.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
2053	B	66	52.9	56.0	56.0	56.0	56.0	56.0	56.0	3.1	3.1	3.1	3.1	3.1	3.1
2054	B	66	51.4	54.4	54.4	54.4	54.4	54.4	54.4	3.0	3.0	3.0	3.0	3.0	3.0
2055	B	66	51.7	54.7	54.7	54.7	54.7	54.7	54.7	3.0	3.0	3.0	3.0	3.0	3.0
2056	B	66	51.2	54.2	54.2	54.2	54.2	54.2	54.2	3.0	3.0	3.0	3.0	3.0	3.0
2057	B	66	66.6	69.9	69.9	69.9	69.9	69.9	69.9	3.3	3.3	3.3	3.3	3.3	3.3
2058	B	66	66.4	69.6	69.6	69.6	69.6	69.6	69.6	3.2	3.2	3.2	3.2	3.2	3.2
2059	B	66	66.8	70.0	70.0	70.0	70.0	70.0	70.0	3.2	3.2	3.2	3.2	3.2	3.2
2060	B	66	55.7	59.1	59.1	59.1	59.1	59.1	59.1	3.4	3.4	3.4	3.4	3.4	3.4
2061	B	66	56.7	60.2	60.2	60.2	60.2	60.2	60.2	3.5	3.5	3.5	3.5	3.5	3.5
2062	B	66	56.7	60.2	60.2	60.2	60.2	60.2	60.2	3.5	3.5	3.5	3.5	3.5	3.5
2063	B	66	56.8	60.3	60.3	60.3	60.3	60.3	60.3	3.5	3.5	3.5	3.5	3.5	3.5
2064	B	66	56.7	60.2	60.2	60.2	60.2	60.2	60.2	3.5	3.5	3.5	3.5	3.5	3.5
2065	B	66	57.1	60.6	60.6	60.6	60.6	60.6	60.6	3.5	3.5	3.5	3.5	3.5	3.5
2066	B	66	57.4	60.8	60.8	60.8	60.8	60.8	60.8	3.4	3.4	3.4	3.4	3.4	3.4
2067	B	66	57.7	61.2	61.2	61.2	61.2	61.2	61.2	3.5	3.5	3.5	3.5	3.5	3.5
2068	B	66	51.8	55.0	55.0	55.0	55.0	55.0	55.0	3.2	3.2	3.2	3.2	3.2	3.2
2069	B	66	52.9	56.1	56.1	56.1	56.1	56.1	56.1	3.2	3.2	3.2	3.2	3.2	3.2
2070	B	66	52.8	56.1	56.1	56.1	56.1	56.1	56.1	3.3	3.3	3.3	3.3	3.3	3.3
2071	B	66	52.9	56.1	56.1	56.1	56.1	56.1	56.1	3.2	3.2	3.2	3.2	3.2	3.2
2072	B	66	52.9	56.2	56.2	56.2	56.2	56.2	56.2	3.3	3.3	3.3	3.3	3.3	3.3
2073	B	66	53.0	56.3	56.3	56.3	56.3	56.3	56.3	3.3	3.3	3.3	3.3	3.3	3.3
2074	B	66	53.3	56.6	56.6	56.6	56.6	56.6	56.6	3.3	3.3	3.3	3.3	3.3	3.3
2075	B	66	53.5	56.8	56.8	56.8	56.8	56.8	56.8	3.3	3.3	3.3	3.3	3.3	3.3
2076	B	66	53.6	56.9	56.9	56.9	56.9	56.9	56.9	3.3	3.3	3.3	3.3	3.3	3.3
2077	B	66	53.8	57.1	57.1	57.1	57.1	57.1	57.1	3.3	3.3	3.3	3.3	3.3	3.3
2078	B	66	61.0	63.0	63.0	63.0	63.0	63.0	63.0	2.0	2.0	2.0	2.0	2.0	2.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA													
			2012 Existing	2035 Build						Difference between Existing/Build						
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC																
2079	B	66	60.7	65.0	65.0	65.0	65.0	65.0	64.0	4.3	4.3	4.3	4.3	4.3	3.3
2080	B	66	64.1	68.6	68.6	68.6	68.6	68.6	68.1	4.5	4.5	4.5	4.5	4.5	4.0
2081	B	66	66.7	70.9	70.9	70.9	70.9	70.9	71.0	4.2	4.2	4.2	4.2	4.2	4.3
2082	B	66	62.6	66.7	66.7	66.7	66.7	66.7	67.1	4.1	4.1	4.1	4.1	4.1	4.5
2083	B	66	60.8	65.0	65.0	65.0	65.0	65.0	65.3	4.2	4.2	4.2	4.2	4.2	4.5
2084	B	66	59.0	63.1	63.1	63.1	63.1	63.1	63.4	4.1	4.1	4.1	4.1	4.1	4.4
2085	B	66	58.1	62.3	62.3	62.3	62.3	62.3	62.6	4.2	4.2	4.2	4.2	4.2	4.5
2086	B	66	57.0	61.0	61.0	61.0	61.0	61.0	61.2	4.0	4.0	4.0	4.0	4.0	4.2
2087	B	66	56.9	60.9	60.9	60.9	60.9	60.9	61.2	4.0	4.0	4.0	4.0	4.0	4.3
2088	B	66	61.4	65.6	65.6	65.6	65.6	65.6	66.0	4.2	4.2	4.2	4.2	4.2	4.6
2089	B	66	61.7	63.5	63.5	63.5	63.5	63.5	63.5	1.8	1.8	1.8	1.8	1.8	1.8
2090	B	66	60.3	62.1	62.1	62.1	62.1	62.1	62.1	1.8	1.8	1.8	1.8	1.8	1.8
2091	B	66	61.9	63.7	63.7	63.7	63.7	63.7	63.7	1.8	1.8	1.8	1.8	1.8	1.8
2092	B	66	60.4	62.2	62.2	62.2	62.2	62.2	62.2	1.8	1.8	1.8	1.8	1.8	1.8
2093	B	66	60.3	62.1	62.1	62.1	62.1	62.1	62.1	1.8	1.8	1.8	1.8	1.8	1.8
2094	B	66	60.3	62.2	62.2	62.2	62.2	62.2	62.2	1.9	1.9	1.9	1.9	1.9	1.9
2095	B	66	60.2	62.0	62.0	62.0	62.0	62.0	62.0	1.8	1.8	1.8	1.8	1.8	1.8
2096	B	66	60.0	61.8	61.8	61.8	61.8	61.8	61.8	1.8	1.8	1.8	1.8	1.8	1.8
2097	B	66	59.9	61.7	61.7	61.7	61.7	61.7	61.7	1.8	1.8	1.8	1.8	1.8	1.8
2098	B	66	61.4	63.2	63.2	63.2	63.2	63.2	63.2	1.8	1.8	1.8	1.8	1.8	1.8
2099	B	66	62.9	64.8	64.8	64.8	64.8	64.8	64.8	1.9	1.9	1.9	1.9	1.9	1.9
2100	B	66	63.8	65.7	65.7	65.7	65.7	65.7	65.7	1.9	1.9	1.9	1.9	1.9	1.9
2101	B	66	64.0	65.9	65.9	65.9	65.9	65.9	65.9	1.9	1.9	1.9	1.9	1.9	1.9
2102	B	66	64.0	65.9	65.9	65.9	65.9	65.9	65.9	1.9	1.9	1.9	1.9	1.9	1.9
2103	B	66	63.4	65.3	65.3	65.3	65.3	65.3	65.3	1.9	1.9	1.9	1.9	1.9	1.9
2104	B	66	63.1	65.1	65.1	65.1	65.1	65.1	65.1	2.0	2.0	2.0	2.0	2.0	2.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
2105	B	66	62.7	64.7	64.7	64.7	64.7	64.7	64.6	2.0	2.0	2.0	2.0	2.0	1.9
2106	B	66	63.2	65.2	65.2	65.2	65.2	65.2	65.2	2.0	2.0	2.0	2.0	2.0	2.0
2107	B	66	62.8	64.7	64.7	64.7	64.7	64.7	64.7	1.9	1.9	1.9	1.9	1.9	1.9
2108	B	66	61.0	63.0	63.0	63.0	63.0	63.0	63.0	2.0	2.0	2.0	2.0	2.0	2.0
2109	B	66	59.8	61.8	61.8	61.7	61.7	61.7	61.7	2.0	2.0	1.9	1.9	1.9	1.9
2110	B	66	59.7	61.6	61.6	61.6	61.6	61.6	61.6	1.9	1.9	1.9	1.9	1.9	1.9
2111	B	66	59.6	61.5	61.5	61.5	61.5	61.5	61.5	1.9	1.9	1.9	1.9	1.9	1.9
2112	B	66	59.4	61.4	61.4	61.4	61.4	61.4	61.4	2.0	2.0	2.0	2.0	2.0	2.0
2113	B	66	59.3	61.2	61.2	61.2	61.2	61.2	61.2	1.9	1.9	1.9	1.9	1.9	1.9
2114	B	66	59.2	61.2	61.2	61.1	61.1	61.1	61.1	2.0	2.0	1.9	1.9	1.9	1.9
2115	B	66	59.1	61.1	61.1	61.1	61.1	61.1	61.1	2.0	2.0	2.0	2.0	2.0	2.0
2116	B	66	59.0	61.0	61.0	61.0	61.0	61.0	61.0	2.0	2.0	2.0	2.0	2.0	2.0
2117	B	66	55.5	61.9	61.9	61.9	61.9	61.9	61.9	6.4	6.4	6.4	6.4	6.4	6.4
2118	B	66	59.7	66.1	66.1	66.1	66.1	66.1	66.1	6.4	6.4	6.4	6.4	6.4	6.4
2119	B	66	61.7	68.1	68.1	68.1	68.1	68.1	68.1	6.4	6.4	6.4	6.4	6.4	6.4
2120	B	66	61.7	68.1	68.1	68.1	68.1	68.1	68.1	6.4	6.4	6.4	6.4	6.4	6.4
2121	B	66	62.9	69.2	69.2	69.2	69.2	69.2	69.2	6.3	6.3	6.3	6.3	6.3	6.3
2122	B	66	57.3	63.6	63.6	63.6	63.6	63.6	63.6	6.3	6.3	6.3	6.3	6.3	6.3
2123	B	66	60.4	66.7	66.7	66.7	66.7	66.7	66.7	6.3	6.3	6.3	6.3	6.3	6.3
2124	B	66	59.8	66.1	66.1	66.1	66.1	66.1	66.1	6.3	6.3	6.3	6.3	6.3	6.3
2125	B	66	57.0	63.6	63.6	63.6	63.6	63.6	63.6	6.6	6.6	6.6	6.6	6.6	6.6
2126	B	66	56.7	63.2	63.2	63.2	63.2	63.2	63.2	6.5	6.5	6.5	6.5	6.5	6.5
2127	B	66	64.7	67.8	67.8	67.8	67.8	67.8	67.8	3.1	3.1	3.1	3.1	3.1	3.1
2128	B	66	50.7	57.2	57.2	57.1	57.1	57.1	57.1	6.5	6.5	6.4	6.4	6.4	6.4
2129	B	66	61.3	68.1	68.1	68.1	68.1	68.1	68.1	6.8	6.8	6.8	6.8	6.8	6.8
2130	B	66	55.4	62.0	62.0	62.0	62.0	62.0	62.0	6.6	6.6	6.6	6.6	6.6	6.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
2131	B	66	52.7	59.2	59.2	59.2	59.2	59.2	59.2	6.5	6.5	6.5	6.5	6.5	6.5
2132	B	66	49.5	55.9	55.9	55.9	55.9	55.9	55.9	6.4	6.4	6.4	6.4	6.4	6.4
2133	B	66	62.3	69.1	69.1	69.1	69.1	69.1	69.1	6.8	6.8	6.8	6.8	6.8	6.8
2134	B	66	61.0	67.8	67.8	67.8	67.8	67.8	67.8	6.8	6.8	6.8	6.8	6.8	6.8
2135	B	66	61.3	68.1	68.1	68.1	68.1	68.1	68.1	6.8	6.8	6.8	6.8	6.8	6.8
2136	B	66	59.9	66.6	66.6	66.6	66.6	66.6	66.6	6.7	6.7	6.7	6.7	6.7	6.7
2137	B	66	60.7	67.4	67.4	67.4	67.4	67.4	67.4	6.7	6.7	6.7	6.7	6.7	6.7
2138	B	66	51.3	57.6	57.6	57.6	57.6	57.6	57.6	6.3	6.3	6.3	6.3	6.3	6.3
2139	B	66	47.8	53.8	53.8	53.8	53.8	53.8	53.8	6.0	6.0	6.0	6.0	6.0	6.0
2140	B	66	48.2	54.1	54.1	54.1	54.1	54.1	54.1	5.9	5.9	5.9	5.9	5.9	5.9
2141	B	66	48.2	54.1	54.1	54.1	54.1	54.1	54.1	5.9	5.9	5.9	5.9	5.9	5.9
2142	B	66	48.4	54.4	54.4	54.4	54.4	54.4	54.4	6.0	6.0	6.0	6.0	6.0	6.0
2143	B	66	48.1	54.2	54.2	54.2	54.2	54.2	54.2	6.1	6.1	6.1	6.1	6.1	6.1
2144	B	66	55.1	61.4	61.4	61.4	61.4	61.4	61.4	6.3	6.3	6.3	6.3	6.3	6.3
2145	B	66	48.4	54.4	54.4	54.4	54.4	54.4	54.4	6.0	6.0	6.0	6.0	6.0	6.0
2146	B	66	48.9	55.4	55.4	55.4	55.4	55.4	55.4	6.5	6.5	6.5	6.5	6.5	6.5
2147	B	66	51.0	57.5	57.5	57.5	57.5	57.5	57.5	6.5	6.5	6.5	6.5	6.5	6.5
2148	B	66	59.5	60.6	60.6	60.6	60.6	60.6	60.6	1.1	1.1	1.1	1.1	1.1	1.1
2149	B	66	55.8	56.9	56.9	56.9	56.9	56.9	56.9	1.1	1.1	1.1	1.1	1.1	1.1
2150	B	66	60.9	62.0	62.0	62.0	62.0	62.0	62.0	1.1	1.1	1.1	1.1	1.1	1.1
2151	B	66	60.0	61.1	61.1	61.1	61.1	61.1	61.1	1.1	1.1	1.1	1.1	1.1	1.1
2152	B	66	64.2	65.3	65.3	65.3	65.3	65.3	65.3	1.1	1.1	1.1	1.1	1.1	1.1
2153	B	66	62.2	63.3	63.3	63.3	63.3	63.3	63.3	1.1	1.1	1.1	1.1	1.1	1.1
2154	B	66	56.3	57.5	57.5	57.5	57.5	57.5	57.5	1.2	1.2	1.2	1.2	1.2	1.2
2155	B	66	53.6	54.8	54.8	54.8	54.8	54.8	54.8	1.2	1.2	1.2	1.2	1.2	1.2
2156	B	66	58.3	59.5	59.5	59.5	59.5	59.5	59.5	1.2	1.2	1.2	1.2	1.2	1.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
2157	B	66	53.2	54.3	54.3	54.3	54.3	54.3	54.3	1.1	1.1	1.1	1.1	1.1	1.1
2158	B	66	59.3	60.5	60.5	60.5	60.5	60.5	60.5	1.2	1.2	1.2	1.2	1.2	1.2
2159	B	66	60.2	61.4	61.4	61.4	61.4	61.4	61.4	1.2	1.2	1.2	1.2	1.2	1.2
2160	B	66	56.3	57.4	57.4	57.4	57.4	57.4	57.4	1.1	1.1	1.1	1.1	1.1	1.1
2161	B	66	62.7	63.9	63.9	63.9	63.9	63.9	63.9	1.2	1.2	1.2	1.2	1.2	1.2
2162	B	66	63.4	64.6	64.6	64.6	64.6	64.6	64.6	1.2	1.2	1.2	1.2	1.2	1.2
2163	B	66	61.5	62.7	62.7	62.7	62.7	62.7	62.7	1.2	1.2	1.2	1.2	1.2	1.2
2164	B	66	57.6	58.8	58.8	58.8	58.8	58.8	58.8	1.2	1.2	1.2	1.2	1.2	1.2
2165	B	66	53.2	54.5	54.5	54.5	54.5	54.5	54.5	1.3	1.3	1.3	1.3	1.3	1.3
2166	B	66	65.6	66.8	66.8	66.8	66.8	66.8	66.8	1.2	1.2	1.2	1.2	1.2	1.2
2167	B	66	65.1	66.3	66.3	66.3	66.3	66.3	66.3	1.2	1.2	1.2	1.2	1.2	1.2
2168	B	66	64.8	65.9	65.9	65.9	65.9	65.9	65.9	1.1	1.1	1.1	1.1	1.1	1.1
2169	B	66	53.3	54.6	54.6	54.6	54.6	54.6	54.6	1.3	1.3	1.3	1.3	1.3	1.3
2170	B	66	53.5	54.7	54.7	54.7	54.7	54.7	54.7	1.2	1.2	1.2	1.2	1.2	1.2
2171	B	66	54.0	55.1	55.1	55.1	55.1	55.1	55.1	1.1	1.1	1.1	1.1	1.1	1.1
2172	B	66	55.8	56.9	56.9	56.9	56.9	56.9	56.9	1.1	1.1	1.1	1.1	1.1	1.1
2173	B	66	55.9	57.0	57.0	57.0	57.0	57.0	57.0	1.1	1.1	1.1	1.1	1.1	1.1
2174	B	66	63.8	65.0	65.0	65.0	65.0	65.0	65.0	1.2	1.2	1.2	1.2	1.2	1.2
2175	B	66	60.7	61.8	61.8	61.8	61.8	61.8	61.8	1.1	1.1	1.1	1.1	1.1	1.1
2176	B	66	57.5	58.6	58.6	58.6	58.6	58.6	58.6	1.1	1.1	1.1	1.1	1.1	1.1
2177	B	66	54.5	55.7	55.7	55.7	55.7	55.7	55.7	1.2	1.2	1.2	1.2	1.2	1.2
2178	B	66	58.3	59.4	59.4	59.4	59.4	59.4	59.4	1.1	1.1	1.1	1.1	1.1	1.1
2179	B	66	54.3	55.5	55.5	55.5	55.5	55.5	55.5	1.2	1.2	1.2	1.2	1.2	1.2
2180	B	66	53.6	54.7	54.7	54.7	54.7	54.7	54.7	1.1	1.1	1.1	1.1	1.1	1.1
2181	B	66	53.6	54.7	54.7	54.7	54.7	54.7	54.7	1.1	1.1	1.1	1.1	1.1	1.1
2182	B	66	53.6	54.7	54.7	54.7	54.7	54.7	54.7	1.1	1.1	1.1	1.1	1.1	1.1

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												
			2012 Existing	2035 Build						Difference between Existing/Build					
				C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1	C1	C2	Cliff-1	Cliff-2	Cliff-3	Rice-1
Shaded cells indicate noise levels that exceed the NAC															
2183	B	66	55.3	56.4	56.4	56.4	56.4	56.4	56.4	1.1	1.1	1.1	1.1	1.1	1.1
2184	B	66	55.4	56.5	56.5	56.5	56.5	56.5	56.5	1.1	1.1	1.1	1.1	1.1	1.1
2185	B	66	56.0	57.1	57.1	57.1	57.1	57.1	57.1	1.1	1.1	1.1	1.1	1.1	1.1
2186	B	66	61.8	62.9	62.9	62.9	62.9	62.9	62.9	1.1	1.1	1.1	1.1	1.1	1.1
2187	B	66	55.6	56.8	56.8	56.8	56.8	56.8	56.8	1.2	1.2	1.2	1.2	1.2	1.2
2188	B	66	58.8	59.9	59.9	59.9	59.9	59.9	59.9	1.1	1.1	1.1	1.1	1.1	1.1
2189	B	66	56.6	57.7	57.7	57.7	57.7	57.7	57.7	1.1	1.1	1.1	1.1	1.1	1.1
2190	B	66	55.9	57.0	57.0	57.0	57.0	57.0	57.0	1.1	1.1	1.1	1.1	1.1	1.1
2191	B	66	59.0	60.1	60.1	60.1	60.1	60.1	60.1	1.1	1.1	1.1	1.1	1.1	1.1
2192	B	66	57.9	59.0	59.0	59.0	59.0	59.0	59.0	1.1	1.1	1.1	1.1	1.1	1.1
2193	B	66	56.5	57.6	57.6	57.6	57.6	57.6	57.6	1.1	1.1	1.1	1.1	1.1	1.1
2194	B	66	56.1	57.2	57.2	57.2	57.2	57.2	57.2	1.1	1.1	1.1	1.1	1.1	1.1

8.Noise Impact Analysis

Noise abatement measures are considered when predicted traffic noise levels approach or exceed the NAC, or when the predicted traffic noise levels substantially exceed existing noise levels. As shown in Table 8, there are 271 impacts predicted under the Existing Alternative, 452 impacts predicted under Future Build Alternatives C1 and C2, and 437 impacts predicted under Future Build Alternatives Cliff-1, Cliff-2, Cliff-3, and Rice-1.

Table 8: Impact Summary

Alternative	Approach/ Exceed NAC	Substantially Exceed	Total Receptors Affected
Existing	271	0	271
Build – C1	452	0	452
Build – C2	452	0	452
Build – Cliff-1	437	0	437
Build – Cliff-2	437	0	437
Build – Cliff-3	437	0	437
Build – Rice-1	437	0	437

8.1. Impacts

8.1.1. Alternative C1

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.5 to +6.8 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 452 traffic noise impacts are predicted to occur as a result of Alternative C1.

8.1.2. Alternative C2

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.5 to +6.8 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 452 traffic noise impacts are predicted to occur as a result of Alternative C2.

8.1.3. Alternative Cliff-1

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.5 to +6.8 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 437 traffic noise impacts are predicted to occur as a result of Alternative Cliff-1.

8.1.4. Alternative Cliff-2

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.5 to +6.8 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 437 traffic noise impacts are predicted to occur as a result of Alternative Cliff-2.

8.1.5. Alternative Cliff-3

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.5 to +6.8 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 437 traffic noise impacts are predicted to occur as a result of Alternative Cliff-3.

8.1.6. Alternative Rice-1

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.5 to +6.8 dBA. The difference in noise levels can be accounted for by the increase in traffic between the existing and build alternatives as well as any changes in geometry. Results of this analysis indicate that 437 traffic noise impacts are predicted to occur as a result of Alternative Rice-1.

9. Noise Abatement Measures

Per the scope for this sub-study, "in areas where future noise levels exceed state and federal criteria (23 CFR, Part 772 and the SDDOT noise policy), noise mitigation options will be identified and the conceptual feasibility of those options will be described. A detailed analysis of the cost reasonability of noise mitigation options will not be conducted at the corridor study phase. In addition, this task excludes specific public involvement for noise mitigation features such as providing ballots to owners and tenants of impacted properties."

Impacts are predicted as a result of all of the Build alternatives. Potential traffic noise abatement measures that could be considered for Build Alternatives C1, C2, Cliff-1, Cliff-2, Cliff-3, and Rice-1 are listed below, along with reasons why some are considered infeasible.

1. Modifying the proposed horizontal and/or vertical alignments of the roadway
    - *Several different alignments are under investigation*
2. Traffic management measures (e.g. modify speed limits and restrict truck traffic)
    - *Impractical given the type of road in question*
3. Construction of noise barriers along or within the ROW
    - *Potentially possible; to be discussed further in Section 9.1.*
4. Acquisition of property rights for construction of noise barriers
    - *Potentially possible; would be investigated further in final design.*
5. Acquisition of property to serve as a buffer zone
    - *Prohibitively expensive*

9.1. Discussion of Feasibility of Noise Barriers (based on SDDOT Guidance)

All of the following conditions must be met in order for noise abatement to be considered feasible. Failure to achieve any single element of feasibility will result in the noise abatement measure being deemed not feasible. Further investigation into feasibility and reasonability (noise reduction goal, cost-effectiveness, viewpoints of benefited receptors) would need to occur once a preferred alternative is selected.

Feasibility

When a traffic noise impact is identified on a project, noise abatement will be considered and evaluated for engineering and acoustical feasibility.

- **Engineering feasibility:**
  - Safety: An abatement measure will be deemed not feasible if it causes an excessive restriction of sight distance, continuous shadow resulting in icing or snow accumulation on driving lanes, or severe drainage problems associated either with the barrier or flood-prone areas.
  - Barrier height: The design of each proposed barrier will be considered on an individual basis when determining barrier height. The designed height of any proposed barrier may be adjusted based on feasibility and reasonableness considerations. Due to safety concerns, SDDOT will generally not construct barriers higher than 20 feet.
  - Topography: If the topography is such that an abatement measure cannot be built, then it will be deemed not feasible.
  - Drainage and utilities: A noise abatement measure is not feasible if access to drainage and utilities cannot be maintained.
  - Maintenance of the abatement measure, maintenance access to adjacent properties, and access to adjacent properties: A noise abatement measure is not feasible if access to the abatement measure, side streets, driveways, ramps, etc., cannot be maintained.

- **Acoustic Feasibility:** A noise abatement measure is considered acoustically feasible when a minimum of 60 percent of front-row receptors directly behind the noise wall (noise wall must extent entirely across receptor's property line) achieve a 5 dBA noise reduction.

To be most effective, a noise barrier must be long and continuous to prevent sounds from passing around the ends. It must also be solid, with few, if any, holes, cracks or openings. The majority of the impacts with each proposed alternative occur along I-229. There is sufficient right-of-way for noise barriers that are continuously long-enough with no breaks or openings to be designed. Noise barriers shielding many of the impacted receptors along I-229 are potentially feasible. Further detailed analysis would need to be performed when a preferred alternative has been chosen to further examine individual noise barrier feasibility and reasonableness.

Noise barriers shielding the impacted receptors along the crossroads are unlikely to be feasible as a lack of sufficient right-of-way to construct many of the noise barriers is available and lack of access control would create too many openings in the noise barrier to allow access to driveways and cross-streets.

10. Construction Noise and Vibration

Construction of the Project would result in temporary noise and vibration increases within the Project area. The evaluation and control of construction noise and vibration must be considered along with traffic noise. This Project is bordered by commercial and residential receptors for which impacts from construction noise and vibration are a concern.

The following are basic categories for mitigation measures for construction noise. Due to the interrelatedness of construction noise and vibration, some of these measures will also apply for vibration resulting from construction activities.

Design Considerations: Design considerations include measures in the plans and specifications to minimize or eliminate adverse impacts. The proposed changes and their proximity to noise sensitive receptors were considered during design.

Community Awareness: It is important for people to be made aware of the possible inconvenience construction can cause, and to know its approximate duration so they can plan their activities accordingly. It is SDDOT's policy to submit such Project information to all local news media.

Source Control: Source control involves reducing noise impacts from construction by controlling the noise emissions at their source. This can be accomplished by specifying proper muffler systems, either as a requirement in the plans and specifications on this Project or through an established local noise ordinance requiring mufflers. Contractors generally maintain proper muffler systems on their equipment to ensure efficient operation and to minimize noise for the benefit of their own personnel as well as the adjacent receptors.

Site Control: Site control involves the specification of certain areas where extra precautions should be taken to minimize construction noise. One way to reduce construction noise impacts at sensitive receptors is to operate stationary equipment, such as air compressors or generators, as far away from the sensitive receptors as possible. Another method might be placing a temporary noise barrier in front of the equipment. As a general rule, good coordination between the project engineer, the contractor and the affected receptors is less confusing, less likely to increase the cost of the project ,and provides a more personal approach to work out ways to minimize construction noise impacts in the more noise-sensitive areas. No specific construction-noise, site-control specifications will be included in the plans.

Time and Activity Constraints: Limiting working hours on a construction site can be very beneficial during the hours of sleep or on Sundays and holidays. However, most construction activities do not occur at night and usually not on Sundays. Exceptions due to weather, schedule, and time-related phases of construction could occur. No specific constraints will be incorporated in the plans of this improvement. Enforcement of such constraints could be handled through a general city or county ordinance, either listing the exceptions or granting them on a case-by-case basis.

11. Information for Local Officials

Local officials will be provided with information on noise compatible planning techniques that can be used to prevent future highway traffic noise impacts. To assist local officials within whose jurisdiction a Type I highway project is located, SDDOT will provide information on future noise levels for each Activity Category located along the project. This is accomplished by providing a copy of the noise analysis report to the local official. The local official will also be provided with an estimation of future noise levels at various distances from the highway (Appendix B Noise Contours).

12. Conclusion

Noise levels were evaluated for the existing conditions and future Build Alternatives C1, C2, Cliff-1, Cliff-2, Cliff-3, and Rice-1 at 2,194 receptors in the Project area. There are 271 impacts predicted under the Existing Alternative, 452 impacts predicted under Future Build Alternatives C1 and C2, and 437 impacts predicted under Future Build Alternatives Cliff-1, Cliff-2, Cliff-3, and Rice-1.

13. References

South Dakota Department of Transportation, “Noise Analysis and Abatement Guidance,” July 13, 2011.

Federal Highway Administration (FHWA), “Procedures for Abatement of Highway Traffic Noise and Construction Noise,” July 13, 2011.

Methods for evaluation and control of construction noise were taken from the FHWA Special Report – “Highway Construction Noise: Measurement, Prediction and Mitigation.”

Appendix A
Traffic Volumes

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
NB229 Tallgrass2LouiseoffR (outside)	65	818	89.61%	0.00%	10.39%	0.00%	0.00%	733	0	85	0	0
NB229 Tallgrass2LouiseoffR (inside)	65	818	89.61%	0.00%	10.39%	0.00%	0.00%	733	0	85	0	0
NB229 LouiseoffR2LouiseonR (outside)	65	623	89.61%	0.00%	10.39%	0.00%	0.00%	558	0	65	0	0
NB229 LouiseoffR2LouiseonR (inside)	65	623	89.61%	0.00%	10.39%	0.00%	0.00%	558	0	65	0	0
NB229 LouiseonR2LouiseonR (outside)	65	555	89.61%	0.00%	10.39%	0.00%	0.00%	497	0	58	0	0
NB229 LouiseonR2LouiseonR (middle)	65	555	89.61%	0.00%	10.39%	0.00%	0.00%	497	0	58	0	0
NB229 LouiseonR2LouiseonR (inside)	65	555	89.61%	0.00%	10.39%	0.00%	0.00%	497	0	58	0	0
NB229 LouiseonR2WesternoffR (outside)	65	728	94.12%	0.00%	5.88%	0.00%	0.00%	686	0	43	0	0
NB229 LouiseonR2WesternoffR (middle)	65	728	94.12%	0.00%	5.88%	0.00%	0.00%	686	0	43	0	0
NB229 LouiseonR2WesternoffR (inside)	65	728	94.12%	0.00%	5.88%	0.00%	0.00%	686	0	43	0	0
NB229 btn Western ramps (outside)	65	915	94.12%	0.00%	5.88%	0.00%	0.00%	861	0	54	0	0
NB229 btn Western ramps (inside)	65	915	94.12%	0.00%	5.88%	0.00%	0.00%	861	0	54	0	0
NB229 WesternonR2MinnesotaoffR (out	65	797	94.84%	0.00%	5.16%	0.00%	0.00%	756	0	41	0	0
NB229 WesternonR2MinnesotaoffR (mid	65	797	94.84%	0.00%	5.16%	0.00%	0.00%	756	0	41	0	0
NB229 WesternonR2MinnesotaoffR (insi	65	797	94.84%	0.00%	5.16%	0.00%	0.00%	756	0	41	0	0
NB229 btn Minnesota ramps (outside)	65	950	94.84%	0.00%	5.16%	0.00%	0.00%	901	0	49	0	0
NB229 btn Minnesota ramps (inside)	65	950	94.84%	0.00%	5.16%	0.00%	0.00%	901	0	49	0	0
NB229 MinnesotaonR2CliffoffR (outside)	65	745	95.07%	0.00%	4.93%	0.00%	0.00%	708	0	37	0	0
NB229 MinnesotaonR2CliffoffR (middle)	65	745	95.07%	0.00%	4.93%	0.00%	0.00%	708	0	37	0	0
NB229 MinnesotaonR2CliffoffR (inside)	65	745	95.07%	0.00%	4.93%	0.00%	0.00%	708	0	37	0	0
NB229 btn Cliff Ave ramps (outside)	65	868	95.07%	0.00%	4.93%	0.00%	0.00%	825	0	43	0	0
NB229 btn Cliff Ave ramps (inside)	65	868	95.07%	0.00%	4.93%	0.00%	0.00%	825	0	43	0	0
NB229 CliffonR2E26thoffR (outside)	65	725	93.71%	0.00%	6.29%	0.00%	0.00%	679	0	46	0	0
NB229 CliffonR2E26thoffR (middle)	65	725	93.71%	0.00%	6.29%	0.00%	0.00%	679	0	46	0	0
NB229 CliffonR2E26thoffR (inside)	65	725	93.71%	0.00%	6.29%	0.00%	0.00%	679	0	46	0	0
NB229 btn E26th ramps (outside)	65	855	93.71%	0.00%	6.29%	0.00%	0.00%	801	0	54	0	0
NB229 btn E26th ramps (inside)	65	855	93.71%	0.00%	6.29%	0.00%	0.00%	801	0	54	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
NB229 E26thonR210thStoffR (outside)	65	1068	91.33%	0.00%	8.67%	0.00%	0.00%	975	0	93	0	0
NB229 E26thonR210thStoffR (inside)	65	1068	91.33%	0.00%	8.67%	0.00%	0.00%	975	0	93	0	0
NB229 btn 10thSt ramps (outside)	65	798	91.33%	0.00%	8.67%	0.00%	0.00%	728	0	69	0	0
NB229 btn 10thSt ramps (inside)	65	798	91.33%	0.00%	8.67%	0.00%	0.00%	728	0	69	0	0
NB229 10thStonR2RiceoffR (outside)	65	720	91.54%	0.00%	8.46%	0.00%	0.00%	659	0	61	0	0
NB229 10thStonR2RiceoffR (middle)	65	720	91.54%	0.00%	8.46%	0.00%	0.00%	659	0	61	0	0
NB229 10thStonR2RiceoffR (inside)	65	720	91.54%	0.00%	8.46%	0.00%	0.00%	659	0	61	0	0
NB229 btn Rice St ramps (outside)	65	948	91.54%	0.00%	8.46%	0.00%	0.00%	867	0	80	0	0
NB229 btn Rice St ramps (inside)	65	948	91.54%	0.00%	8.46%	0.00%	0.00%	867	0	80	0	0
NB229 RiceonR2BensonoffR (outside)	65	713	93.28%	0.00%	6.72%	0.00%	0.00%	665	0	48	0	0
NB229 RiceonR2BensonoffR (middle)	65	713	93.28%	0.00%	6.72%	0.00%	0.00%	665	0	48	0	0
NB229 RiceonR2BensonoffR (inside)	65	713	93.28%	0.00%	6.72%	0.00%	0.00%	665	0	48	0	0
NB229 btn Benson Rd ramps (outside)	65	315	93.28%	0.00%	6.72%	0.00%	0.00%	294	0	21	0	0
NB229 btn Benson Rd ramps (inside)	65	315	93.28%	0.00%	6.72%	0.00%	0.00%	294	0	21	0	0
NB229 BensononR2I90offR (outside)	65	353	91.55%	0.00%	8.45%	0.00%	0.00%	323	0	30	0	0
NB229 BensononR2I90offR (inside)	65	353	91.55%	0.00%	8.45%	0.00%	0.00%	323	0	30	0	0
SB229 I90onR2BensonoffR (outside)	65	520	91.55%	0.00%	8.45%	0.00%	0.00%	476	0	44	0	0
SB229 I90onR2BensonoffR (inside)	65	520	91.55%	0.00%	8.45%	0.00%	0.00%	476	0	44	0	0
SB229 btn Benson ramps (outside)	65	463	91.55%	0.00%	8.45%	0.00%	0.00%	423	0	39	0	0
SB229 btn Benson ramps (inside)	65	463	91.55%	0.00%	8.45%	0.00%	0.00%	423	0	39	0	0
SB229 BensononR2RiceoffR (outside)	65	412	93.28%	0.00%	6.72%	0.00%	0.00%	384	0	28	0	0
SB229 BensononR2RiceoffR (middle)	65	412	93.28%	0.00%	6.72%	0.00%	0.00%	384	0	28	0	0
SB229 BensononR2RiceoffR (inside)	65	412	93.28%	0.00%	6.72%	0.00%	0.00%	384	0	28	0	0
SB229 btn Rice St ramps (outside)	65	548	93.28%	0.00%	6.72%	0.00%	0.00%	511	0	37	0	0
SB229 btn Rice St ramps (inside)	65	548	93.28%	0.00%	6.72%	0.00%	0.00%	511	0	37	0	0
SB229 RiceonR2E10thoffR (outside)	65	512	91.54%	0.00%	8.46%	0.00%	0.00%	468	0	43	0	0
SB229 RiceonR2E10thoffR (middle)	65	512	91.54%	0.00%	8.46%	0.00%	0.00%	468	0	43	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SB229 RiceonR2E10thoffR (inside)	65	512	91.54%	0.00%	8.46%	0.00%	0.00%	468	0	43	0	0
SB229 btn E10th ramps (outside)	65	535	91.54%	0.00%	8.46%	0.00%	0.00%	490	0	45	0	0
SB229 btn E10th ramps (inside)	65	535	91.54%	0.00%	8.46%	0.00%	0.00%	490	0	45	0	0
SB229 E10thonR2E26thoffR (outside)	65	850	91.33%	0.00%	8.67%	0.00%	0.00%	776	0	74	0	0
SB229 E10thonR2E26thoffR (inside)	65	850	91.33%	0.00%	8.67%	0.00%	0.00%	776	0	74	0	0
SB229 btn E26th ramps (outside)	65	723	91.33%	0.00%	8.67%	0.00%	0.00%	660	0	63	0	0
SB229 btn E26th ramps (inside)	65	723	91.33%	0.00%	8.67%	0.00%	0.00%	660	0	63	0	0
SB229 E26thonR2CliffoffR (outside)	65	712	93.71%	0.00%	6.29%	0.00%	0.00%	667	0	45	0	0
SB229 E26thonR2CliffoffR (middle)	65	712	93.71%	0.00%	6.29%	0.00%	0.00%	667	0	45	0	0
SB229 E26thonR2CliffoffR (inside)	65	712	93.71%	0.00%	6.29%	0.00%	0.00%	667	0	45	0	0
SB229 btn Cliff Ave ramps (outside)	65	958	93.71%	0.00%	6.29%	0.00%	0.00%	897	0	60	0	0
SB229 btn Cliff Ave ramps (inside)	65	958	93.71%	0.00%	6.29%	0.00%	0.00%	897	0	60	0	0
SB229 CliffonR2MinnesotaoffR (outside)	65	815	95.07%	0.00%	4.93%	0.00%	0.00%	775	0	40	0	0
SB229 CliffonR2MinnesotaoffR (middle)	65	815	95.07%	0.00%	4.93%	0.00%	0.00%	775	0	40	0	0
SB229 CliffonR2MinnesotaoffR (inside)	65	815	95.07%	0.00%	4.93%	0.00%	0.00%	775	0	40	0	0
SB229 btn Minnesota ramps (outside)	65	1035	95.07%	0.00%	4.93%	0.00%	0.00%	984	0	51	0	0
SB229 btn Minnesota ramps (inside)	65	1035	95.07%	0.00%	4.93%	0.00%	0.00%	984	0	51	0	0
SB229 MinnesotaonR2WesternoffR (out	65	825	94.84%	0.00%	5.16%	0.00%	0.00%	782	0	43	0	0
SB229 MinnesotaonR2WesternoffR (mid	65	825	94.84%	0.00%	5.16%	0.00%	0.00%	782	0	43	0	0
SB229 MinnesotaonR2WesternoffR (insi	65	825	94.84%	0.00%	5.16%	0.00%	0.00%	782	0	43	0	0
SB229 btn Western Ave ramps (outside)	65	813	94.84%	0.00%	5.16%	0.00%	0.00%	771	0	42	0	0
SB229 btn Western Ave ramps (inside)	65	813	94.84%	0.00%	5.16%	0.00%	0.00%	771	0	42	0	0
SB229 WesternonR2LouiseoffR (outside	65	597	94.12%	0.00%	5.88%	0.00%	0.00%	562	0	35	0	0
SB229 WesternonR2LouiseoffR (middle)	65	597	94.12%	0.00%	5.88%	0.00%	0.00%	562	0	35	0	0
SB229 WesternonR2LouiseoffR (inside)	65	597	94.12%	0.00%	5.88%	0.00%	0.00%	562	0	35	0	0
SB229 btn Louise Ave ramps (outside)	65	520	94.12%	0.00%	5.88%	0.00%	0.00%	489	0	31	0	0
SB229 btn Louise Ave ramps (inside)	65	520	94.12%	0.00%	5.88%	0.00%	0.00%	489	0	31	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SB229 LouiseonR2I29offR (outside)	65	710	89.61%	0.00%	10.39%	0.00%	0.00%	636	0	74	0	0
SB229 LouiseonR2I29offR (inside)	65	710	89.61%	0.00%	10.39%	0.00%	0.00%	636	0	74	0	0
OFFR from NB229 to LouiseAve	40	390	98.00%	0.00%	2.00%	0.00%	0.00%	382	0	8	0	0
ONR from NBLouiseAve to NB229	40	515	98.00%	0.00%	2.00%	0.00%	0.00%	505	0	10	0	0
OFFR from SB229 to LouiseAve	40	755	98.00%	0.00%	2.00%	0.00%	0.00%	740	0	15	0	0
ONR from LouiseAve to SB229	40	385	98.00%	0.00%	2.00%	0.00%	0.00%	377	0	8	0	0
ONR from SBLouiseAve to NB229	40	425	98.00%	0.00%	2.00%	0.00%	0.00%	417	0	9	0	0
OFFR from NB229 to Western Ave	40	350	98.00%	0.00%	2.00%	0.00%	0.00%	343	0	7	0	0
ONR from Western Ave to NB229	40	560	98.00%	0.00%	2.00%	0.00%	0.00%	549	0	11	0	0
OFFR from SB229 to Western Ave	40	855	98.00%	0.00%	2.00%	0.00%	0.00%	838	0	17	0	0
ONR from Western Ave to SB229	40	170	98.00%	0.00%	2.00%	0.00%	0.00%	167	0	3	0	0
OFFR from NB229 to Minnesota Ave	40	490	97.00%	0.00%	3.00%	0.00%	0.00%	475	0	15	0	0
ONR from Minnesota Ave to NB229	40	340	97.00%	0.00%	3.00%	0.00%	0.00%	330	0	10	0	0
OFFR from SB229 to Minnesota Ave	40	375	97.00%	0.00%	3.00%	0.00%	0.00%	364	0	11	0	0
ONR from Minnesota Ave to SB229	40	410	97.00%	0.00%	3.00%	0.00%	0.00%	398	0	12	0	0
OFFR from NB229 to Cliff Ave	40	500	97.00%	0.00%	3.00%	0.00%	0.00%	485	0	15	0	0
ONR from Cliff Ave to NB229	40	440	97.00%	0.00%	3.00%	0.00%	0.00%	427	0	13	0	0
OFFR from SB229 to Cliff Ave	40	220	97.00%	0.00%	3.00%	0.00%	0.00%	213	0	7	0	0
ONR from Cliff Ave to SB229	40	530	97.00%	0.00%	3.00%	0.00%	0.00%	514	0	16	0	0
OFFR from NB229 to 26th Street	40	465	97.00%	0.00%	3.00%	0.00%	0.00%	451	0	14	0	0
ONR from 26th Street to NB229	40	100	97.00%	0.00%	3.00%	0.00%	0.00%	97	0	3	0	0
OFFR from SB229 to 26th Street	40	255	97.00%	0.00%	3.00%	0.00%	0.00%	247	0	8	0	0
ONR from 26th Street to SB229	40	690	97.00%	0.00%	3.00%	0.00%	0.00%	669	0	21	0	0
OFFR from NB229 to 10th Street	40	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
ONR from 10th Street to NB229	40	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
OFFR from SB229 to 10th Street	40	465	94.00%	0.00%	6.00%	0.00%	0.00%	437	0	28	0	0
ONR from 10th Street to SB229	40	630	94.00%	0.00%	6.00%	0.00%	0.00%	592	0	38	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
OFFR from NB229 to Rice Street	40	265	94.00%	0.00%	6.00%	0.00%	0.00%	249	0	16	0	0
ONR from Rice Street to NB229	40	245	94.00%	0.00%	6.00%	0.00%	0.00%	230	0	15	0	0
OFFR from SB229 to Rice Street	40	140	94.00%	0.00%	6.00%	0.00%	0.00%	132	0	8	0	0
ONR from Rice Street to SB229	40	440	94.00%	0.00%	6.00%	0.00%	0.00%	414	0	26	0	0
OFFR from NB229 to Benson Street	40	1510	94.00%	0.00%	6.00%	0.00%	0.00%	1419	0	91	0	0
ONR from Benson Street to NB229	40	75	94.00%	0.00%	6.00%	0.00%	0.00%	71	0	5	0	0
OFFR from SB229 to Benson Street	40	115	94.00%	0.00%	6.00%	0.00%	0.00%	108	0	7	0	0
ONR from Benson Street to SB229	40	310	94.00%	0.00%	6.00%	0.00%	0.00%	291	0	19	0	0
OFFR from NB229 to EB90 Street	40	1	98.00%	0.00%	2.00%	0.00%	0.00%	1	0	0	0	0
ONR from EB90 to SB229	40	1	98.00%	0.00%	2.00%	0.00%	0.00%	1	0	0	0	0
EB60th from Cliff to Lewis	35	235	85.06%	10.95%	2.99%	1.00%	0.00%	200	26	7	2	0
EB60th from Lewis to east of I229	35	95	85.06%	10.95%	2.99%	1.00%	0.00%	81	10	3	1	0
WB60th east of I229 to Lewis	35	300	85.06%	10.95%	2.99%	1.00%	0.00%	255	33	9	3	0
WB60th Lewis to Cliff Ave	35	260	85.06%	10.95%	2.99%	1.00%	0.00%	221	28	8	3	0
60th Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
EBBenson to Cliff Ave (outside)	40	225	95.14%	2.62%	2.24%	0.00%	0.00%	214	6	5	0	0
EBBenson to Cliff Ave (inside)	40	225	95.14%	2.62%	2.24%	0.00%	0.00%	214	6	5	0	0
EBBenson Cliff to Lewis (outside)	40	238	95.14%	2.62%	2.24%	0.00%	0.00%	226	6	5	0	0
EBBenson Cliff to Lewis (inside)	40	238	95.14%	2.62%	2.24%	0.00%	0.00%	226	6	5	0	0
EBBenson Lewis to onR (outside)	40	195	95.14%	2.62%	2.24%	0.00%	0.00%	186	5	4	0	0
EBBenson Lewis to onR (inside)	40	195	95.14%	2.62%	2.24%	0.00%	0.00%	186	5	4	0	0
EBBenson onR to offR (outside)	40	50	95.14%	2.62%	2.24%	0.00%	0.00%	48	1	1	0	0
EBBenson onR to offR (inside)	40	50	95.14%	2.62%	2.24%	0.00%	0.00%	48	1	1	0	0
EBBenson offR to Hall (outside)	40	23	95.14%	2.62%	2.24%	0.00%	0.00%	21	1	1	0	0
EBBenson offR to Hall (inside)	40	23	95.14%	2.62%	2.24%	0.00%	0.00%	21	1	1	0	0
EBBenson offR to Hall	40	45	95.14%	2.62%	2.24%	0.00%	0.00%	43	1	1	0	0
EBBenson east of Hall	40	30	95.14%	2.62%	2.24%	0.00%	0.00%	29	1	1	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
WBBenson east of Hall	40	130	95.14%	2.62%	2.24%	0.00%	0.00%	124	3	3	0	0
WBBenson Hall to onR	40	130	95.14%	2.62%	2.24%	0.00%	0.00%	124	3	3	0	0
WBBenson Hall to onR (outside)	40	65	95.14%	2.62%	2.24%	0.00%	0.00%	62	2	1	0	0
WBBenson Hall to onR (inside)	40	65	95.14%	2.62%	2.24%	0.00%	0.00%	62	2	1	0	0
WBBenson onR to offR (outside)	40	813	95.14%	2.62%	2.24%	0.00%	0.00%	773	21	18	0	0
WBBenson onR to offR (inside)	40	813	95.14%	2.62%	2.24%	0.00%	0.00%	773	21	18	0	0
WBBenson offR to Lewis (outside)	40	560	95.14%	2.62%	2.24%	0.00%	0.00%	533	15	13	0	0
WBBenson offR to Lewis (inside)	40	560	95.14%	2.62%	2.24%	0.00%	0.00%	533	15	13	0	0
WBBenson Lewis to Cliff (outside)	40	478	95.14%	2.62%	2.24%	0.00%	0.00%	454	13	11	0	0
WBBenson Lewis to Cliff (inside)	40	478	95.14%	2.62%	2.24%	0.00%	0.00%	454	13	11	0	0
WBBenson west of Cliff (outside)	40	373	95.14%	2.62%	2.24%	0.00%	0.00%	354	10	8	0	0
WBBenson west of Cliff (inside)	40	373	95.14%	2.62%	2.24%	0.00%	0.00%	354	10	8	0	0
Benson Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
EBRice west of Wayland	35	255	94.00%	0.00%	6.00%	0.00%	0.00%	240	0	15	0	0
EBRice Wayland to on/off ramp (outside)	35	135	94.00%	0.00%	6.00%	0.00%	0.00%	127	0	8	0	0
EBRice Wayland to on/off ramp (inside)	35	135	94.00%	0.00%	6.00%	0.00%	0.00%	127	0	8	0	0
EBRice between ramps (outside)	35	138	94.00%	0.00%	6.00%	0.00%	0.00%	129	0	8	0	0
EBRice between ramps (inside)	35	138	94.00%	0.00%	6.00%	0.00%	0.00%	129	0	8	0	0
EBRice on/off ramp to Bahnson	45	240	94.00%	0.00%	6.00%	0.00%	0.00%	226	0	14	0	0
EBRice east of Bahnson	45	200	94.00%	0.00%	6.00%	0.00%	0.00%	188	0	12	0	0
WBRice east of Bahnson	45	690	94.00%	0.00%	6.00%	0.00%	0.00%	649	0	41	0	0
WBRice Bahnson to on/off ramp	45	735	94.00%	0.00%	6.00%	0.00%	0.00%	691	0	44	0	0
WBRice between ramps (outside)	35	530	94.00%	0.00%	6.00%	0.00%	0.00%	498	0	32	0	0
WBRice between ramps (inside)	35	530	94.00%	0.00%	6.00%	0.00%	0.00%	498	0	32	0	0
WBRice on/off ramp to Wayland (outside	35	375	94.00%	0.00%	6.00%	0.00%	0.00%	353	0	23	0	0
WBRice on/off ramp to Wayland (inside)	35	375	94.00%	0.00%	6.00%	0.00%	0.00%	353	0	23	0	0
WBRice west of Wayland	35	765	94.00%	0.00%	6.00%	0.00%	0.00%	719	0	46	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
Wayland Turning Lane (no traffic) - 1	--	--	--	--	--	--	--	--	--	--	--	--
Wayland Turning Lane (no traffic) - 2	--	--	--	--	--	--	--	--	--	--	--	--
Wayland Turning Lane (no traffic) - 3	--	--	--	--	--	--	--	--	--	--	--	--
EB6thSt west of Lowell	30	335	97.75%	1.50%	0.00%	0.75%	0.00%	327	5	0	3	0
EB6thSt Lowell to Cleveland	30	325	97.75%	1.50%	0.00%	0.75%	0.00%	318	5	0	2	0
EB6thSt Lowell to Cleveland (outside)	30	163	97.75%	1.50%	0.00%	0.75%	0.00%	159	2	0	1	0
EB6thSt Lowell to Cleveland (inside)	30	163	97.75%	1.50%	0.00%	0.75%	0.00%	159	2	0	1	0
EB6thSt east of Cleveland (outside)	35	180	97.75%	1.50%	0.00%	0.75%	0.00%	176	3	0	1	0
EB6thSt east of Cleveland (inside)	35	180	97.75%	1.50%	0.00%	0.75%	0.00%	176	3	0	1	0
WB6thSt east of Cleveland (outside)	35	373	97.75%	1.50%	0.00%	0.75%	0.00%	364	6	0	3	0
WB6thSt east of Cleveland (inside)	35	373	97.75%	1.50%	0.00%	0.75%	0.00%	364	6	0	3	0
WB6thSt Cleveland to Lowell (outside)	30	300	97.75%	1.50%	0.00%	0.75%	0.00%	293	5	0	2	0
WB6thSt Cleveland to Lowell (inside)	30	300	97.75%	1.50%	0.00%	0.75%	0.00%	293	5	0	2	0
WB6thSt Cleveland to Lowell	30	600	97.75%	1.50%	0.00%	0.75%	0.00%	587	9	0	5	0
WB6thSt west of Lowell	30	610	97.75%	1.50%	0.00%	0.75%	0.00%	596	9	0	5	0
6thSt Turning Lane (no traffic) - 1	--	--	--	--	--	--	--	--	--	--	--	--
6thSt Turning Lane (no traffic) - 2	--	--	--	--	--	--	--	--	--	--	--	--
EB10th west of Lowell (outside)	30	328	94.00%	0.00%	6.00%	0.00%	0.00%	308	0	20	0	0
EB10th west of Lowell (inside)	30	328	94.00%	0.00%	6.00%	0.00%	0.00%	308	0	20	0	0
EB10th Lowell to ramps (outside)	30	400	94.00%	0.00%	6.00%	0.00%	0.00%	376	0	24	0	0
EB10th Lowell to ramps (inside)	30	400	94.00%	0.00%	6.00%	0.00%	0.00%	376	0	24	0	0
EB10th between ramps (outside)	30	303	94.00%	0.00%	6.00%	0.00%	0.00%	284	0	18	0	0
EB10th between ramps (inside)	30	303	94.00%	0.00%	6.00%	0.00%	0.00%	284	0	18	0	0
EB10th ramps to Blaine (outside)	30	453	94.00%	0.00%	6.00%	0.00%	0.00%	425	0	27	0	0
EB10th ramps to Blaine (inside)	30	453	94.00%	0.00%	6.00%	0.00%	0.00%	425	0	27	0	0
EB10th Blaine to Cleveland (outside)	30	453	94.00%	0.00%	6.00%	0.00%	0.00%	425	0	27	0	0
EB10th Blaine to Cleveland (inside)	30	453	94.00%	0.00%	6.00%	0.00%	0.00%	425	0	27	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
EB10th Cleveland to Campbell (outside)	35	368	94.00%	0.00%	6.00%	0.00%	0.00%	345	0	22	0	0
EB10th Cleveland to Campbell (inside)	35	368	94.00%	0.00%	6.00%	0.00%	0.00%	345	0	22	0	0
EB10th Campbell to Bahnson (outside)	35	368	94.00%	0.00%	6.00%	0.00%	0.00%	345	0	22	0	0
EB10th Campbell to Bahnson (inside)	35	368	94.00%	0.00%	6.00%	0.00%	0.00%	345	0	22	0	0
EB10th Bahnson to Sycamore (outside)	35	368	94.00%	0.00%	6.00%	0.00%	0.00%	345	0	22	0	0
EB10th Bahnson to Sycamore (inside)	35	368	94.00%	0.00%	6.00%	0.00%	0.00%	345	0	22	0	0
EB10th east of Sycamore (outside)	35	368	94.00%	0.00%	6.00%	0.00%	0.00%	345	0	22	0	0
EB10th east of Sycamore (inside)	35	368	94.00%	0.00%	6.00%	0.00%	0.00%	345	0	22	0	0
WB10th east of Sycamore (outside)	35	603	94.00%	0.00%	6.00%	0.00%	0.00%	566	0	36	0	0
WB10th east of Sycamore (inside)	35	603	94.00%	0.00%	6.00%	0.00%	0.00%	566	0	36	0	0
WB10th Sycamore to Bahnson (outside)	35	603	94.00%	0.00%	6.00%	0.00%	0.00%	566	0	36	0	0
WB10th Sycamore to Bahnson (inside)	35	603	94.00%	0.00%	6.00%	0.00%	0.00%	566	0	36	0	0
WB10th Bahnson to Campbell (outside)	35	603	94.00%	0.00%	6.00%	0.00%	0.00%	566	0	36	0	0
WB10th Bahnson to Campbell (inside)	35	603	94.00%	0.00%	6.00%	0.00%	0.00%	566	0	36	0	0
WB10th Campbell to Cleveland (outside)	35	603	94.00%	0.00%	6.00%	0.00%	0.00%	566	0	36	0	0
WB10th Campbell to Cleveland (inside)	35	603	94.00%	0.00%	6.00%	0.00%	0.00%	566	0	36	0	0
WB10th Cleveland to Blaine (outside)	30	788	94.00%	0.00%	6.00%	0.00%	0.00%	740	0	47	0	0
WB10th Cleveland to Blaine (inside)	30	788	94.00%	0.00%	6.00%	0.00%	0.00%	740	0	47	0	0
WB10th Blaine to ramps (outside)	30	788	94.00%	0.00%	6.00%	0.00%	0.00%	740	0	47	0	0
WB10th Blaine to ramps (inside)	30	788	94.00%	0.00%	6.00%	0.00%	0.00%	740	0	47	0	0
WB10th between ramps (outside)	30	500	94.00%	0.00%	6.00%	0.00%	0.00%	470	0	30	0	0
WB10th between ramps (inside)	30	500	94.00%	0.00%	6.00%	0.00%	0.00%	470	0	30	0	0
WB10th ramps to Lowell (outside)	30	648	94.00%	0.00%	6.00%	0.00%	0.00%	609	0	39	0	0
WB10th ramps to Lowell (inside)	30	648	94.00%	0.00%	6.00%	0.00%	0.00%	609	0	39	0	0
WB10th west of Lowell (outside)	30	623	94.00%	0.00%	6.00%	0.00%	0.00%	585	0	37	0	0
WB10th west of Lowell (inside)	30	623	94.00%	0.00%	6.00%	0.00%	0.00%	585	0	37	0	0
10th Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
EB12th west of Lowell	30	135	99.50%	0.50%	0.00%	0.00%	0.00%	134	1	0	0	0
EB12th Lowell to Cleveland	30	125	99.50%	0.50%	0.00%	0.00%	0.00%	124	1	0	0	0
EB12th east of Cleveland	30	135	99.50%	0.50%	0.00%	0.00%	0.00%	134	1	0	0	0
WB12th east of Cleveland	30	315	99.50%	0.50%	0.00%	0.00%	0.00%	313	2	0	0	0
WB12th Cleveland to Lowell	30	345	99.50%	0.50%	0.00%	0.00%	0.00%	343	2	0	0	0
WB12th west of Lowell	30	345	99.50%	0.50%	0.00%	0.00%	0.00%	343	2	0	0	0
12th Street Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
EB18th west of Southeastern	35	180	97.50%	1.50%	0.00%	1.00%	0.00%	176	3	0	2	0
EB18th Southeastern to Cleveland	30	120	97.50%	1.50%	0.00%	1.00%	0.00%	117	2	0	1	0
EB18th east of Cleveland	30	105	97.50%	1.50%	0.00%	1.00%	0.00%	102	2	0	1	0
WB18th east of Cleveland	30	315	97.50%	1.50%	0.00%	1.00%	0.00%	307	5	0	3	0
WB18th Cleveland to Southeastern	30	355	97.50%	1.50%	0.00%	1.00%	0.00%	346	5	0	4	0
WB18th west of Southeastern	35	920	97.50%	1.50%	0.00%	1.00%	0.00%	897	14	0	9	0
18th Street Turning Lane (no traffic) - 1	--	--	--	--	--	--	--	--	--	--	--	--
18th Street Turning Lane (no traffic) - 2	--	--	--	--	--	--	--	--	--	--	--	--
SBSoutheastern north of 18th	30	70	97.00%	0.00%	3.00%	0.00%	0.00%	68	0	2	0	0
SBSoutheastern 18th to 26th	30	175	97.00%	0.00%	3.00%	0.00%	0.00%	170	0	5	0	0
SBSoutheastern 18th to 26th (outside)	35	88	97.00%	0.00%	3.00%	0.00%	0.00%	85	0	3	0	0
SBSoutheastern 18th to 26th (inside)	35	88	97.00%	0.00%	3.00%	0.00%	0.00%	85	0	3	0	0
SBSoutheastern south of 26th (outside)	35	128	97.00%	0.00%	3.00%	0.00%	0.00%	124	0	4	0	0
SBSoutheastern south of 26th (inside)	35	128	97.00%	0.00%	3.00%	0.00%	0.00%	124	0	4	0	0
NBSoutheastern south of 26th (outside)	35	540	97.00%	0.00%	3.00%	0.00%	0.00%	524	0	16	0	0
NBSoutheastern south of 26th (inside)	35	540	97.00%	0.00%	3.00%	0.00%	0.00%	524	0	16	0	0
NBSoutheastern 26th to 18th (outside)	30	360	97.00%	0.00%	3.00%	0.00%	0.00%	349	0	11	0	0
NBSoutheastern 26th to 18th (inside)	30	360	97.00%	0.00%	3.00%	0.00%	0.00%	349	0	11	0	0
NBSoutheastern 26th to 18th	30	720	97.00%	0.00%	3.00%	0.00%	0.00%	698	0	22	0	0
NBSoutheastern north of 18th	30	115	97.00%	0.00%	3.00%	0.00%	0.00%	112	0	3	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
Southeastern Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
EB26th west of Cliff	30	525	97.00%	0.00%	3.00%	0.00%	0.00%	509	0	16	0	0
EB26th Cliff to VanEps	30	465	97.00%	0.00%	3.00%	0.00%	0.00%	451	0	14	0	0
EB26th VanEps to Yeager	30	495	97.00%	0.00%	3.00%	0.00%	0.00%	480	0	15	0	0
EB26th Yeager to ramps (outside)	30	315	97.00%	0.00%	3.00%	0.00%	0.00%	306	0	9	0	0
EB26th Yeager to ramps (inside)	30	315	97.00%	0.00%	3.00%	0.00%	0.00%	306	0	9	0	0
EB26th ramps to Southeastern (outside)	30	453	97.00%	0.00%	3.00%	0.00%	0.00%	439	0	14	0	0
EB26th ramps to Southeastern (inside)	30	453	97.00%	0.00%	3.00%	0.00%	0.00%	439	0	14	0	0
EB26th east of Southeastern (outside)	30	433	97.00%	0.00%	3.00%	0.00%	0.00%	420	0	13	0	0
EB26th east of Southeastern (inside)	30	433	97.00%	0.00%	3.00%	0.00%	0.00%	420	0	13	0	0
WB26th east of Southeastern (outside)	30	758	97.00%	0.00%	3.00%	0.00%	0.00%	735	0	23	0	0
WB26th east of Southeastern (inside)	30	758	97.00%	0.00%	3.00%	0.00%	0.00%	735	0	23	0	0
WB26th Southeastern to ramps (outside	30	915	97.00%	0.00%	3.00%	0.00%	0.00%	888	0	27	0	0
WB26th Southeastern to ramps (inside)	30	915	97.00%	0.00%	3.00%	0.00%	0.00%	888	0	27	0	0
WB26th ramps to Yeager (outside)	30	783	97.00%	0.00%	3.00%	0.00%	0.00%	759	0	23	0	0
WB26th ramps to Yeager (inside)	30	783	97.00%	0.00%	3.00%	0.00%	0.00%	759	0	23	0	0
WB26th Yaeger to VanEps	30	845	97.00%	0.00%	3.00%	0.00%	0.00%	820	0	25	0	0
WB26th VanEps to Cliff	30	845	97.00%	0.00%	3.00%	0.00%	0.00%	820	0	25	0	0
WB26th west of Cliff	30	750	97.00%	0.00%	3.00%	0.00%	0.00%	728	0	23	0	0
WB26th Turning Lane (no traffic) - 1	--	--	--	--	--	--	--	--	--	--	--	--
WB26th Turning Lane (no traffic) - 2	--	--	--	--	--	--	--	--	--	--	--	--
SBYeagerRd 26th to ramps	35	880	99.50%	0.50%	0.00%	0.00%	0.00%	876	4	0	0	0
SBYeagerRd ramps to Cliff Ave	30	260	99.50%	0.50%	0.00%	0.00%	0.00%	259	1	0	0	0
NBYeagerRd Cliff Ave to ramps	30	105	99.50%	0.50%	0.00%	0.00%	0.00%	104	1	0	0	0
NBYeagerRd ramps to 26th St	35	295	99.50%	0.50%	0.00%	0.00%	0.00%	294	1	0	0	0
SBCliffAve 33rd to 41st (outside)	30	280	97.00%	0.00%	3.00%	0.00%	0.00%	272	0	8	0	0
SBCliffAve 33rd to 41st (inside)	30	280	97.00%	0.00%	3.00%	0.00%	0.00%	272	0	8	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBCliffAve 41st to onramp (outside)	30	370	97.00%	0.00%	3.00%	0.00%	0.00%	359	0	11	0	0
SBCliffAve 41st to onramp (inside)	30	370	97.00%	0.00%	3.00%	0.00%	0.00%	359	0	11	0	0
SBCliffAve onramp to offramp (outside)	30	270	97.00%	0.00%	3.00%	0.00%	0.00%	262	0	8	0	0
SBCliffAve onramp to offramp (inside)	30	270	97.00%	0.00%	3.00%	0.00%	0.00%	262	0	8	0	0
SBCliffAve offramp to 49th (outside)	30	278	97.00%	0.00%	3.00%	0.00%	0.00%	269	0	8	0	0
SBCliffAve offramp to 49th (inside)	30	278	97.00%	0.00%	3.00%	0.00%	0.00%	269	0	8	0	0
SBCliffAve south of 49th (outside)	30	215	97.00%	0.00%	3.00%	0.00%	0.00%	209	0	6	0	0
SBCliffAve south of 49th (inside)	30	215	97.00%	0.00%	3.00%	0.00%	0.00%	209	0	6	0	0
SBCliffAve south of 49th	30	430	97.00%	0.00%	3.00%	0.00%	0.00%	417	0	13	0	0
NBCliffAve south of 49th	30	1055	97.00%	0.00%	3.00%	0.00%	0.00%	1023	0	32	0	0
NBCliffAve south of 49th (outside)	30	528	97.00%	0.00%	3.00%	0.00%	0.00%	512	0	16	0	0
NBCliffAve south of 49th (inside)	30	528	97.00%	0.00%	3.00%	0.00%	0.00%	512	0	16	0	0
NBCliffAve 49th to onramp (outside)	30	833	97.00%	0.00%	3.00%	0.00%	0.00%	808	0	25	0	0
NBCliffAve 49th to onramp (inside)	30	833	97.00%	0.00%	3.00%	0.00%	0.00%	808	0	25	0	0
NBCliffAve onramp to onramp (outside)	30	845	97.00%	0.00%	3.00%	0.00%	0.00%	820	0	25	0	0
NBCliffAve onramp to onramp (inside)	30	845	97.00%	0.00%	3.00%	0.00%	0.00%	820	0	25	0	0
NBCliffAve onramp to 41st (outside)	30	683	97.00%	0.00%	3.00%	0.00%	0.00%	662	0	20	0	0
NBCliffAve onramp to 41st (inside)	30	683	97.00%	0.00%	3.00%	0.00%	0.00%	662	0	20	0	0
NBCliffAve 41st to 33rd (outside)	30	438	97.00%	0.00%	3.00%	0.00%	0.00%	424	0	13	0	0
NBCliffAve 41st to 33rd (inside)	30	438	97.00%	0.00%	3.00%	0.00%	0.00%	424	0	13	0	0
Cliff Ave Turn Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
SBMinnesota north of 41st (outside)	30	448	98.75%	1.00%	0.25%	0.00%	0.00%	442	4	1	0	0
SBMinnesota north of 41st (inside)	30	448	98.75%	1.00%	0.25%	0.00%	0.00%	442	4	1	0	0
SBMinnesota 41st to 49th (outside)	30	428	98.75%	1.00%	0.25%	0.00%	0.00%	422	4	1	0	0
SBMinnesota 41st to 49th (inside)	30	428	98.75%	1.00%	0.25%	0.00%	0.00%	422	4	1	0	0
SBMinnesota 49th to ramps (outside)	30	440	98.75%	1.00%	0.25%	0.00%	0.00%	435	4	1	0	0
SBMinnesota 49th to ramps (inside)	30	440	98.75%	1.00%	0.25%	0.00%	0.00%	435	4	1	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBMinnesota between ramps (outside)	30	368	98.75%	1.00%	0.25%	0.00%	0.00%	363	4	1	0	0
SBMinnesota between ramps (inside)	30	368	98.75%	1.00%	0.25%	0.00%	0.00%	363	4	1	0	0
SBMinnesota ramps to 57th (outside)	40	340	98.75%	1.00%	0.25%	0.00%	0.00%	336	3	1	0	0
SBMinnesota ramps to 57th (inside)	40	340	98.75%	1.00%	0.25%	0.00%	0.00%	336	3	1	0	0
SBMinnesota south of 57th (outside)	40	305	98.75%	1.00%	0.25%	0.00%	0.00%	301	3	1	0	0
SBMinnesota south of 57th (inside)	40	305	98.75%	1.00%	0.25%	0.00%	0.00%	301	3	1	0	0
NBMinnesota south of 57th (outside)	40	578	98.75%	1.00%	0.25%	0.00%	0.00%	570	6	1	0	0
NBMinnesota south of 57th (inside)	40	578	98.75%	1.00%	0.25%	0.00%	0.00%	570	6	1	0	0
NBMinnesota 57th to ramps (outside)	40	768	98.75%	1.00%	0.25%	0.00%	0.00%	758	8	2	0	0
NBMinnesota 57th to ramps (inside)	40	768	98.75%	1.00%	0.25%	0.00%	0.00%	758	8	2	0	0
NBMinnesota between ramps (outside)	30	850	98.75%	1.00%	0.25%	0.00%	0.00%	839	9	2	0	0
NBMinnesota between ramps (inside)	30	850	98.75%	1.00%	0.25%	0.00%	0.00%	839	9	2	0	0
NBMinnesota ramps to 49th (outside)	30	905	98.75%	1.00%	0.25%	0.00%	0.00%	894	9	2	0	0
NBMinnesota ramps to 49th (inside)	30	905	98.75%	1.00%	0.25%	0.00%	0.00%	894	9	2	0	0
NBMinnesota 49th to 41st (outside)	30	740	98.75%	1.00%	0.25%	0.00%	0.00%	731	7	2	0	0
NBMinnesota 49th to 41st (inside)	30	740	98.75%	1.00%	0.25%	0.00%	0.00%	731	7	2	0	0
NBMinnesota north of 41st (outside)	30	825	98.75%	1.00%	0.25%	0.00%	0.00%	815	8	2	0	0
NBMinnesota north of 41st (inside)	30	825	98.75%	1.00%	0.25%	0.00%	0.00%	815	8	2	0	0
Minnesota Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
SBWestern north of 49th (outside)	35	285	98.27%	0.86%	0.62%	0.25%	0.00%	280	2	2	1	0
SBWestern north of 49th (inside)	35	285	98.27%	0.86%	0.62%	0.25%	0.00%	280	2	2	1	0
SBWestern 49th to ramps (outside)	35	315	98.27%	0.86%	0.62%	0.25%	0.00%	310	3	2	1	0
SBWestern 49th to ramps (inside)	35	315	98.27%	0.86%	0.62%	0.25%	0.00%	310	3	2	1	0
SBWestern between ramps (outside)	35	423	98.27%	0.86%	0.62%	0.25%	0.00%	415	4	3	1	0
SBWestern between ramps (inside)	35	423	98.27%	0.86%	0.62%	0.25%	0.00%	415	4	3	1	0
SBWestern ramps to 57th (outside)	35	390	98.27%	0.86%	0.62%	0.25%	0.00%	383	3	2	1	0
SBWestern ramps to 57th (inside)	35	390	98.27%	0.86%	0.62%	0.25%	0.00%	383	3	2	1	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBWestern south of 57th (outside)	35	313	98.27%	0.86%	0.62%	0.25%	0.00%	307	3	2	1	0
SBWestern south of 57th (inside)	35	313	98.27%	0.86%	0.62%	0.25%	0.00%	307	3	2	1	0
SBWestern south of 57th	35	625	98.27%	0.86%	0.62%	0.25%	0.00%	614	5	4	2	0
NBWestern south of 57th	35	815	98.27%	0.86%	0.62%	0.25%	0.00%	801	7	5	2	0
NBWestern south of 57th (outside)	35	408	98.27%	0.86%	0.62%	0.25%	0.00%	400	4	3	1	0
NBWestern south of 57th (inside)	35	408	98.27%	0.86%	0.62%	0.25%	0.00%	400	4	3	1	0
NBWestern 57th to ramps (outside)	35	580	98.27%	0.86%	0.62%	0.25%	0.00%	570	5	4	1	0
NBWestern 57th to ramps (inside)	35	580	98.27%	0.86%	0.62%	0.25%	0.00%	570	5	4	1	0
NBWestern between ramps (outside)	35	513	98.27%	0.86%	0.62%	0.25%	0.00%	504	4	3	1	0
NBWestern between ramps (inside)	35	513	98.27%	0.86%	0.62%	0.25%	0.00%	504	4	3	1	0
NBWestern ramps to 49th (outside)	35	745	98.27%	0.86%	0.62%	0.25%	0.00%	732	6	5	2	0
NBWestern ramps to 49th (inside)	35	745	98.27%	0.86%	0.62%	0.25%	0.00%	732	6	5	2	0
NBWestern north of 49th (outside)	35	625	98.27%	0.86%	0.62%	0.25%	0.00%	614	5	4	2	0
NBWestern north of 49th (inside)	35	625	98.27%	0.86%	0.62%	0.25%	0.00%	614	5	4	2	0
Western Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
WB57th east of Western (outside)	40	418	98.00%	0.00%	2.00%	0.00%	0.00%	409	0	8	0	0
WB57th east of Western (inside)	40	418	98.00%	0.00%	2.00%	0.00%	0.00%	409	0	8	0	0
WB57th Western to Louise (outside)	40	453	98.00%	0.00%	2.00%	0.00%	0.00%	443	0	9	0	0
WB57th Western to Louise (inside)	40	453	98.00%	0.00%	2.00%	0.00%	0.00%	443	0	9	0	0
EB57th Louise to Western (outside)	40	398	98.00%	0.00%	2.00%	0.00%	0.00%	390	0	8	0	0
EB57th Louise to Western (inside)	40	398	98.00%	0.00%	2.00%	0.00%	0.00%	390	0	8	0	0
EB57th east of Western (outside)	40	265	98.00%	0.00%	2.00%	0.00%	0.00%	260	0	5	0	0
EB57th east of Western (inside)	40	265	98.00%	0.00%	2.00%	0.00%	0.00%	260	0	5	0	0
57th Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
SBLouise north of 57th (outside) 1	30	263	98.76%	0.99%	0.25%	0.00%	0.00%	259	3	1	0	0
SBLouise north of 57th (inside) 1	30	263	98.76%	0.99%	0.25%	0.00%	0.00%	259	3	1	0	0
SBLouise north of 57th (outside) 2	30	175	98.76%	0.99%	0.25%	0.00%	0.00%	173	2	0	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBLouise north of 57th (middle) 2	30	175	98.76%	0.99%	0.25%	0.00%	0.00%	173	2	0	0	0
SBLouise north of 57th (inside) 2	30	175	98.76%	0.99%	0.25%	0.00%	0.00%	173	2	0	0	0
SBLouise 57th to 59th (outside)	40	503	98.76%	0.99%	0.25%	0.00%	0.00%	496	5	1	0	0
SBLouise 57th to 59th (middle)	40	503	98.76%	0.99%	0.25%	0.00%	0.00%	496	5	1	0	0
SBLouise 59th to ramps (outside)	40	368	98.76%	0.99%	0.25%	0.00%	0.00%	364	4	1	0	0
SBLouise 59th to ramps (middle)	40	368	98.76%	0.99%	0.25%	0.00%	0.00%	364	4	1	0	0
SBLouise 59th to ramps (inside)	40	368	98.76%	0.99%	0.25%	0.00%	0.00%	364	4	1	0	0
SBLouise between ramps (outside)	40	378	98.76%	0.99%	0.25%	0.00%	0.00%	374	4	1	0	0
SBLouise between ramps (middle)	40	378	98.76%	0.99%	0.25%	0.00%	0.00%	374	4	1	0	0
SBLouise between ramps (inside)	40	378	98.76%	0.99%	0.25%	0.00%	0.00%	374	4	1	0	0
SBLouise ramps to 69th (outside)	40	358	98.76%	0.99%	0.25%	0.00%	0.00%	353	4	1	0	0
SBLouise ramps to 69th (inside)	40	358	98.76%	0.99%	0.25%	0.00%	0.00%	353	4	1	0	0
SBLouise south of 69th (outside)	40	165	98.76%	0.99%	0.25%	0.00%	0.00%	163	2	0	0	0
SBLouise south of 69th (inside)	40	165	98.76%	0.99%	0.25%	0.00%	0.00%	163	2	0	0	0
NBLouise south of 69th (outside)	40	543	98.76%	0.99%	0.25%	0.00%	0.00%	536	5	1	0	0
NBLouise south of 69th (inside)	40	543	98.76%	0.99%	0.25%	0.00%	0.00%	536	5	1	0	0
NBLouise 69th to ramps (outside)	40	725	98.76%	0.99%	0.25%	0.00%	0.00%	716	7	2	0	0
NBLouise 69th to ramps (inside)	40	725	98.76%	0.99%	0.25%	0.00%	0.00%	716	7	2	0	0
NBLouise between ramps (outside)	40	555	98.76%	0.99%	0.25%	0.00%	0.00%	548	5	1	0	0
NBLouise between ramps (inside)	40	555	98.76%	0.99%	0.25%	0.00%	0.00%	548	5	1	0	0
NBLouise ramps to 59th (outside)	40	725	98.76%	0.99%	0.25%	0.00%	0.00%	716	7	2	0	0
NBLouise ramps to 59th (inside)	40	725	98.76%	0.99%	0.25%	0.00%	0.00%	716	7	2	0	0
NBLouise 59th to 57th (outside)	40	630	98.76%	0.99%	0.25%	0.00%	0.00%	622	6	2	0	0
NBLouise 59th to 57th (inside)	30	630	98.76%	0.99%	0.25%	0.00%	0.00%	622	6	2	0	0
NBLouise north of 57th (outside)	30	420	98.76%	0.99%	0.25%	0.00%	0.00%	415	4	1	0	0
NBLouise north of 57th (inside)	30	420	98.76%	0.99%	0.25%	0.00%	0.00%	415	4	1	0	0
Louise Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					EXISTING (2012) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBSolberg north of 57th	30	195	99.27%	0.73%	0.00%	0.00%	0.00%	194	1	0	0	0
SBSolberg 57th to 69th (outside)	35	280	99.27%	0.73%	0.00%	0.00%	0.00%	278	2	0	0	0
SBSolberg 57th to 69th (inside)	35	280	99.27%	0.73%	0.00%	0.00%	0.00%	278	2	0	0	0
SBSolberg south of 69th (outside)	40	280	99.27%	0.73%	0.00%	0.00%	0.00%	278	2	0	0	0
SBSolberg south of 69th (inside)	40	280	99.27%	0.73%	0.00%	0.00%	0.00%	278	2	0	0	0
NBSolberg south of 69th (outside)	40	35	99.27%	0.73%	0.00%	0.00%	0.00%	35	0	0	0	0
NBSolberg south of 69th (inside)	40	35	99.27%	0.73%	0.00%	0.00%	0.00%	35	0	0	0	0
NBSolberg 69th to 57th (outside)	35	35	99.27%	0.73%	0.00%	0.00%	0.00%	35	0	0	0	0
NBSolberg 69th to 57th (inside)	35	35	99.27%	0.73%	0.00%	0.00%	0.00%	35	0	0	0	0
NBSolberg north of 57th	30	100	99.27%	0.73%	0.00%	0.00%	0.00%	99	1	0	0	0
Soberg Turning Lane (no traffic) 1	--	--	--	--	--	--	--	--	--	--	--	--
Soberg Turning Lane (no traffic) 2	--	--	--	--	--	--	--	--	--	--	--	--

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
NB229 Tallgrass2LouiseoffR (outside)	65	1055	89.61%	0.00%	10.39%	0.00%	0.00%	945	0	110	0	0
NB229 Tallgrass2LouiseoffR (inside)	65	1055	89.61%	0.00%	10.39%	0.00%	0.00%	945	0	110	0	0
NB229 LouiseoffR2LouiseonR (outside)	65	845	89.61%	0.00%	10.39%	0.00%	0.00%	757	0	88	0	0
NB229 LouiseoffR2LouiseonR (inside)	65	845	89.61%	0.00%	10.39%	0.00%	0.00%	757	0	88	0	0
NB229 LouiseonR2LouiseonR (outside)	65	763	89.61%	0.00%	10.39%	0.00%	0.00%	684	0	79	0	0
NB229 LouiseonR2LouiseonR (middle)	65	763	89.61%	0.00%	10.39%	0.00%	0.00%	684	0	79	0	0
NB229 LouiseonR2LouiseonR (inside)	65	763	89.61%	0.00%	10.39%	0.00%	0.00%	684	0	79	0	0
NB229 LouiseonR2WesternoffR (outside)	65	953	94.12%	0.00%	5.88%	0.00%	0.00%	897	0	56	0	0
NB229 LouiseonR2WesternoffR (middle)	65	953	94.12%	0.00%	5.88%	0.00%	0.00%	897	0	56	0	0
NB229 LouiseonR2WesternoffR (inside)	65	953	94.12%	0.00%	5.88%	0.00%	0.00%	897	0	56	0	0
NB229 btn Western ramps (outside)	65	1200	94.12%	0.00%	5.88%	0.00%	0.00%	1129	0	71	0	0
NB229 btn Western ramps (inside)	65	1200	94.12%	0.00%	5.88%	0.00%	0.00%	1129	0	71	0	0
NB229 WesternonR2MinnesotaoffR (out	65	1000	94.84%	0.00%	5.16%	0.00%	0.00%	948	0	52	0	0
NB229 WesternonR2MinnesotaoffR (mid	65	1000	94.84%	0.00%	5.16%	0.00%	0.00%	948	0	52	0	0
NB229 WesternonR2MinnesotaoffR (insi	65	1000	94.84%	0.00%	5.16%	0.00%	0.00%	948	0	52	0	0
NB229 btn Minnesota ramps (outside)	65	1240	94.84%	0.00%	5.16%	0.00%	0.00%	1176	0	64	0	0
NB229 btn Minnesota ramps (inside)	65	1240	94.84%	0.00%	5.16%	0.00%	0.00%	1176	0	64	0	0
NB229 MinnesotaonR2CliffoffR (outside)	65	990	95.07%	0.00%	4.93%	0.00%	0.00%	941	0	49	0	0
NB229 MinnesotaonR2CliffoffR (middle)	65	990	95.07%	0.00%	4.93%	0.00%	0.00%	941	0	49	0	0
NB229 MinnesotaonR2CliffoffR (inside)	65	990	95.07%	0.00%	4.93%	0.00%	0.00%	941	0	49	0	0
NB229 btn Cliff Ave ramps (outside)	65	1200	95.07%	0.00%	4.93%	0.00%	0.00%	1141	0	59	0	0
NB229 btn Cliff Ave ramps (inside)	65	1200	95.07%	0.00%	4.93%	0.00%	0.00%	1141	0	59	0	0
NB229 CliffonR2E26thoffR (outside)	65	973	93.71%	0.00%	6.29%	0.00%	0.00%	912	0	61	0	0
NB229 CliffonR2E26thoffR (middle)	65	973	93.71%	0.00%	6.29%	0.00%	0.00%	912	0	61	0	0
NB229 CliffonR2E26thoffR (inside)	65	973	93.71%	0.00%	6.29%	0.00%	0.00%	912	0	61	0	0
NB229 btn E26th ramps (outside)	65	1190	93.71%	0.00%	6.29%	0.00%	0.00%	1115	0	75	0	0
NB229 btn E26th ramps (inside)	65	1190	93.71%	0.00%	6.29%	0.00%	0.00%	1115	0	75	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
NB229 E26thonR210thStoffR (outside)	65	1475	91.33%	0.00%	8.67%	0.00%	0.00%	1347	0	128	0	0
NB229 E26thonR210thStoffR (inside)	65	1475	91.33%	0.00%	8.67%	0.00%	0.00%	1347	0	128	0	0
NB229 btn 10thSt ramps (outside)	65	1090	91.33%	0.00%	8.67%	0.00%	0.00%	995	0	95	0	0
NB229 btn 10thSt ramps (inside)	65	1090	91.33%	0.00%	8.67%	0.00%	0.00%	995	0	95	0	0
NB229 10thStonR2RiceoffR (outside)	65	930	91.54%	0.00%	8.46%	0.00%	0.00%	851	0	79	0	0
NB229 10thStonR2RiceoffR (middle)	65	930	91.54%	0.00%	8.46%	0.00%	0.00%	851	0	79	0	0
NB229 10thStonR2RiceoffR (inside)	65	930	91.54%	0.00%	8.46%	0.00%	0.00%	851	0	79	0	0
NB229 btn Rice St ramps (outside)	65	1195	91.54%	0.00%	8.46%	0.00%	0.00%	1094	0	101	0	0
NB229 btn Rice St ramps (inside)	65	1195	91.54%	0.00%	8.46%	0.00%	0.00%	1094	0	101	0	0
NB229 RiceonR2BensonoffR (outside)	65	987	93.28%	0.00%	6.72%	0.00%	0.00%	920	0	66	0	0
NB229 RiceonR2BensonoffR (middle)	65	987	93.28%	0.00%	6.72%	0.00%	0.00%	920	0	66	0	0
NB229 RiceonR2BensonoffR (inside)	65	987	93.28%	0.00%	6.72%	0.00%	0.00%	920	0	66	0	0
NB229 btn Benson Rd ramps (outside)	65	650	93.28%	0.00%	6.72%	0.00%	0.00%	606	0	44	0	0
NB229 btn Benson Rd ramps (inside)	65	650	93.28%	0.00%	6.72%	0.00%	0.00%	606	0	44	0	0
NB229 BensononR2I90offR (outside)	65	705	91.55%	0.00%	8.45%	0.00%	0.00%	645	0	60	0	0
NB229 BensononR2I90offR (inside)	65	705	91.55%	0.00%	8.45%	0.00%	0.00%	645	0	60	0	0
SB229 I90onR2BensonoffR (outside)	65	905	91.55%	0.00%	8.45%	0.00%	0.00%	829	0	76	0	0
SB229 I90onR2BensonoffR (inside)	65	905	91.55%	0.00%	8.45%	0.00%	0.00%	829	0	76	0	0
SB229 btn Benson ramps (outside)	65	795	91.55%	0.00%	8.45%	0.00%	0.00%	728	0	67	0	0
SB229 btn Benson ramps (inside)	65	795	91.55%	0.00%	8.45%	0.00%	0.00%	728	0	67	0	0
SB229 BensononR2RiceoffR (outside)	65	747	93.28%	0.00%	6.72%	0.00%	0.00%	696	0	50	0	0
SB229 BensononR2RiceoffR (middle)	65	747	93.28%	0.00%	6.72%	0.00%	0.00%	696	0	50	0	0
SB229 BensononR2RiceoffR (inside)	65	747	93.28%	0.00%	6.72%	0.00%	0.00%	696	0	50	0	0
SB229 btn Rice St ramps (outside)	65	1015	93.28%	0.00%	6.72%	0.00%	0.00%	947	0	68	0	0
SB229 btn Rice St ramps (inside)	65	1015	93.28%	0.00%	6.72%	0.00%	0.00%	947	0	68	0	0
SB229 RiceonR2E10thoffR (outside)	65	870	91.54%	0.00%	8.46%	0.00%	0.00%	796	0	74	0	0
SB229 RiceonR2E10thoffR (middle)	65	870	91.54%	0.00%	8.46%	0.00%	0.00%	796	0	74	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SB229 RiceonR2E10thoffR (inside)	65	870	91.54%	0.00%	8.46%	0.00%	0.00%	796	0	74	0	0
SB229 btn E10th ramps (outside)	65	1045	91.54%	0.00%	8.46%	0.00%	0.00%	957	0	88	0	0
SB229 btn E10th ramps (inside)	65	1045	91.54%	0.00%	8.46%	0.00%	0.00%	957	0	88	0	0
SB229 E10thonR2E26thoffR (outside)	65	1425	91.33%	0.00%	8.67%	0.00%	0.00%	1301	0	124	0	0
SB229 E10thonR2E26thoffR (inside)	65	1425	91.33%	0.00%	8.67%	0.00%	0.00%	1301	0	124	0	0
SB229 btn E26th ramps (outside)	65	1160	91.33%	0.00%	8.67%	0.00%	0.00%	1059	0	101	0	0
SB229 btn E26th ramps (inside)	65	1160	91.33%	0.00%	8.67%	0.00%	0.00%	1059	0	101	0	0
SB229 E26thonR2CliffoffR (outside)	65	1037	93.71%	0.00%	6.29%	0.00%	0.00%	971	0	65	0	0
SB229 E26thonR2CliffoffR (middle)	65	1037	93.71%	0.00%	6.29%	0.00%	0.00%	971	0	65	0	0
SB229 E26thonR2CliffoffR (inside)	65	1037	93.71%	0.00%	6.29%	0.00%	0.00%	971	0	65	0	0
SB229 btn Cliff Ave ramps (outside)	65	1340	93.71%	0.00%	6.29%	0.00%	0.00%	1256	0	84	0	0
SB229 btn Cliff Ave ramps (inside)	65	1340	93.71%	0.00%	6.29%	0.00%	0.00%	1256	0	84	0	0
SB229 CliffonR2MinnesotaoffR (outside)	65	1083	95.07%	0.00%	4.93%	0.00%	0.00%	1030	0	53	0	0
SB229 CliffonR2MinnesotaoffR (middle)	65	1083	95.07%	0.00%	4.93%	0.00%	0.00%	1030	0	53	0	0
SB229 CliffonR2MinnesotaoffR (inside)	65	1083	95.07%	0.00%	4.93%	0.00%	0.00%	1030	0	53	0	0
SB229 btn Minnesota ramps (outside)	65	1390	95.07%	0.00%	4.93%	0.00%	0.00%	1321	0	69	0	0
SB229 btn Minnesota ramps (inside)	65	1390	95.07%	0.00%	4.93%	0.00%	0.00%	1321	0	69	0	0
SB229 MinnesotaonR2WesternoffR (out	65	1067	94.84%	0.00%	5.16%	0.00%	0.00%	1012	0	55	0	0
SB229 MinnesotaonR2WesternoffR (mid	65	1067	94.84%	0.00%	5.16%	0.00%	0.00%	1012	0	55	0	0
SB229 MinnesotaonR2WesternoffR (insi	65	1067	94.84%	0.00%	5.16%	0.00%	0.00%	1012	0	55	0	0
SB229 btn Western Ave ramps (outside)	65	1165	94.84%	0.00%	5.16%	0.00%	0.00%	1105	0	60	0	0
SB229 btn Western Ave ramps (inside)	65	1165	94.84%	0.00%	5.16%	0.00%	0.00%	1105	0	60	0	0
SB229 WesternonR2LouiseoffR (outside	65	853	94.12%	0.00%	5.88%	0.00%	0.00%	803	0	50	0	0
SB229 WesternonR2LouiseoffR (middle)	65	853	94.12%	0.00%	5.88%	0.00%	0.00%	803	0	50	0	0
SB229 WesternonR2LouiseoffR (inside)	65	853	94.12%	0.00%	5.88%	0.00%	0.00%	803	0	50	0	0
SB229 btn Louise Ave ramps (outside)	65	710	94.12%	0.00%	5.88%	0.00%	0.00%	668	0	42	0	0
SB229 btn Louise Ave ramps (inside)	65	710	94.12%	0.00%	5.88%	0.00%	0.00%	668	0	42	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SB229 LouiseonR2I29offR (outside)	65	925	89.61%	0.00%	10.39%	0.00%	0.00%	829	0	96	0	0
SB229 LouiseonR2I29offR (inside)	65	925	89.61%	0.00%	10.39%	0.00%	0.00%	829	0	96	0	0
OFFR from NB229 to LouiseAve	40	420	98.00%	0.00%	2.00%	0.00%	0.00%	412	0	8	0	0
ONR from NBLouiseAve to NB229	40	570	98.00%	0.00%	2.00%	0.00%	0.00%	559	0	11	0	0
OFFR from SB229 to LouiseAve	40	1140	98.00%	0.00%	2.00%	0.00%	0.00%	1117	0	23	0	0
ONR from LouiseAve to SB229	40	430	98.00%	0.00%	2.00%	0.00%	0.00%	421	0	9	0	0
ONR from SBLouiseAve to NB229	40	600	98.00%	0.00%	2.00%	0.00%	0.00%	588	0	12	0	0
OFFR from NB229 to Western Ave	40	460	98.00%	0.00%	2.00%	0.00%	0.00%	451	0	9	0	0
ONR from Western Ave to NB229	40	600	98.00%	0.00%	2.00%	0.00%	0.00%	588	0	12	0	0
OFFR from SB229 to Western Ave	40	870	98.00%	0.00%	2.00%	0.00%	0.00%	853	0	17	0	0
ONR from Western Ave to SB229	40	230	98.00%	0.00%	2.00%	0.00%	0.00%	225	0	5	0	0
OFFR from NB229 to Minnesota Ave	40	520	97.00%	0.00%	3.00%	0.00%	0.00%	504	0	16	0	0
ONR from Minnesota Ave to NB229	40	490	97.00%	0.00%	3.00%	0.00%	0.00%	475	0	15	0	0
OFFR from SB229 to Minnesota Ave	40	470	97.00%	0.00%	3.00%	0.00%	0.00%	456	0	14	0	0
ONR from Minnesota Ave to SB229	40	420	97.00%	0.00%	3.00%	0.00%	0.00%	407	0	13	0	0
OFFR from NB229 to Cliff Ave	40	570	97.00%	0.00%	3.00%	0.00%	0.00%	553	0	17	0	0
ONR from Cliff Ave to NB229	40	520	97.00%	0.00%	3.00%	0.00%	0.00%	504	0	16	0	0
OFFR from SB229 to Cliff Ave	40	430	97.00%	0.00%	3.00%	0.00%	0.00%	417	0	13	0	0
ONR from Cliff Ave to SB229	40	570	97.00%	0.00%	3.00%	0.00%	0.00%	553	0	17	0	0
OFFR from NB229 to 26th Street	40	540	97.00%	0.00%	3.00%	0.00%	0.00%	524	0	16	0	0
ONR from 26th Street to NB229	40	570	97.00%	0.00%	3.00%	0.00%	0.00%	553	0	17	0	0
OFFR from SB229 to 26th Street	40	530	97.00%	0.00%	3.00%	0.00%	0.00%	514	0	16	0	0
ONR from 26th Street to SB229	40	790	97.00%	0.00%	3.00%	0.00%	0.00%	766	0	24	0	0
OFFR from NB229 to 10th Street	40	770	94.00%	0.00%	6.00%	0.00%	0.00%	724	0	46	0	0
ONR from 10th Street to NB229	40	610	94.00%	0.00%	6.00%	0.00%	0.00%	573	0	37	0	0
OFFR from SB229 to 10th Street	40	520	94.00%	0.00%	6.00%	0.00%	0.00%	489	0	31	0	0
ONR from 10th Street to SB229	40	760	94.00%	0.00%	6.00%	0.00%	0.00%	714	0	46	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
OFFR from NB229 to Rice Street	40	400	94.00%	0.00%	6.00%	0.00%	0.00%	376	0	24	0	0
ONR from Rice Street to NB229	40	570	94.00%	0.00%	6.00%	0.00%	0.00%	536	0	34	0	0
OFFR from SB229 to Rice Street	40	210	94.00%	0.00%	6.00%	0.00%	0.00%	197	0	13	0	0
ONR from Rice Street to SB229	40	580	94.00%	0.00%	6.00%	0.00%	0.00%	545	0	35	0	0
OFFR from NB229 to Benson Street	40	1660	94.00%	0.00%	6.00%	0.00%	0.00%	1560	0	100	0	0
ONR from Benson Street to NB229	40	110	94.00%	0.00%	6.00%	0.00%	0.00%	103	0	7	0	0
OFFR from SB229 to Benson Street	40	220	94.00%	0.00%	6.00%	0.00%	0.00%	207	0	13	0	0
ONR from Benson Street to SB229	40	650	94.00%	0.00%	6.00%	0.00%	0.00%	611	0	39	0	0
OFFR from NB229 to EB90 Street	40	1	98.00%	0.00%	2.00%	0.00%	0.00%	1	0	0	0	0
ONR from EB90 to SB229	40	1	98.00%	0.00%	2.00%	0.00%	0.00%	1	0	0	0	0
EB60th from Cliff to Lewis	35	740	85.06%	10.95%	2.99%	1.00%	0.00%	629	81	22	7	0
EB60th from Lewis to east of I229	35	530	85.06%	10.95%	2.99%	1.00%	0.00%	451	58	16	5	0
WB60th east of I229 to Lewis	35	1590	85.06%	10.95%	2.99%	1.00%	0.00%	1352	174	48	16	0
WB60th Lewis to Cliff Ave	35	1560	85.06%	10.95%	2.99%	1.00%	0.00%	1327	171	47	16	0
60th Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
EBBenson to Cliff Ave (outside)	40	355	95.14%	2.62%	2.24%	0.00%	0.00%	338	9	8	0	0
EBBenson to Cliff Ave (inside)	40	355	95.14%	2.62%	2.24%	0.00%	0.00%	338	9	8	0	0
EBBenson Cliff to Lewis (outside)	40	455	95.14%	2.62%	2.24%	0.00%	0.00%	433	12	10	0	0
EBBenson Cliff to Lewis (inside)	40	455	95.14%	2.62%	2.24%	0.00%	0.00%	433	12	10	0	0
EBBenson Lewis to onR (outside)	40	420	95.14%	2.62%	2.24%	0.00%	0.00%	400	11	9	0	0
EBBenson Lewis to onR (inside)	40	420	95.14%	2.62%	2.24%	0.00%	0.00%	400	11	9	0	0
EBBenson onR to offR (outside)	40	275	95.14%	2.62%	2.24%	0.00%	0.00%	262	7	6	0	0
EBBenson onR to offR (inside)	40	275	95.14%	2.62%	2.24%	0.00%	0.00%	262	7	6	0	0
EBBenson offR to Hall (outside)	40	275	95.14%	2.62%	2.24%	0.00%	0.00%	262	7	6	0	0
EBBenson offR to Hall (inside)	40	275	95.14%	2.62%	2.24%	0.00%	0.00%	262	7	6	0	0
EBBenson offR to Hall	40	550	95.14%	2.62%	2.24%	0.00%	0.00%	523	14	12	0	0
EBBenson east of Hall	40	490	95.14%	2.62%	2.24%	0.00%	0.00%	466	13	11	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
WBBenson east of Hall	40	1400	95.14%	2.62%	2.24%	0.00%	0.00%	1332	37	31	0	0
WBBenson Hall to onR	40	1400	95.14%	2.62%	2.24%	0.00%	0.00%	1332	37	31	0	0
WBBenson Hall to onR (outside)	40	690	95.14%	2.62%	2.24%	0.00%	0.00%	656	18	15	0	0
WBBenson Hall to onR (inside)	40	690	95.14%	2.62%	2.24%	0.00%	0.00%	656	18	15	0	0
WBBenson onR to offR (outside)	40	1465	95.14%	2.62%	2.24%	0.00%	0.00%	1394	38	33	0	0
WBBenson onR to offR (inside)	40	1465	95.14%	2.62%	2.24%	0.00%	0.00%	1394	38	33	0	0
WBBenson offR to Lewis (outside)	40	950	95.14%	2.62%	2.24%	0.00%	0.00%	904	25	21	0	0
WBBenson offR to Lewis (inside)	40	950	95.14%	2.62%	2.24%	0.00%	0.00%	904	25	21	0	0
WBBenson Lewis to Cliff (outside)	40	825	95.14%	2.62%	2.24%	0.00%	0.00%	785	22	18	0	0
WBBenson Lewis to Cliff (inside)	40	825	95.14%	2.62%	2.24%	0.00%	0.00%	785	22	18	0	0
WBBenson west of Cliff (outside)	40	790	95.14%	2.62%	2.24%	0.00%	0.00%	752	21	18	0	0
WBBenson west of Cliff (inside)	40	790	95.14%	2.62%	2.24%	0.00%	0.00%	752	21	18	0	0
Benson Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
EBRice west of Wayland	35	620	94.00%	0.00%	6.00%	0.00%	0.00%	583	0	37	0	0
EBRice Wayland to on/off ramp (outside)	35	345	94.00%	0.00%	6.00%	0.00%	0.00%	324	0	21	0	0
EBRice Wayland to on/off ramp (inside)	35	345	94.00%	0.00%	6.00%	0.00%	0.00%	324	0	21	0	0
EBRice between ramps (outside)	35	355	94.00%	0.00%	6.00%	0.00%	0.00%	334	0	21	0	0
EBRice between ramps (inside)	35	355	94.00%	0.00%	6.00%	0.00%	0.00%	334	0	21	0	0
EBRice on/off ramp to Bahnson	45	1010	94.00%	0.00%	6.00%	0.00%	0.00%	949	0	61	0	0
EBRice east of Bahnson	45	800	94.00%	0.00%	6.00%	0.00%	0.00%	752	0	48	0	0
WBRice east of Bahnson	45	1690	94.00%	0.00%	6.00%	0.00%	0.00%	1589	0	101	0	0
WBRice Bahnson to on/off ramp	45	1680	94.00%	0.00%	6.00%	0.00%	0.00%	1579	0	101	0	0
WBRice between ramps (outside)	35	920	94.00%	0.00%	6.00%	0.00%	0.00%	865	0	55	0	0
WBRice between ramps (inside)	35	920	94.00%	0.00%	6.00%	0.00%	0.00%	865	0	55	0	0
WBRice on/off ramp to Wayland (outside	35	725	94.00%	0.00%	6.00%	0.00%	0.00%	682	0	44	0	0
WBRice on/off ramp to Wayland (inside)	35	725	94.00%	0.00%	6.00%	0.00%	0.00%	682	0	44	0	0
WBRice west of Wayland	35	1420	94.00%	0.00%	6.00%	0.00%	0.00%	1335	0	85	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
Wayland Turning Lane (no traffic) - 1	--	--	--	--	--	--	--	--	--	--	--	--
Wayland Turning Lane (no traffic) - 2	--	--	--	--	--	--	--	--	--	--	--	--
Wayland Turning Lane (no traffic) - 3	--	--	--	--	--	--	--	--	--	--	--	--
EB6thSt west of Lowell	30	360	97.75%	1.50%	0.00%	0.75%	0.00%	352	5	0	3	0
EB6thSt Lowell to Cleveland	30	420	97.75%	1.50%	0.00%	0.75%	0.00%	411	6	0	3	0
EB6thSt Lowell to Cleveland (outside)	30	210	97.75%	1.50%	0.00%	0.75%	0.00%	205	3	0	2	0
EB6thSt Lowell to Cleveland (inside)	30	210	97.75%	1.50%	0.00%	0.75%	0.00%	205	3	0	2	0
EB6thSt east of Cleveland (outside)	35	275	97.75%	1.50%	0.00%	0.75%	0.00%	269	4	0	2	0
EB6thSt east of Cleveland (inside)	35	275	97.75%	1.50%	0.00%	0.75%	0.00%	269	4	0	2	0
WB6thSt east of Cleveland (outside)	35	515	97.75%	1.50%	0.00%	0.75%	0.00%	503	8	0	4	0
WB6thSt east of Cleveland (inside)	35	515	97.75%	1.50%	0.00%	0.75%	0.00%	503	8	0	4	0
WB6thSt Cleveland to Lowell (outside)	30	375	97.75%	1.50%	0.00%	0.75%	0.00%	367	6	0	3	0
WB6thSt Cleveland to Lowell (inside)	30	375	97.75%	1.50%	0.00%	0.75%	0.00%	367	6	0	3	0
WB6thSt Cleveland to Lowell	30	750	97.75%	1.50%	0.00%	0.75%	0.00%	733	11	0	6	0
WB6thSt west of Lowell	30	660	97.75%	1.50%	0.00%	0.75%	0.00%	645	10	0	5	0
6thSt Turning Lane (no traffic) - 1	--	--	--	--	--	--	--	--	--	--	--	--
6thSt Turning Lane (no traffic) - 2	--	--	--	--	--	--	--	--	--	--	--	--
EB10th west of Lowell (outside)	30	405	94.00%	0.00%	6.00%	0.00%	0.00%	381	0	24	0	0
EB10th west of Lowell (inside)	30	405	94.00%	0.00%	6.00%	0.00%	0.00%	381	0	24	0	0
EB10th Lowell to ramps (outside)	30	470	94.00%	0.00%	6.00%	0.00%	0.00%	442	0	28	0	0
EB10th Lowell to ramps (inside)	30	470	94.00%	0.00%	6.00%	0.00%	0.00%	442	0	28	0	0
EB10th between ramps (outside)	30	360	94.00%	0.00%	6.00%	0.00%	0.00%	338	0	22	0	0
EB10th between ramps (inside)	30	360	94.00%	0.00%	6.00%	0.00%	0.00%	338	0	22	0	0
EB10th ramps to Blaine (outside)	30	610	94.00%	0.00%	6.00%	0.00%	0.00%	573	0	37	0	0
EB10th ramps to Blaine (inside)	30	610	94.00%	0.00%	6.00%	0.00%	0.00%	573	0	37	0	0
EB10th Blaine to Cleveland (outside)	30	610	94.00%	0.00%	6.00%	0.00%	0.00%	573	0	37	0	0
EB10th Blaine to Cleveland (inside)	30	610	94.00%	0.00%	6.00%	0.00%	0.00%	573	0	37	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
EB10th Cleveland to Campbell (outside)	35	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
EB10th Cleveland to Campbell (inside)	35	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
EB10th Campbell to Bahnson (outside)	35	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
EB10th Campbell to Bahnson (inside)	35	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
EB10th Bahnson to Sycamore (outside)	35	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
EB10th Bahnson to Sycamore (inside)	35	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
EB10th east of Sycamore (outside)	35	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
EB10th east of Sycamore (inside)	35	565	94.00%	0.00%	6.00%	0.00%	0.00%	531	0	34	0	0
WB10th east of Sycamore (outside)	35	850	94.00%	0.00%	6.00%	0.00%	0.00%	799	0	51	0	0
WB10th east of Sycamore (inside)	35	850	94.00%	0.00%	6.00%	0.00%	0.00%	799	0	51	0	0
WB10th Sycamore to Bahnson (outside)	35	850	94.00%	0.00%	6.00%	0.00%	0.00%	799	0	51	0	0
WB10th Sycamore to Bahnson (inside)	35	850	94.00%	0.00%	6.00%	0.00%	0.00%	799	0	51	0	0
WB10th Bahnson to Campbell (outside)	35	850	94.00%	0.00%	6.00%	0.00%	0.00%	799	0	51	0	0
WB10th Bahnson to Campbell (inside)	35	850	94.00%	0.00%	6.00%	0.00%	0.00%	799	0	51	0	0
WB10th Campbell to Cleveland (outside)	35	850	94.00%	0.00%	6.00%	0.00%	0.00%	799	0	51	0	0
WB10th Campbell to Cleveland (inside)	35	850	94.00%	0.00%	6.00%	0.00%	0.00%	799	0	51	0	0
WB10th Cleveland to Blaine (outside)	30	975	94.00%	0.00%	6.00%	0.00%	0.00%	917	0	59	0	0
WB10th Cleveland to Blaine (inside)	30	975	94.00%	0.00%	6.00%	0.00%	0.00%	917	0	59	0	0
WB10th Blaine to ramps (outside)	30	975	94.00%	0.00%	6.00%	0.00%	0.00%	917	0	59	0	0
WB10th Blaine to ramps (inside)	30	975	94.00%	0.00%	6.00%	0.00%	0.00%	917	0	59	0	0
WB10th between ramps (outside)	30	650	94.00%	0.00%	6.00%	0.00%	0.00%	611	0	39	0	0
WB10th between ramps (inside)	30	650	94.00%	0.00%	6.00%	0.00%	0.00%	611	0	39	0	0
WB10th ramps to Lowell (outside)	30	830	94.00%	0.00%	6.00%	0.00%	0.00%	780	0	50	0	0
WB10th ramps to Lowell (inside)	30	830	94.00%	0.00%	6.00%	0.00%	0.00%	780	0	50	0	0
WB10th west of Lowell (outside)	30	775	94.00%	0.00%	6.00%	0.00%	0.00%	729	0	47	0	0
WB10th west of Lowell (inside)	30	775	94.00%	0.00%	6.00%	0.00%	0.00%	729	0	47	0	0
10th Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
EB12th west of Lowell	30	270	99.50%	0.50%	0.00%	0.00%	0.00%	269	1	0	0	0
EB12th Lowell to Cleveland	30	270	99.50%	0.50%	0.00%	0.00%	0.00%	269	1	0	0	0
EB12th east of Cleveland	30	220	99.50%	0.50%	0.00%	0.00%	0.00%	219	1	0	0	0
WB12th east of Cleveland	30	490	99.50%	0.50%	0.00%	0.00%	0.00%	488	2	0	0	0
WB12th Cleveland to Lowell	30	670	99.50%	0.50%	0.00%	0.00%	0.00%	667	3	0	0	0
WB12th west of Lowell	30	650	99.50%	0.50%	0.00%	0.00%	0.00%	647	3	0	0	0
12th Street Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
EB18th west of Southeastern	35	360	97.50%	1.50%	0.00%	1.00%	0.00%	351	5	0	4	0
EB18th Southeastern to Cleveland	30	240	97.50%	1.50%	0.00%	1.00%	0.00%	234	4	0	2	0
EB18th east of Cleveland	30	200	97.50%	1.50%	0.00%	1.00%	0.00%	195	3	0	2	0
WB18th east of Cleveland	30	400	97.50%	1.50%	0.00%	1.00%	0.00%	390	6	0	4	0
WB18th Cleveland to Southeastern	30	430	97.50%	1.50%	0.00%	1.00%	0.00%	419	6	0	4	0
WB18th west of Southeastern	35	1610	97.50%	1.50%	0.00%	1.00%	0.00%	1570	24	0	16	0
18th Street Turning Lane (no traffic) - 1	--	--	--	--	--	--	--	--	--	--	--	--
18th Street Turning Lane (no traffic) - 2	--	--	--	--	--	--	--	--	--	--	--	--
SBSoutheastern north of 18th	30	110	97.00%	0.00%	3.00%	0.00%	0.00%	107	0	3	0	0
SBSoutheastern 18th to 26th	30	300	97.00%	0.00%	3.00%	0.00%	0.00%	291	0	9	0	0
SBSoutheastern 18th to 26th (outside)	35	150	97.00%	0.00%	3.00%	0.00%	0.00%	146	0	5	0	0
SBSoutheastern 18th to 26th (inside)	35	150	97.00%	0.00%	3.00%	0.00%	0.00%	146	0	5	0	0
SBSoutheastern south of 26th (outside)	35	170	97.00%	0.00%	3.00%	0.00%	0.00%	165	0	5	0	0
SBSoutheastern south of 26th (inside)	35	170	97.00%	0.00%	3.00%	0.00%	0.00%	165	0	5	0	0
NBSoutheastern south of 26th (outside)	35	1120	97.00%	0.00%	3.00%	0.00%	0.00%	1086	0	34	0	0
NBSoutheastern south of 26th (inside)	35	1120	97.00%	0.00%	3.00%	0.00%	0.00%	1086	0	34	0	0
NBSoutheastern 26th to 18th (outside)	30	725	97.00%	0.00%	3.00%	0.00%	0.00%	703	0	22	0	0
NBSoutheastern 26th to 18th (inside)	30	725	97.00%	0.00%	3.00%	0.00%	0.00%	703	0	22	0	0
NBSoutheastern 26th to 18th	30	1450	97.00%	0.00%	3.00%	0.00%	0.00%	1407	0	44	0	0
NBSoutheastern north of 18th	30	200	97.00%	0.00%	3.00%	0.00%	0.00%	194	0	6	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
Southeastern Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
EB26th west of Cliff	30	500	97.00%	0.00%	3.00%	0.00%	0.00%	485	0	15	0	0
EB26th Cliff to VanEps	30	440	97.00%	0.00%	3.00%	0.00%	0.00%	427	0	13	0	0
EB26th VanEps to Yeager	30	480	97.00%	0.00%	3.00%	0.00%	0.00%	466	0	14	0	0
EB26th Yeager to ramps (outside)	30	263	97.00%	0.00%	3.00%	0.00%	0.00%	255	0	8	0	0
EB26th Yeager to ramps (inside)	30	263	97.00%	0.00%	3.00%	0.00%	0.00%	255	0	8	0	0
EB26th ramps to Southeastern (outside)	30	495	97.00%	0.00%	3.00%	0.00%	0.00%	480	0	15	0	0
EB26th ramps to Southeastern (inside)	30	495	97.00%	0.00%	3.00%	0.00%	0.00%	480	0	15	0	0
EB26th east of Southeastern (outside)	30	525	97.00%	0.00%	3.00%	0.00%	0.00%	509	0	16	0	0
EB26th east of Southeastern (inside)	30	525	97.00%	0.00%	3.00%	0.00%	0.00%	509	0	16	0	0
WB26th east of Southeastern (outside)	30	745	97.00%	0.00%	3.00%	0.00%	0.00%	723	0	22	0	0
WB26th east of Southeastern (inside)	30	745	97.00%	0.00%	3.00%	0.00%	0.00%	723	0	22	0	0
WB26th Southeastern to ramps (outside	30	1090	97.00%	0.00%	3.00%	0.00%	0.00%	1057	0	33	0	0
WB26th Southeastern to ramps (inside)	30	1090	97.00%	0.00%	3.00%	0.00%	0.00%	1057	0	33	0	0
WB26th ramps to Yeager (outside)	30	713	97.00%	0.00%	3.00%	0.00%	0.00%	691	0	21	0	0
WB26th ramps to Yeager (inside)	30	713	97.00%	0.00%	3.00%	0.00%	0.00%	691	0	21	0	0
WB26th Yaeger to VanEps	30	1150	97.00%	0.00%	3.00%	0.00%	0.00%	1116	0	35	0	0
WB26th VanEps to Cliff	30	1160	97.00%	0.00%	3.00%	0.00%	0.00%	1125	0	35	0	0
WB26th west of Cliff	30	970	97.00%	0.00%	3.00%	0.00%	0.00%	941	0	29	0	0
WB26th Turning Lane (no traffic) - 1	--	--	--	--	--	--	--	--	--	--	--	--
WB26th Turning Lane (no traffic) - 2	--	--	--	--	--	--	--	--	--	--	--	--
SBYeagerRd 26th to ramps	35	325	99.50%	0.50%	0.00%	0.00%	0.00%	323	2	0	0	0
SBYeagerRd ramps to Cliff Ave	30	325	99.50%	0.50%	0.00%	0.00%	0.00%	323	2	0	0	0
NBYeagerRd Cliff Ave to ramps	30	95	99.50%	0.50%	0.00%	0.00%	0.00%	95	0	0	0	0
NBYeagerRd ramps to 26th St	35	95	99.50%	0.50%	0.00%	0.00%	0.00%	95	0	0	0	0
SBCliffAve 33rd to 41st (outside)	30	400	97.00%	0.00%	3.00%	0.00%	0.00%	388	0	12	0	0
SBCliffAve 33rd to 41st (inside)	30	400	97.00%	0.00%	3.00%	0.00%	0.00%	388	0	12	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBCliffAve 41st to onramp (outside)	30	580	97.00%	0.00%	3.00%	0.00%	0.00%	563	0	17	0	0
SBCliffAve 41st to onramp (inside)	30	580	97.00%	0.00%	3.00%	0.00%	0.00%	563	0	17	0	0
SBCliffAve onramp to offramp (outside)	30	470	97.00%	0.00%	3.00%	0.00%	0.00%	456	0	14	0	0
SBCliffAve onramp to offramp (inside)	30	470	97.00%	0.00%	3.00%	0.00%	0.00%	456	0	14	0	0
SBCliffAve offramp to 49th (outside)	30	485	97.00%	0.00%	3.00%	0.00%	0.00%	470	0	15	0	0
SBCliffAve offramp to 49th (inside)	30	485	97.00%	0.00%	3.00%	0.00%	0.00%	470	0	15	0	0
SBCliffAve south of 49th (outside)	30	410	97.00%	0.00%	3.00%	0.00%	0.00%	398	0	12	0	0
SBCliffAve south of 49th (inside)	30	410	97.00%	0.00%	3.00%	0.00%	0.00%	398	0	12	0	0
SBCliffAve south of 49th	30	820	97.00%	0.00%	3.00%	0.00%	0.00%	795	0	25	0	0
NBCliffAve south of 49th	30	1390	97.00%	0.00%	3.00%	0.00%	0.00%	1348	0	42	0	0
NBCliffAve south of 49th (outside)	30	695	97.00%	0.00%	3.00%	0.00%	0.00%	674	0	21	0	0
NBCliffAve south of 49th (inside)	30	695	97.00%	0.00%	3.00%	0.00%	0.00%	674	0	21	0	0
NBCliffAve 49th to onramp (outside)	30	1010	97.00%	0.00%	3.00%	0.00%	0.00%	980	0	30	0	0
NBCliffAve 49th to onramp (inside)	30	1010	97.00%	0.00%	3.00%	0.00%	0.00%	980	0	30	0	0
NBCliffAve onramp to onramp (outside)	30	1020	97.00%	0.00%	3.00%	0.00%	0.00%	989	0	31	0	0
NBCliffAve onramp to onramp (inside)	30	1020	97.00%	0.00%	3.00%	0.00%	0.00%	989	0	31	0	0
NBCliffAve onramp to 41st (outside)	30	845	97.00%	0.00%	3.00%	0.00%	0.00%	820	0	25	0	0
NBCliffAve onramp to 41st (inside)	30	845	97.00%	0.00%	3.00%	0.00%	0.00%	820	0	25	0	0
NBCliffAve 41st to 33rd (outside)	30	515	97.00%	0.00%	3.00%	0.00%	0.00%	500	0	15	0	0
NBCliffAve 41st to 33rd (inside)	30	515	97.00%	0.00%	3.00%	0.00%	0.00%	500	0	15	0	0
Cliff Ave Turn Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
SBMinnesota north of 41st (outside)	30	510	98.75%	1.00%	0.25%	0.00%	0.00%	504	5	1	0	0
SBMinnesota north of 41st (inside)	30	510	98.75%	1.00%	0.25%	0.00%	0.00%	504	5	1	0	0
SBMinnesota 41st to 49th (outside)	30	530	98.75%	1.00%	0.25%	0.00%	0.00%	523	5	1	0	0
SBMinnesota 41st to 49th (inside)	30	530	98.75%	1.00%	0.25%	0.00%	0.00%	523	5	1	0	0
SBMinnesota 49th to ramps (outside)	30	495	98.75%	1.00%	0.25%	0.00%	0.00%	489	5	1	0	0
SBMinnesota 49th to ramps (inside)	30	495	98.75%	1.00%	0.25%	0.00%	0.00%	489	5	1	0	0

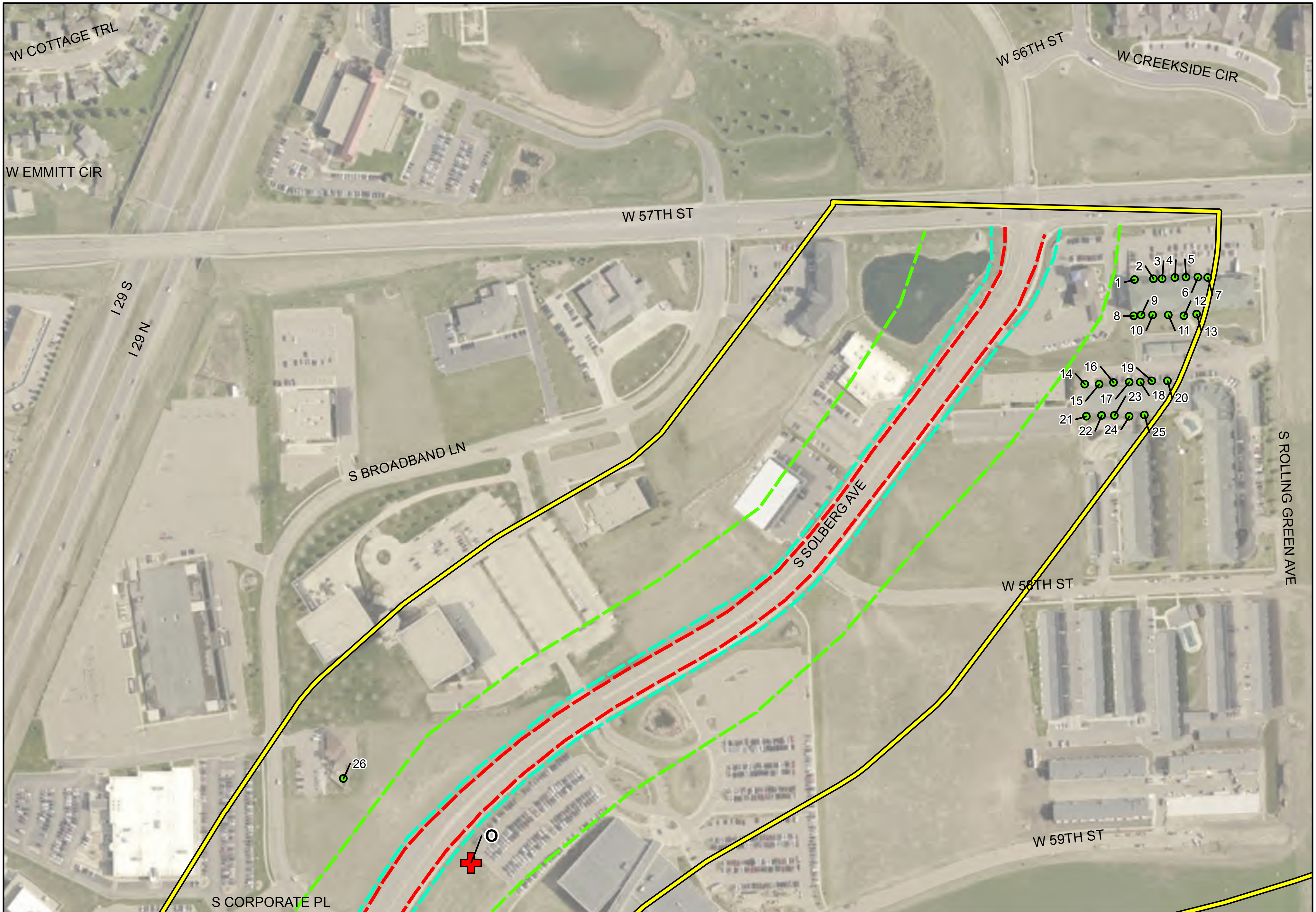
Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBMinnesota between ramps (outside)	30	450	98.75%	1.00%	0.25%	0.00%	0.00%	444	5	1	0	0
SBMinnesota between ramps (inside)	30	450	98.75%	1.00%	0.25%	0.00%	0.00%	444	5	1	0	0
SBMinnesota ramps to 57th (outside)	40	425	98.75%	1.00%	0.25%	0.00%	0.00%	420	4	1	0	0
SBMinnesota ramps to 57th (inside)	40	425	98.75%	1.00%	0.25%	0.00%	0.00%	420	4	1	0	0
SBMinnesota south of 57th (outside)	40	455	98.75%	1.00%	0.25%	0.00%	0.00%	449	5	1	0	0
SBMinnesota south of 57th (inside)	40	455	98.75%	1.00%	0.25%	0.00%	0.00%	449	5	1	0	0
NBMinnesota south of 57th (outside)	40	775	98.75%	1.00%	0.25%	0.00%	0.00%	765	8	2	0	0
NBMinnesota south of 57th (inside)	40	775	98.75%	1.00%	0.25%	0.00%	0.00%	765	8	2	0	0
NBMinnesota 57th to ramps (outside)	40	1010	98.75%	1.00%	0.25%	0.00%	0.00%	997	10	3	0	0
NBMinnesota 57th to ramps (inside)	40	1010	98.75%	1.00%	0.25%	0.00%	0.00%	997	10	3	0	0
NBMinnesota between ramps (outside)	30	1040	98.75%	1.00%	0.25%	0.00%	0.00%	1027	10	3	0	0
NBMinnesota between ramps (inside)	30	1040	98.75%	1.00%	0.25%	0.00%	0.00%	1027	10	3	0	0
NBMinnesota ramps to 49th (outside)	30	1110	98.75%	1.00%	0.25%	0.00%	0.00%	1096	11	3	0	0
NBMinnesota ramps to 49th (inside)	30	1110	98.75%	1.00%	0.25%	0.00%	0.00%	1096	11	3	0	0
NBMinnesota 49th to 41st (outside)	30	805	98.75%	1.00%	0.25%	0.00%	0.00%	795	8	2	0	0
NBMinnesota 49th to 41st (inside)	30	805	98.75%	1.00%	0.25%	0.00%	0.00%	795	8	2	0	0
NBMinnesota north of 41st (outside)	30	890	98.75%	1.00%	0.25%	0.00%	0.00%	879	9	2	0	0
NBMinnesota north of 41st (inside)	30	890	98.75%	1.00%	0.25%	0.00%	0.00%	879	9	2	0	0
Minnesota Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
SBWestern north of 49th (outside)	35	420	98.27%	0.86%	0.62%	0.25%	0.00%	413	4	3	1	0
SBWestern north of 49th (inside)	35	420	98.27%	0.86%	0.62%	0.25%	0.00%	413	4	3	1	0
SBWestern 49th to ramps (outside)	35	440	98.27%	0.86%	0.62%	0.25%	0.00%	432	4	3	1	0
SBWestern 49th to ramps (inside)	35	440	98.27%	0.86%	0.62%	0.25%	0.00%	432	4	3	1	0
SBWestern between ramps (outside)	35	540	98.27%	0.86%	0.62%	0.25%	0.00%	531	5	3	1	0
SBWestern between ramps (inside)	35	540	98.27%	0.86%	0.62%	0.25%	0.00%	531	5	3	1	0
SBWestern ramps to 57th (outside)	35	530	98.27%	0.86%	0.62%	0.25%	0.00%	521	5	3	1	0
SBWestern ramps to 57th (inside)	35	530	98.27%	0.86%	0.62%	0.25%	0.00%	521	5	3	1	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBWestern south of 57th (outside)	35	420	98.27%	0.86%	0.62%	0.25%	0.00%	413	4	3	1	0
SBWestern south of 57th (inside)	35	420	98.27%	0.86%	0.62%	0.25%	0.00%	413	4	3	1	0
SBWestern south of 57th	35	840	98.27%	0.86%	0.62%	0.25%	0.00%	825	7	5	2	0
NBWestern south of 57th	35	1630	98.27%	0.86%	0.62%	0.25%	0.00%	1602	14	10	4	0
NBWestern south of 57th (outside)	35	815	98.27%	0.86%	0.62%	0.25%	0.00%	801	7	5	2	0
NBWestern south of 57th (inside)	35	815	98.27%	0.86%	0.62%	0.25%	0.00%	801	7	5	2	0
NBWestern 57th to ramps (outside)	35	795	98.27%	0.86%	0.62%	0.25%	0.00%	781	7	5	2	0
NBWestern 57th to ramps (inside)	35	795	98.27%	0.86%	0.62%	0.25%	0.00%	781	7	5	2	0
NBWestern between ramps (outside)	35	735	98.27%	0.86%	0.62%	0.25%	0.00%	722	6	5	2	0
NBWestern between ramps (inside)	35	735	98.27%	0.86%	0.62%	0.25%	0.00%	722	6	5	2	0
NBWestern ramps to 49th (outside)	35	955	98.27%	0.86%	0.62%	0.25%	0.00%	938	8	6	2	0
NBWestern ramps to 49th (inside)	35	955	98.27%	0.86%	0.62%	0.25%	0.00%	938	8	6	2	0
NBWestern north of 49th (outside)	35	780	98.27%	0.86%	0.62%	0.25%	0.00%	767	7	5	2	0
NBWestern north of 49th (inside)	35	780	98.27%	0.86%	0.62%	0.25%	0.00%	767	7	5	2	0
Western Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
WB57th east of Western (outside)	40	525	98.00%	0.00%	2.00%	0.00%	0.00%	515	0	11	0	0
WB57th east of Western (inside)	40	525	98.00%	0.00%	2.00%	0.00%	0.00%	515	0	11	0	0
WB57th Western to Louise (outside)	40	675	98.00%	0.00%	2.00%	0.00%	0.00%	662	0	14	0	0
WB57th Western to Louise (inside)	40	675	98.00%	0.00%	2.00%	0.00%	0.00%	662	0	14	0	0
EB57th Louise to Western (outside)	40	500	98.00%	0.00%	2.00%	0.00%	0.00%	490	0	10	0	0
EB57th Louise to Western (inside)	40	500	98.00%	0.00%	2.00%	0.00%	0.00%	490	0	10	0	0
EB57th east of Western (outside)	40	480	98.00%	0.00%	2.00%	0.00%	0.00%	470	0	10	0	0
EB57th east of Western (inside)	40	480	98.00%	0.00%	2.00%	0.00%	0.00%	470	0	10	0	0
57th Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--
SBLouise north of 57th (outside) 1	30	390	98.76%	0.99%	0.25%	0.00%	0.00%	385	4	1	0	0
SBLouise north of 57th (inside) 1	30	390	98.76%	0.99%	0.25%	0.00%	0.00%	385	4	1	0	0
SBLouise north of 57th (outside) 2	30	260	98.76%	0.99%	0.25%	0.00%	0.00%	257	3	1	0	0

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBLouise north of 57th (middle) 2	30	260	98.76%	0.99%	0.25%	0.00%	0.00%	257	3	1	0	0
SBLouise north of 57th (inside) 2	30	260	98.76%	0.99%	0.25%	0.00%	0.00%	257	3	1	0	0
SBLouise 57th to 59th (outside)	40	620	98.76%	0.99%	0.25%	0.00%	0.00%	612	6	2	0	0
SBLouise 57th to 59th (middle)	40	620	98.76%	0.99%	0.25%	0.00%	0.00%	612	6	2	0	0
SBLouise 59th to ramps (outside)	40	423	98.76%	0.99%	0.25%	0.00%	0.00%	418	4	1	0	0
SBLouise 59th to ramps (middle)	40	423	98.76%	0.99%	0.25%	0.00%	0.00%	418	4	1	0	0
SBLouise 59th to ramps (inside)	40	423	98.76%	0.99%	0.25%	0.00%	0.00%	418	4	1	0	0
SBLouise between ramps (outside)	40	527	98.76%	0.99%	0.25%	0.00%	0.00%	520	5	1	0	0
SBLouise between ramps (middle)	40	527	98.76%	0.99%	0.25%	0.00%	0.00%	520	5	1	0	0
SBLouise between ramps (inside)	40	527	98.76%	0.99%	0.25%	0.00%	0.00%	520	5	1	0	0
SBLouise ramps to 69th (outside)	40	480	98.76%	0.99%	0.25%	0.00%	0.00%	474	5	1	0	0
SBLouise ramps to 69th (inside)	40	480	98.76%	0.99%	0.25%	0.00%	0.00%	474	5	1	0	0
SBLouise south of 69th (outside)	40	250	98.76%	0.99%	0.25%	0.00%	0.00%	247	2	1	0	0
SBLouise south of 69th (inside)	40	250	98.76%	0.99%	0.25%	0.00%	0.00%	247	2	1	0	0
NBLouise south of 69th (outside)	40	770	98.76%	0.99%	0.25%	0.00%	0.00%	760	8	2	0	0
NBLouise south of 69th (inside)	40	770	98.76%	0.99%	0.25%	0.00%	0.00%	760	8	2	0	0
NBLouise 69th to ramps (outside)	40	815	98.76%	0.99%	0.25%	0.00%	0.00%	805	8	2	0	0
NBLouise 69th to ramps (inside)	40	815	98.76%	0.99%	0.25%	0.00%	0.00%	805	8	2	0	0
NBLouise between ramps (outside)	40	630	98.76%	0.99%	0.25%	0.00%	0.00%	622	6	2	0	0
NBLouise between ramps (inside)	40	630	98.76%	0.99%	0.25%	0.00%	0.00%	622	6	2	0	0
NBLouise ramps to 59th (outside)	40	830	98.76%	0.99%	0.25%	0.00%	0.00%	820	8	2	0	0
NBLouise ramps to 59th (inside)	40	830	98.76%	0.99%	0.25%	0.00%	0.00%	820	8	2	0	0
NBLouise 59th to 57th (outside)	40	680	98.76%	0.99%	0.25%	0.00%	0.00%	672	7	2	0	0
NBLouise 59th to 57th (inside)	30	680	98.76%	0.99%	0.25%	0.00%	0.00%	672	7	2	0	0
NBLouise north of 57th (outside)	30	535	98.76%	0.99%	0.25%	0.00%	0.00%	528	5	1	0	0
NBLouise north of 57th (inside)	30	535	98.76%	0.99%	0.25%	0.00%	0.00%	528	5	1	0	0
Louise Turning Lane (no traffic)	--	--	--	--	--	--	--	--	--	--	--	--

Roadway Segment	Speed Limit (mph)	AM PHV	VEHICLE MIX					BUILD (2035) AM PEAK HOUR TRAFFIC				
			Autos	MT	HT	Buses	Motorcycles	Autos	MT	HT	Buses	Motorcycles
SBSolberg north of 57th	30	620	99.27%	0.73%	0.00%	0.00%	0.00%	615	5	0	0	0
SBSolberg 57th to 69th (outside)	35	450	99.27%	0.73%	0.00%	0.00%	0.00%	447	3	0	0	0
SBSolberg 57th to 69th (inside)	35	450	99.27%	0.73%	0.00%	0.00%	0.00%	447	3	0	0	0
SBSolberg south of 69th (outside)	40	630	99.27%	0.73%	0.00%	0.00%	0.00%	625	5	0	0	0
SBSolberg south of 69th (inside)	40	630	99.27%	0.73%	0.00%	0.00%	0.00%	625	5	0	0	0
NBSolberg south of 69th (outside)	40	565	99.27%	0.73%	0.00%	0.00%	0.00%	561	4	0	0	0
NBSolberg south of 69th (inside)	40	565	99.27%	0.73%	0.00%	0.00%	0.00%	561	4	0	0	0
NBSolberg 69th to 57th (outside)	35	350	99.27%	0.73%	0.00%	0.00%	0.00%	347	3	0	0	0
NBSolberg 69th to 57th (inside)	35	350	99.27%	0.73%	0.00%	0.00%	0.00%	347	3	0	0	0
NBSolberg north of 57th	30	620	99.27%	0.73%	0.00%	0.00%	0.00%	615	5	0	0	0
Soberg Turning Lane (no traffic) 1	--	--	--	--	--	--	--	--	--	--	--	--
Soberg Turning Lane (no traffic) 2	--	--	--	--	--	--	--	--	--	--	--	--

Appendix B
Figures



Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
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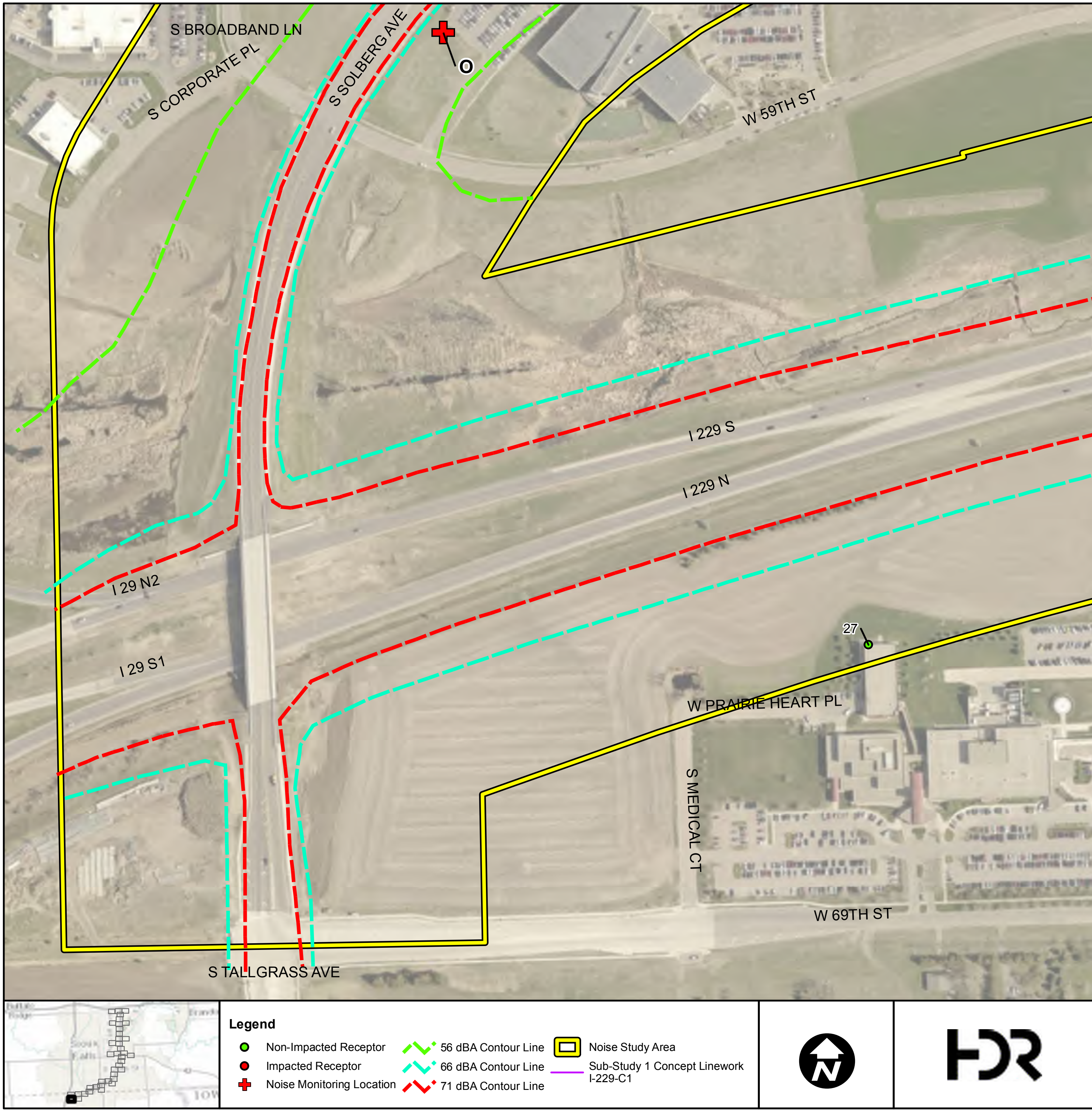
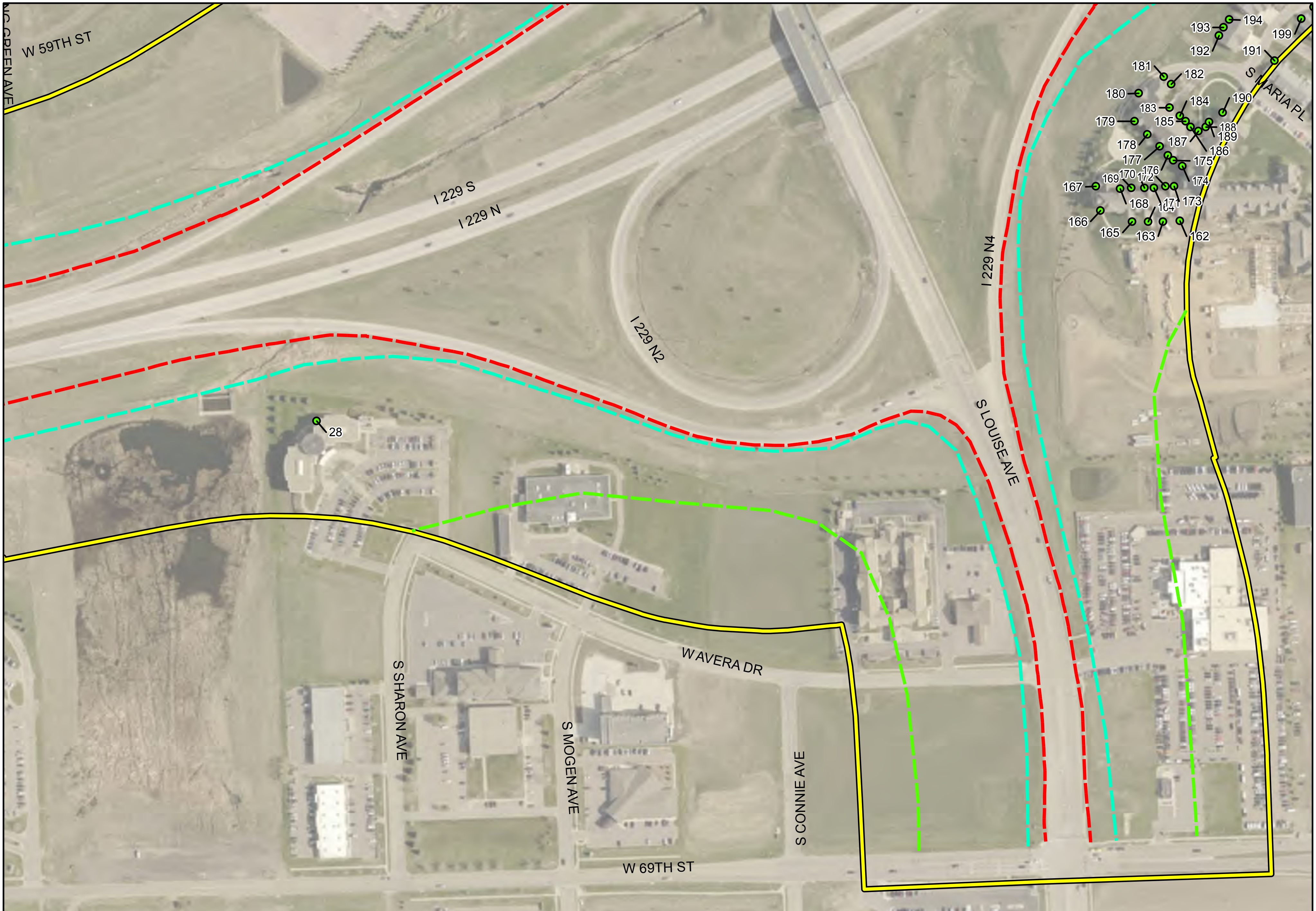
- Noise Study Area
- Sub-Study 1 Concept Linework I-229-C1

HDR

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C1



I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C1



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I-229 Major Investment Corridor Study
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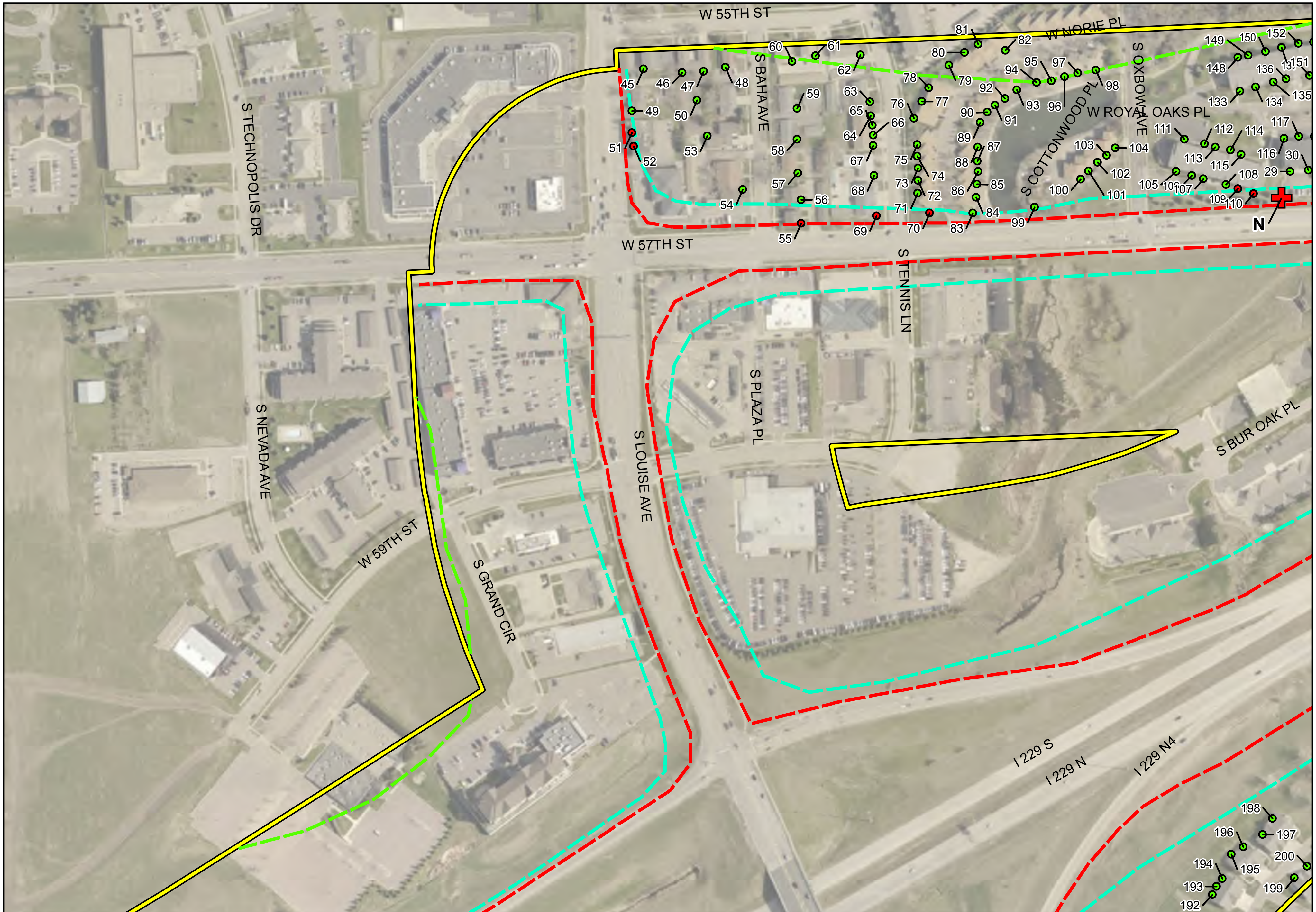

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I-229 Major Investment Corridor Study
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Noise Contour Figures
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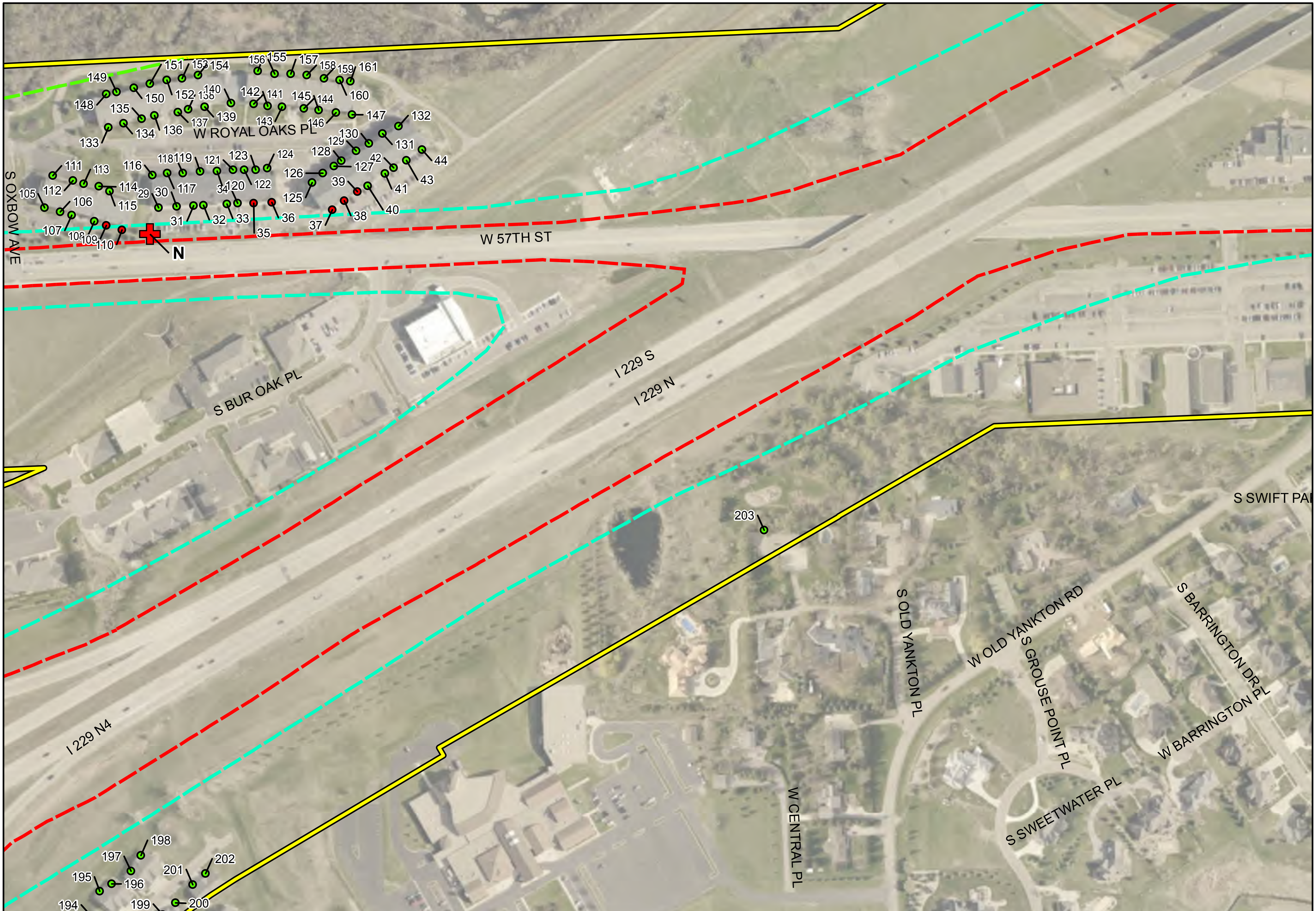

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I-229 Major Investment Corridor Study
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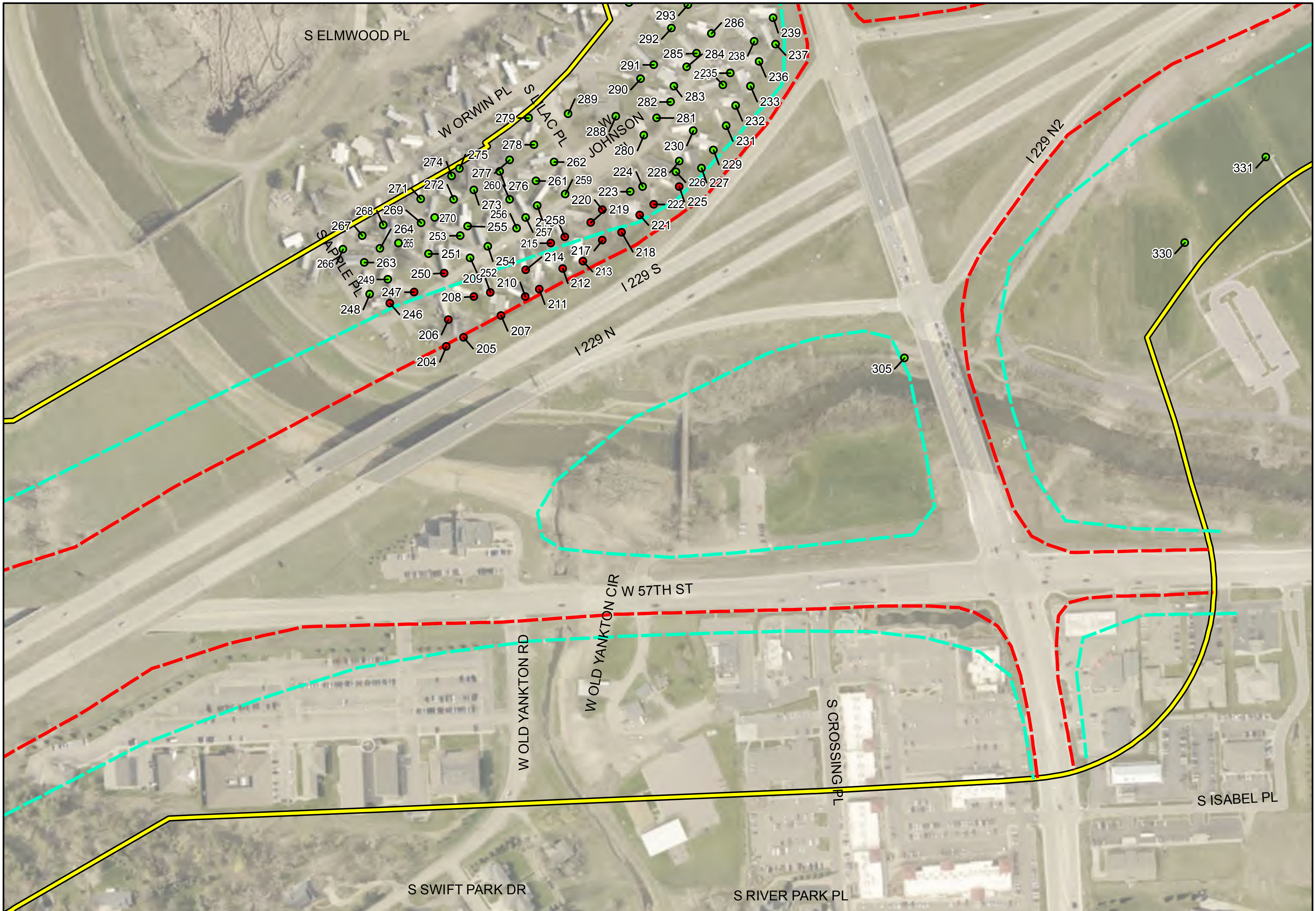

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I-229 Major Investment Corridor Study
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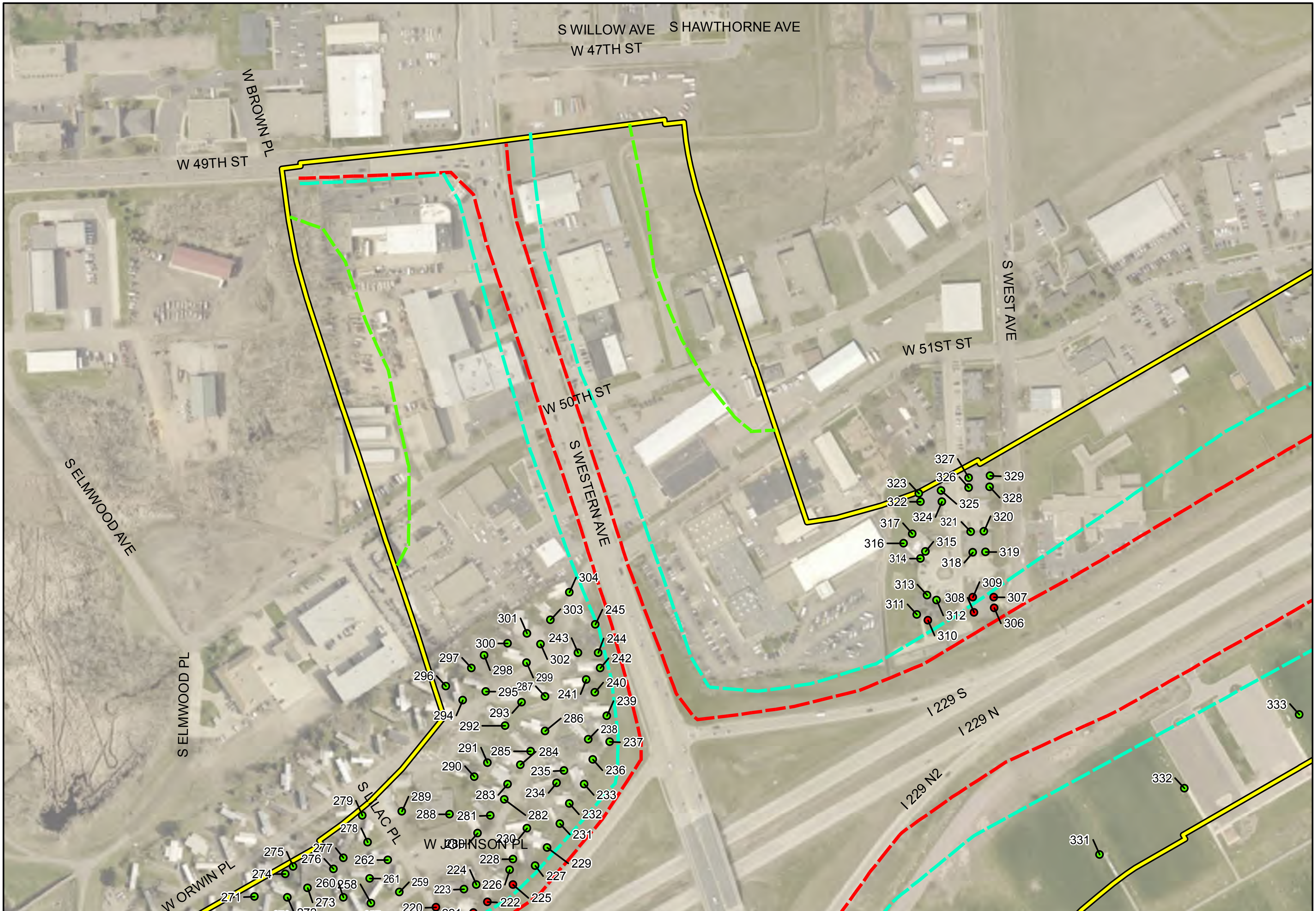

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I-229 Major Investment Corridor Study
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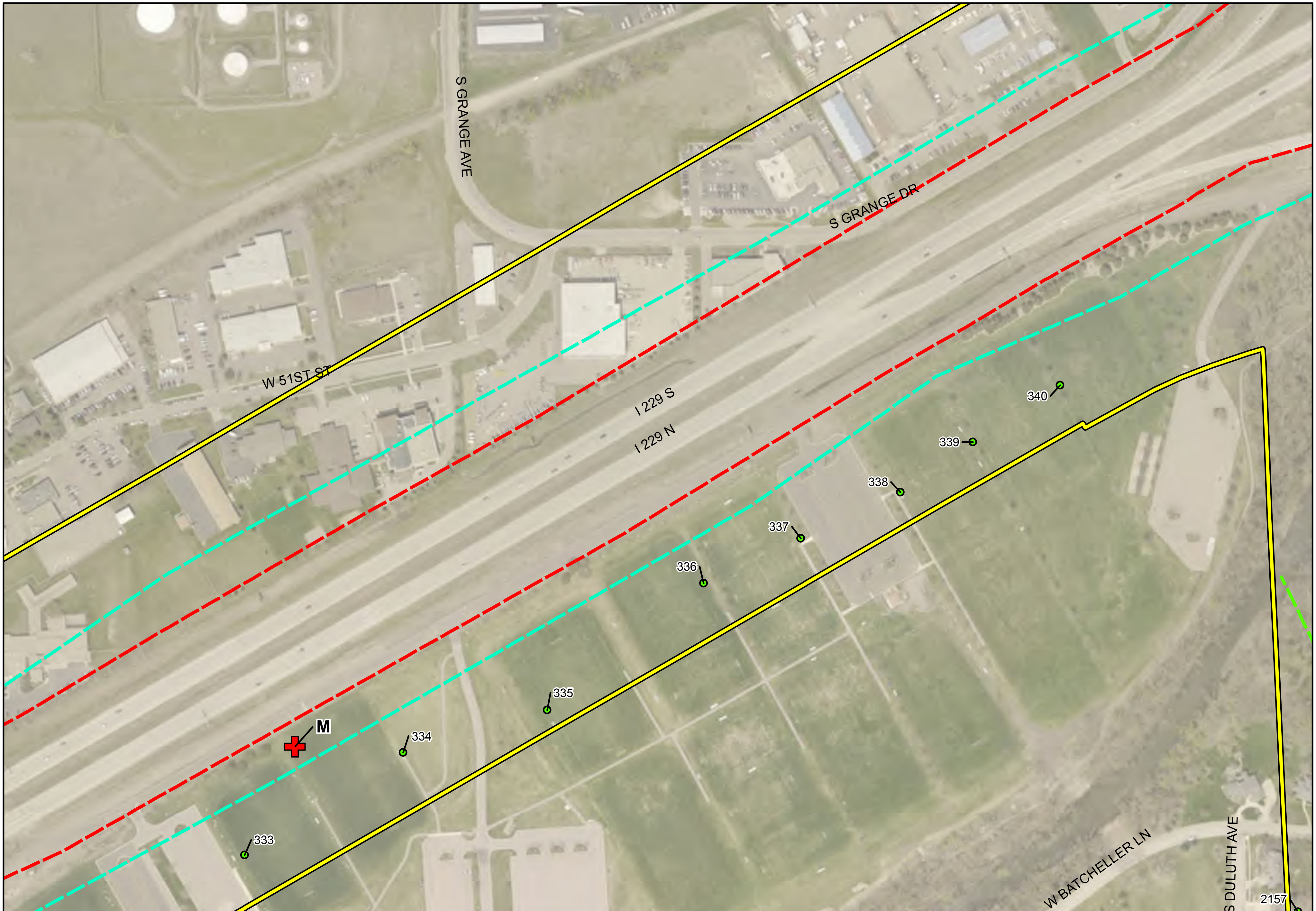

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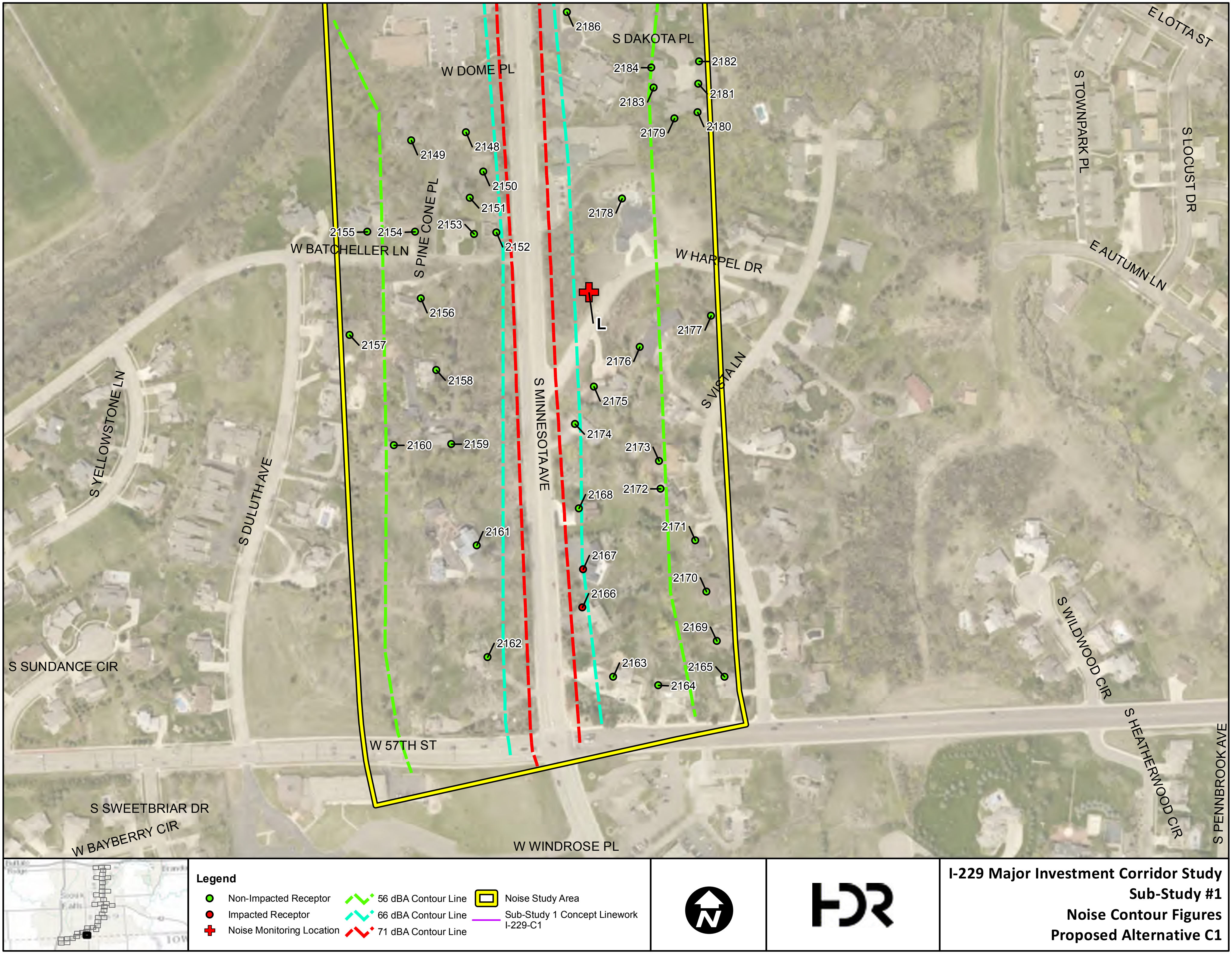

I-229 Major Investment Corridor Study
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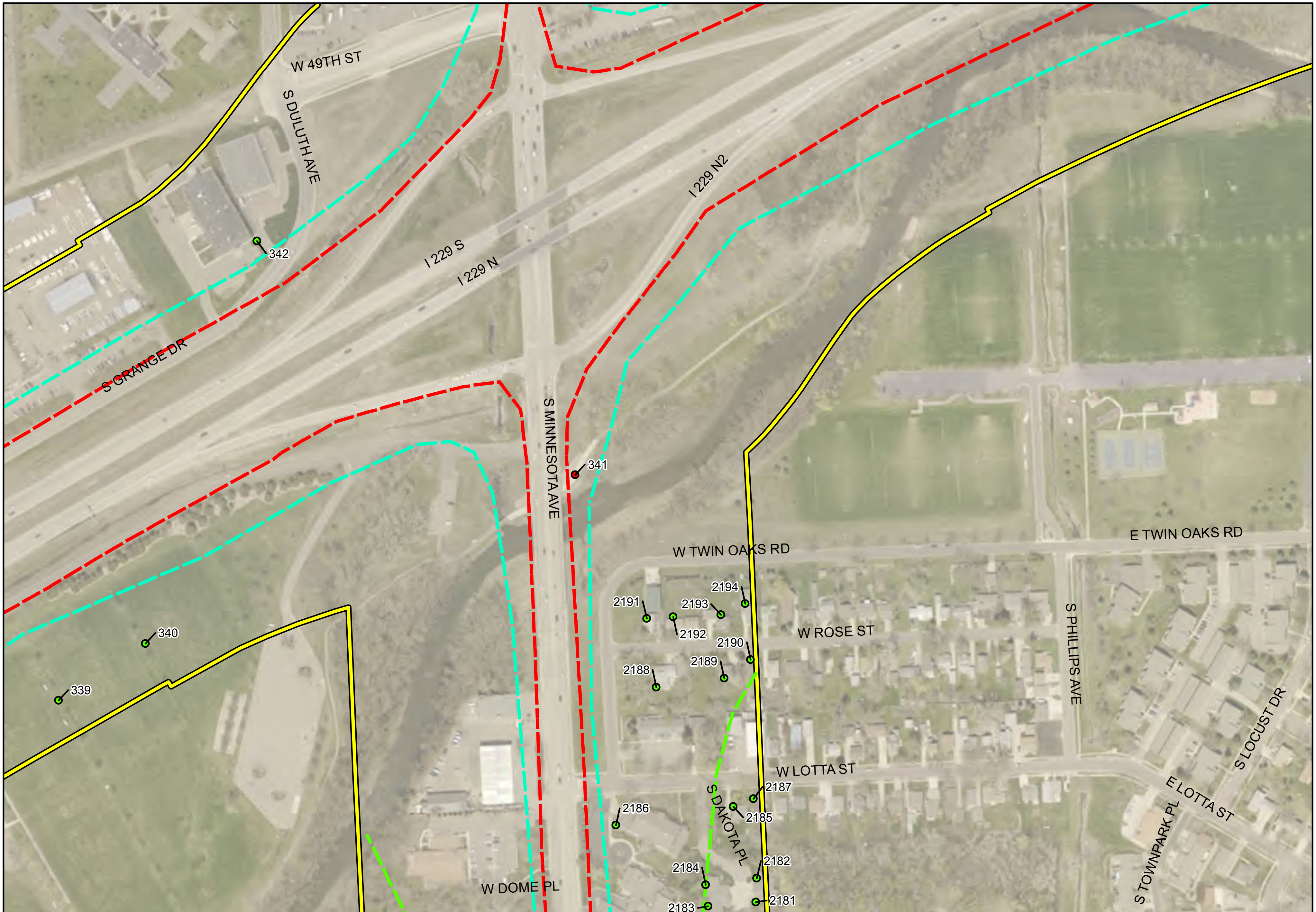
Proposed Alternative C1



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I-229 Major Investment Corridor Study

Sub-Study #1

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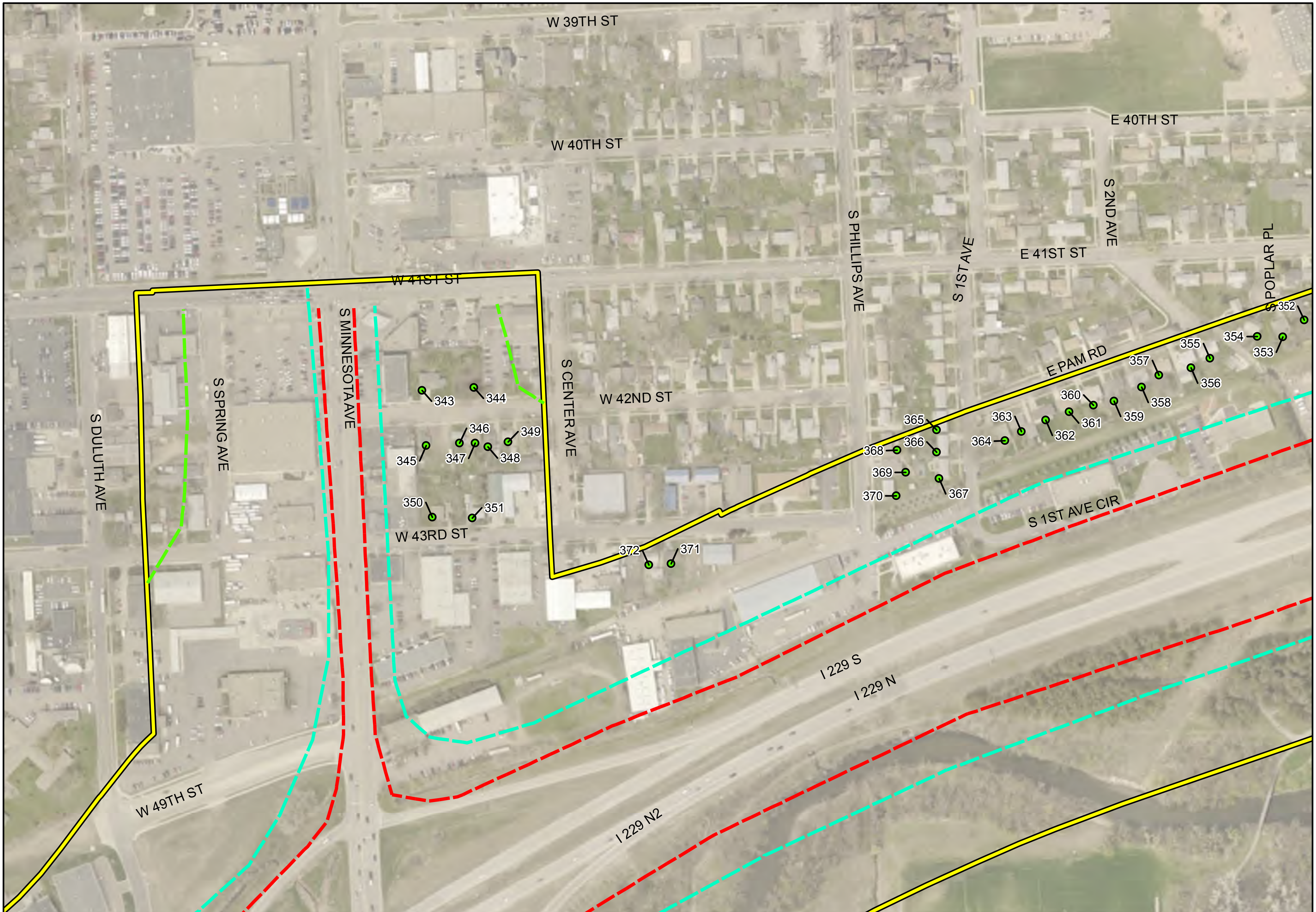

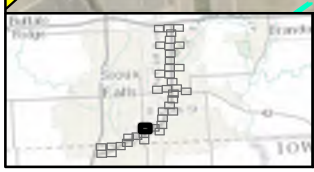

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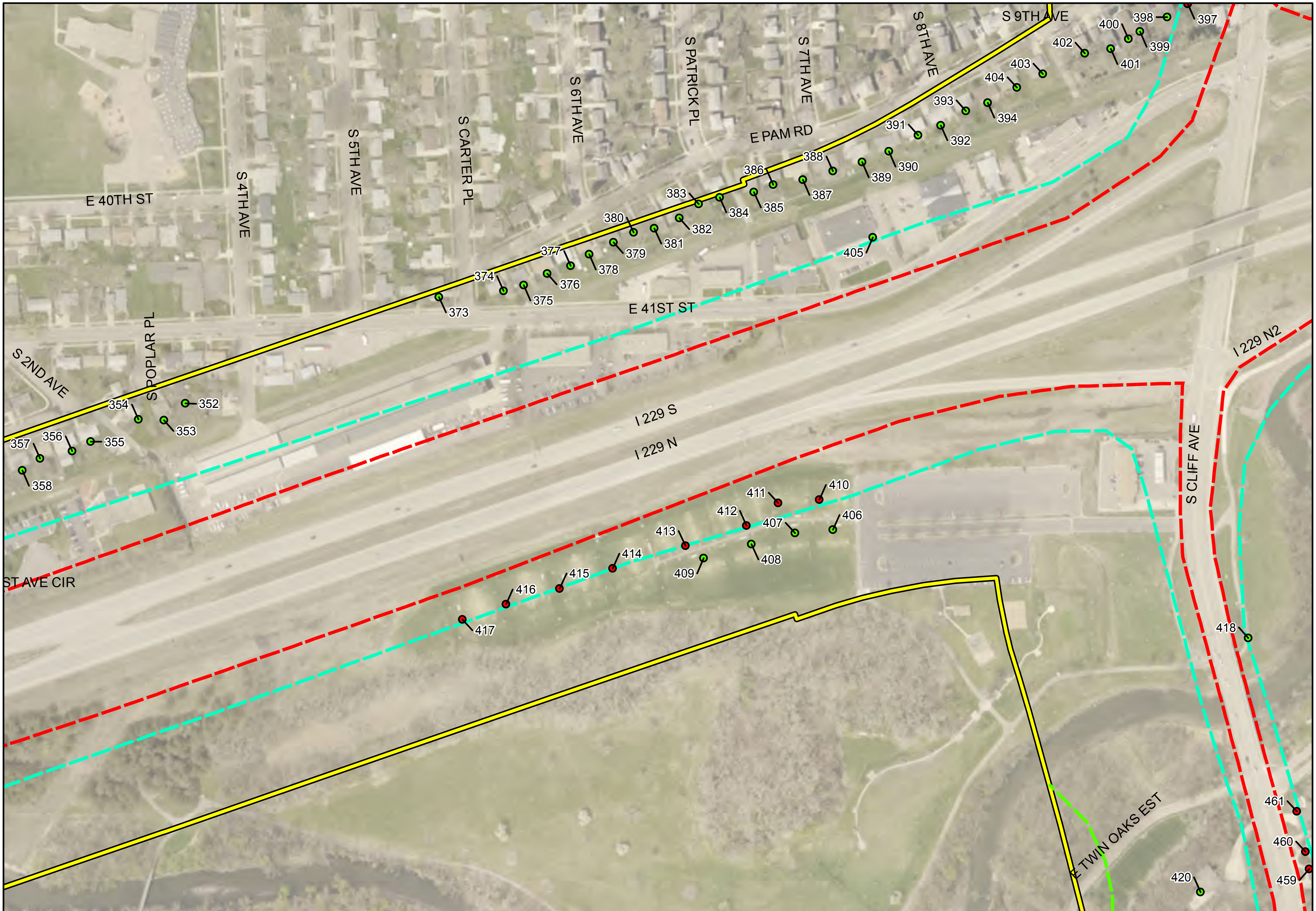

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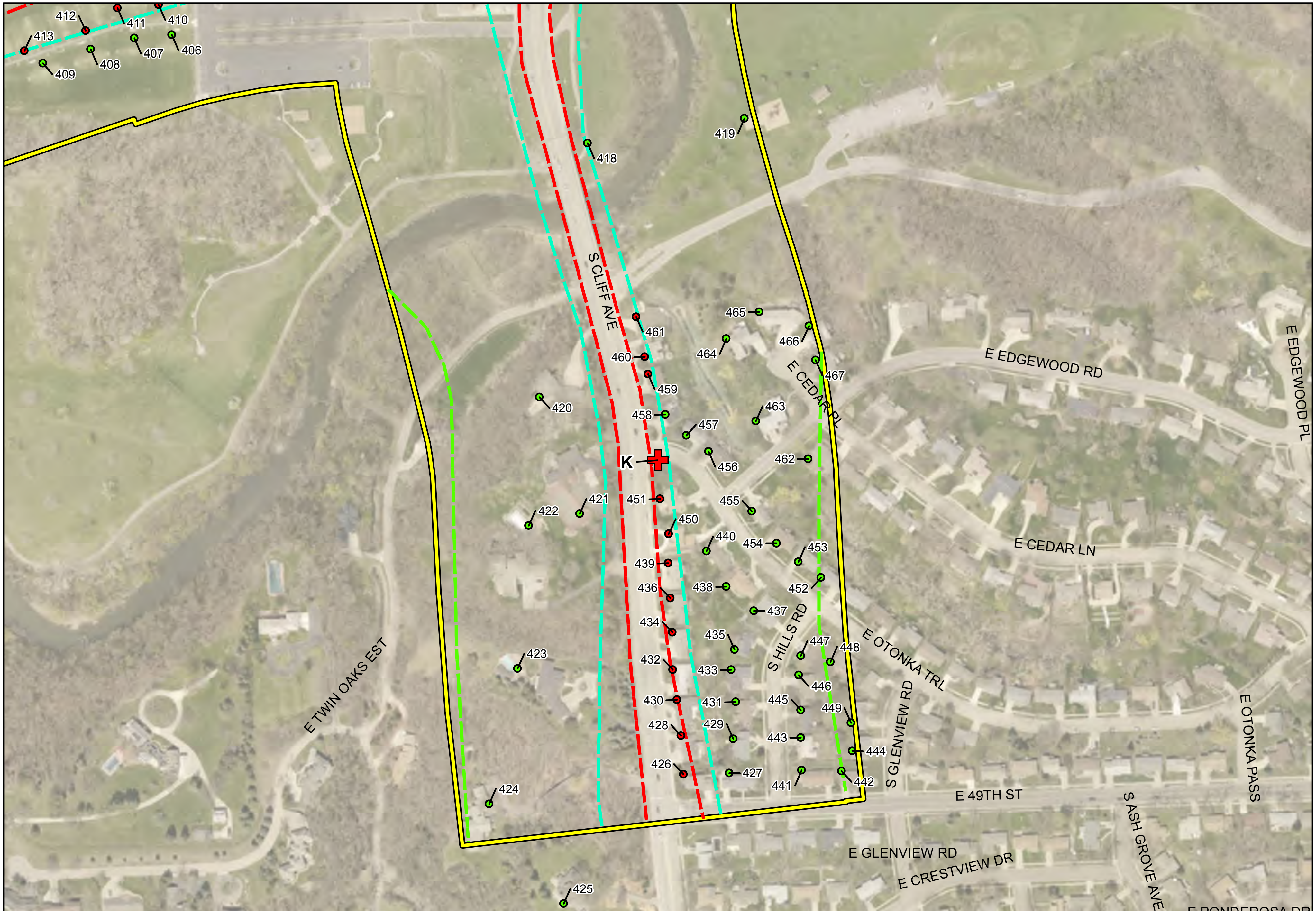

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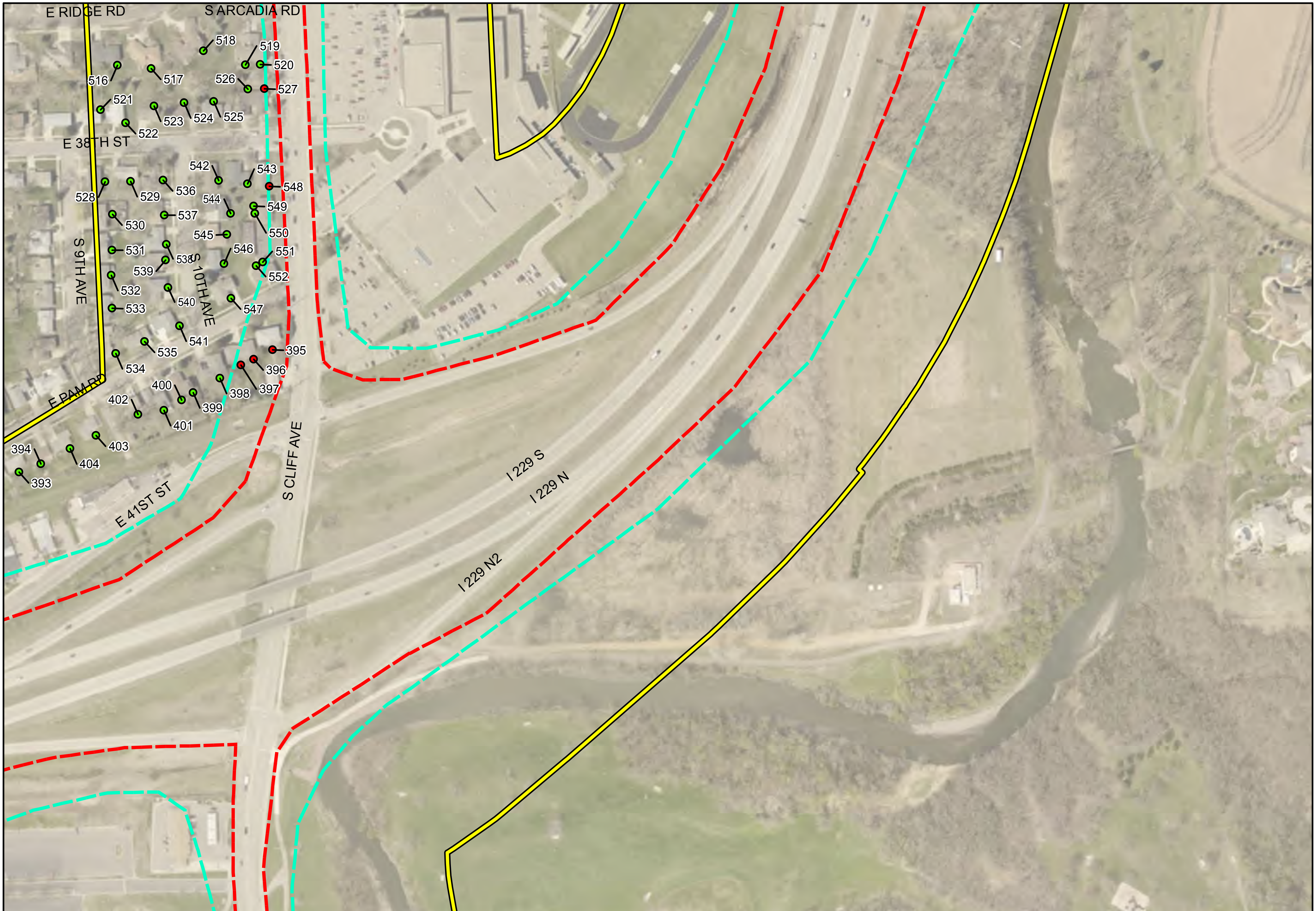

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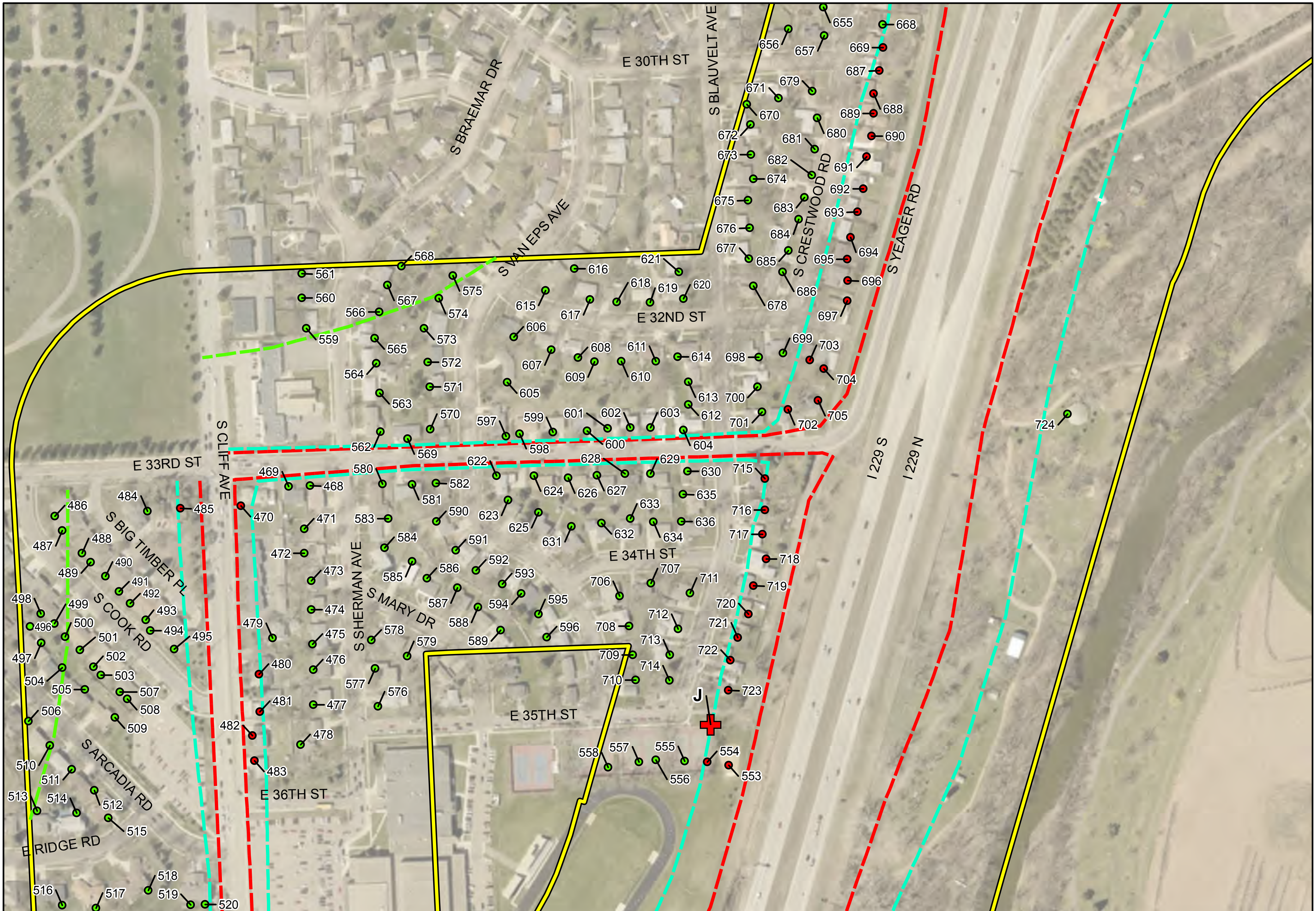

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I-229 Major Investment Corridor Study
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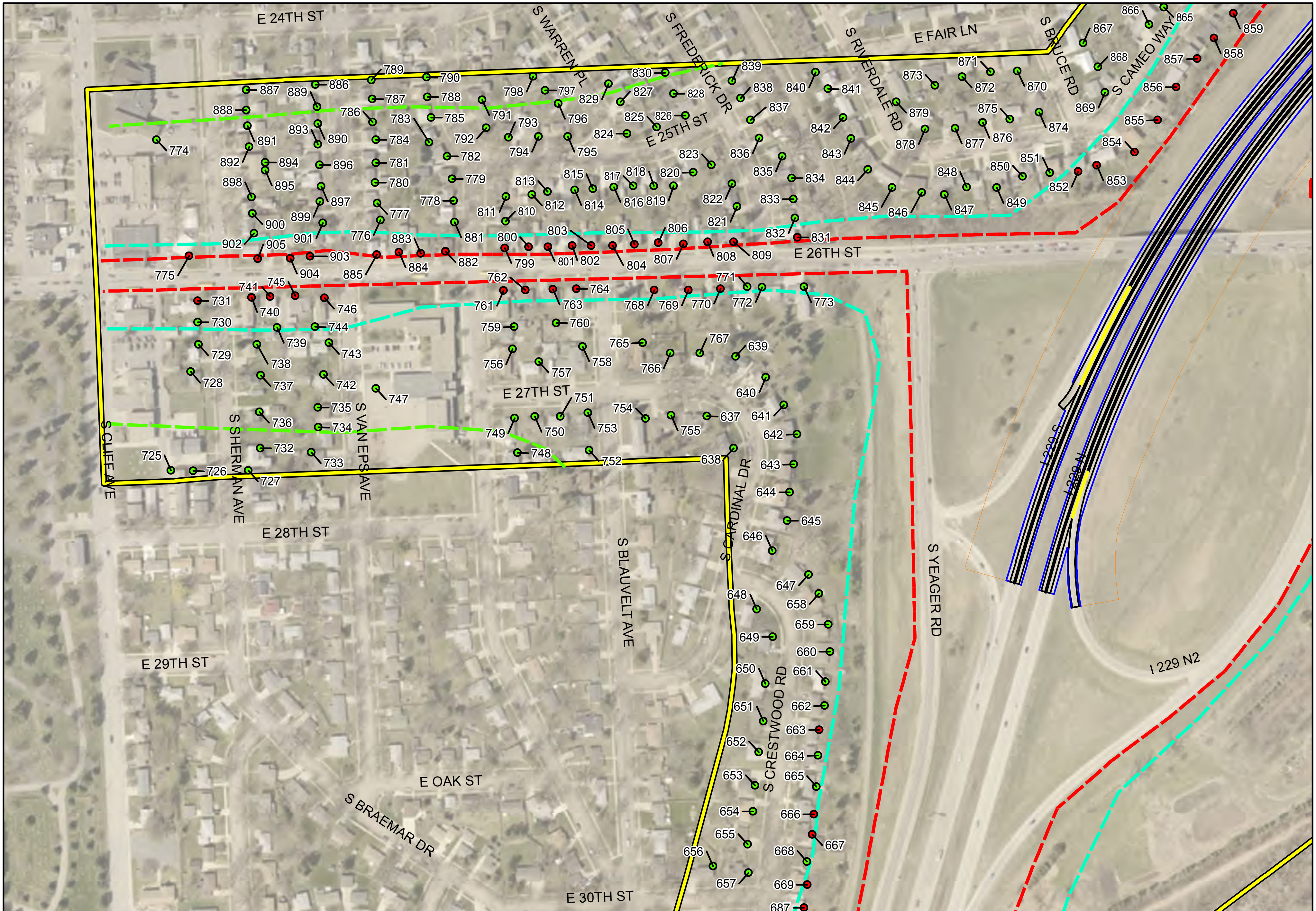

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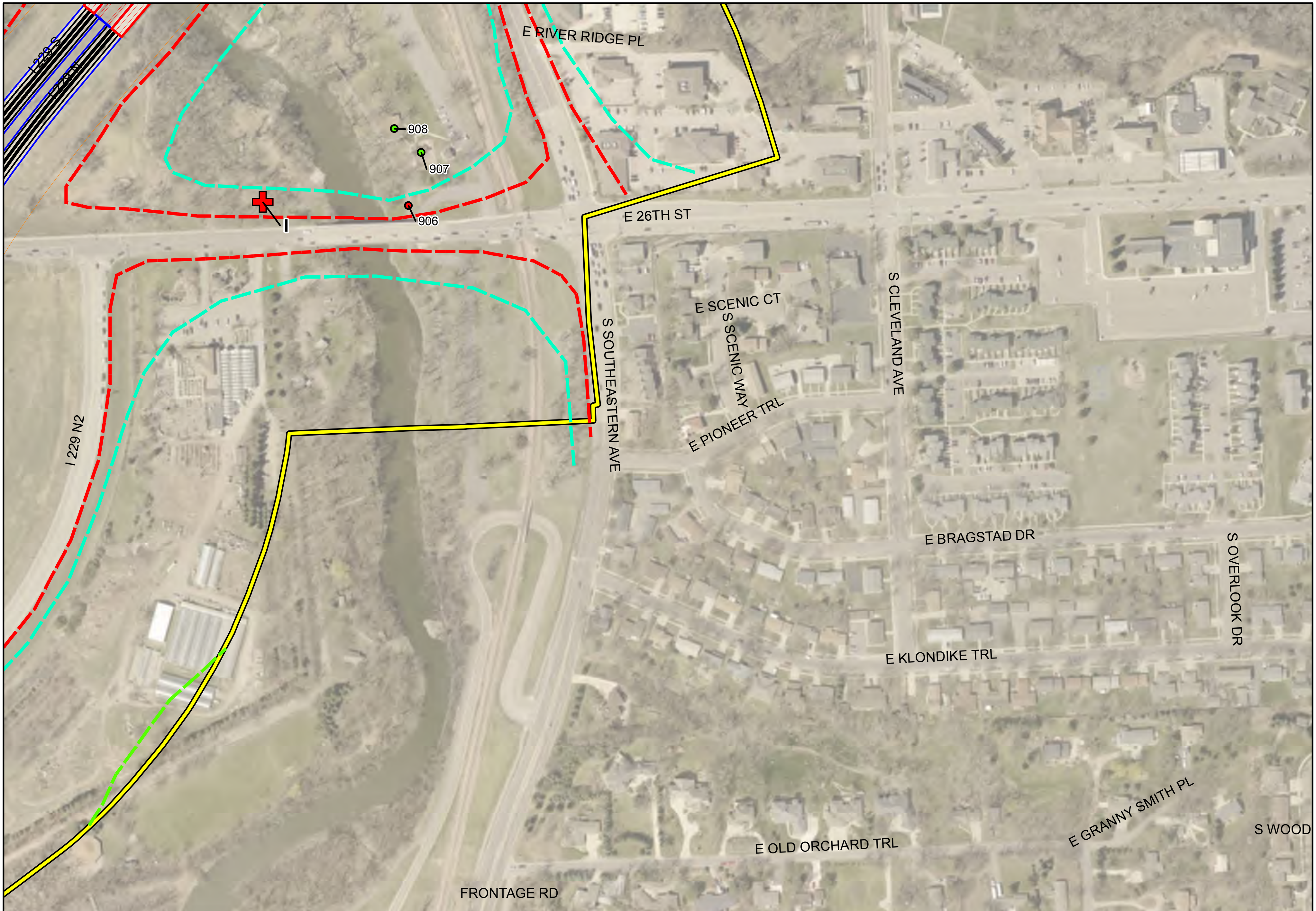

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I-229 Major Investment Corridor Study

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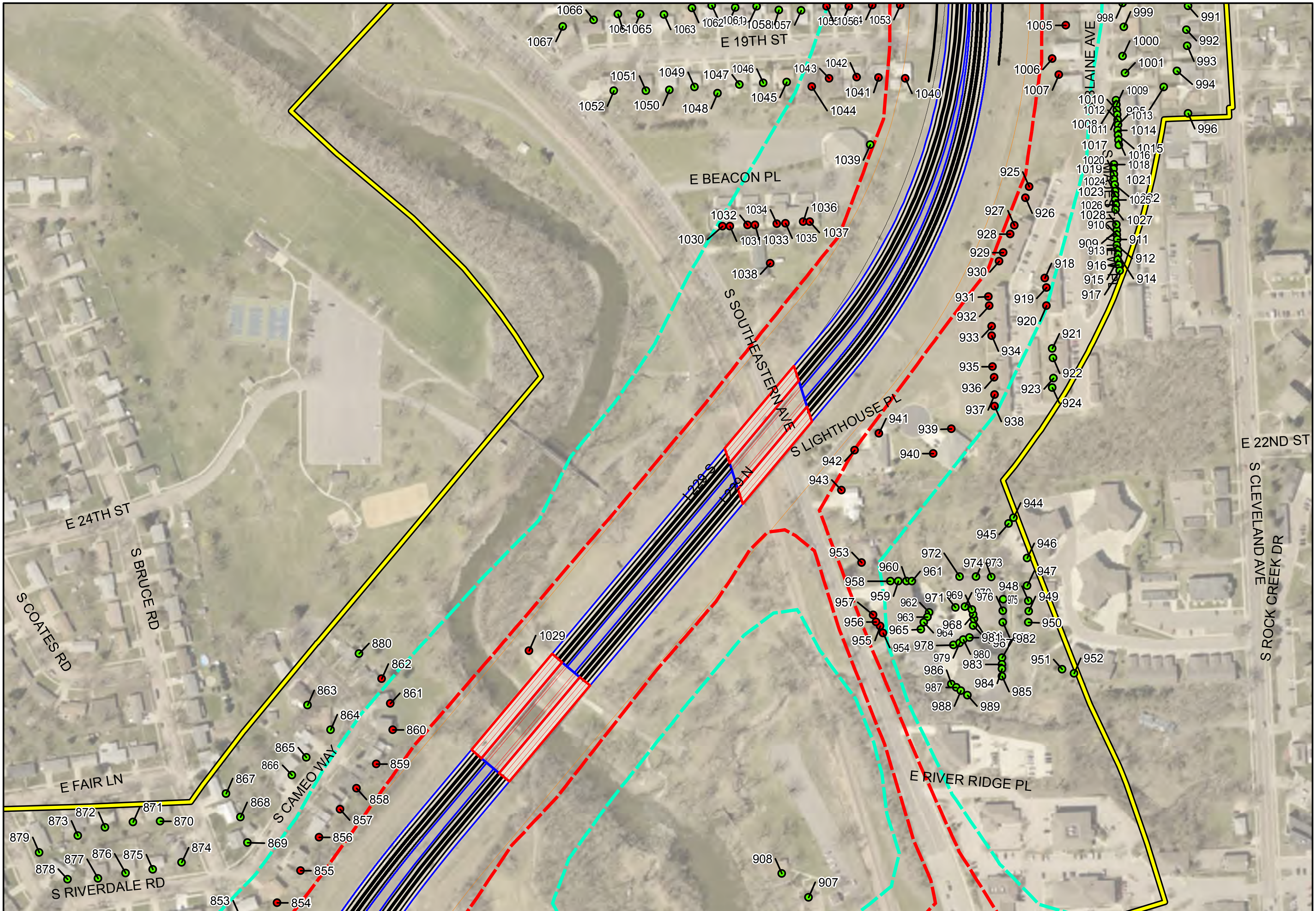

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HDR

I-229 Major Investment Corridor Study
Sub-Study #1
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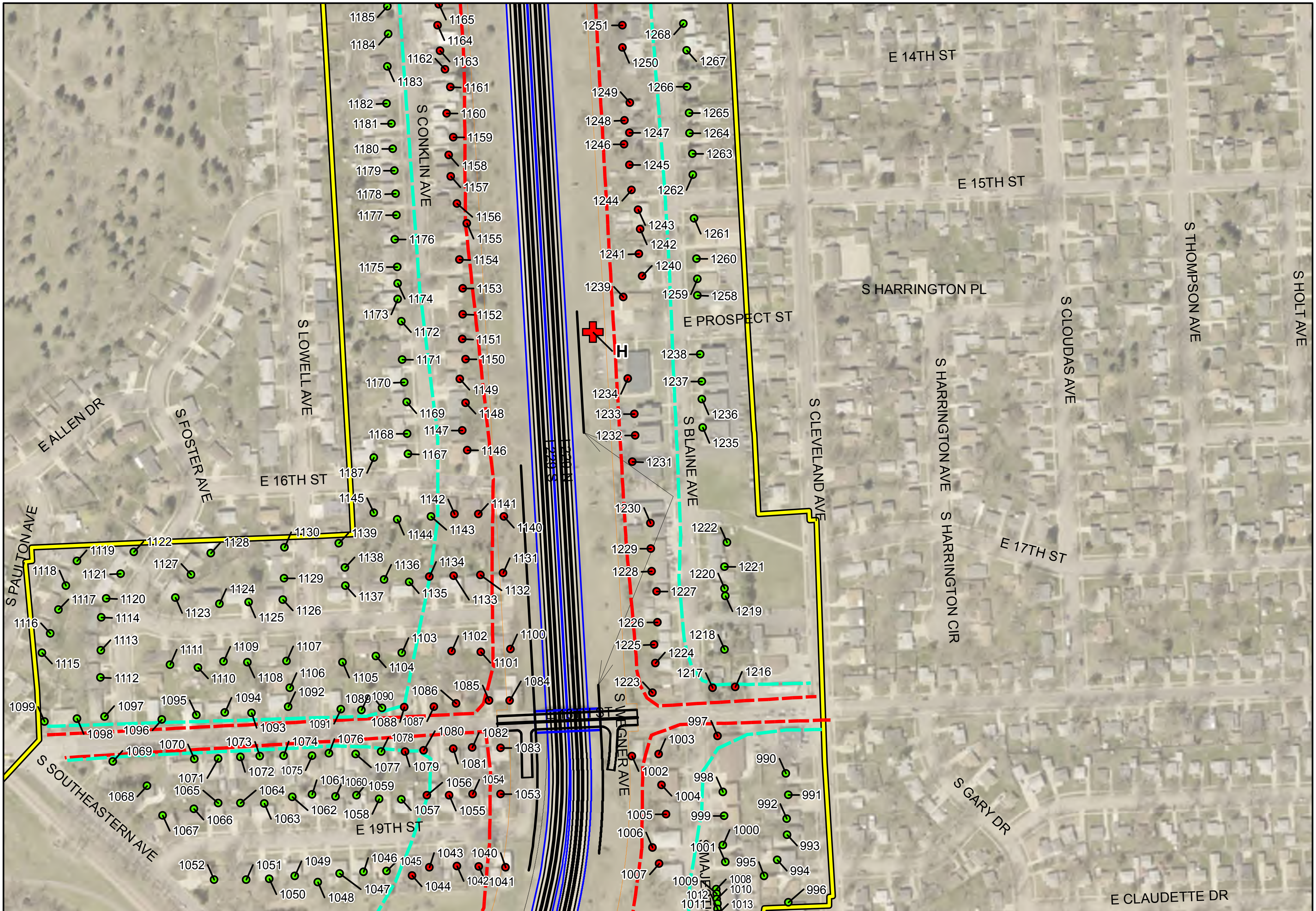

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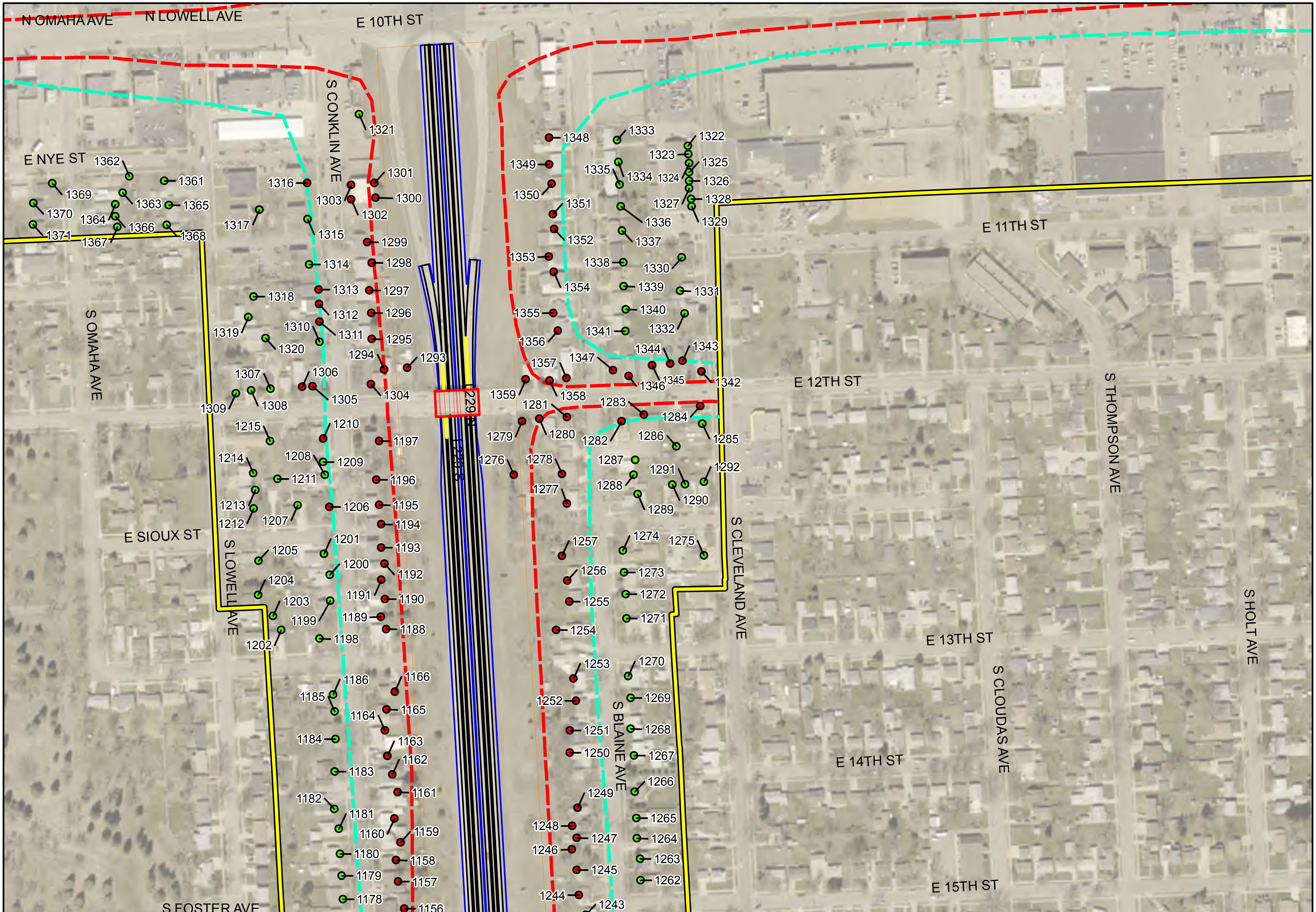

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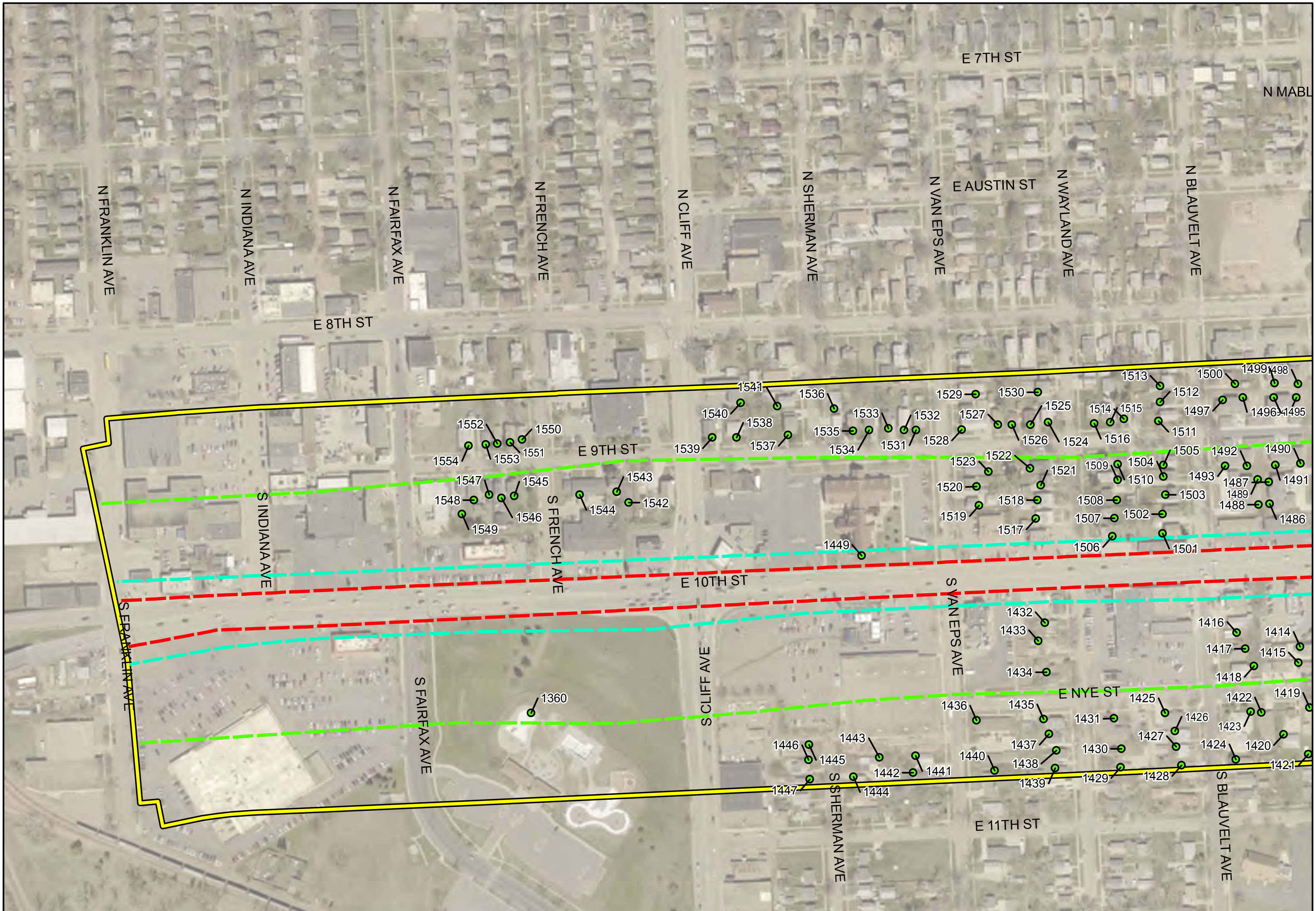

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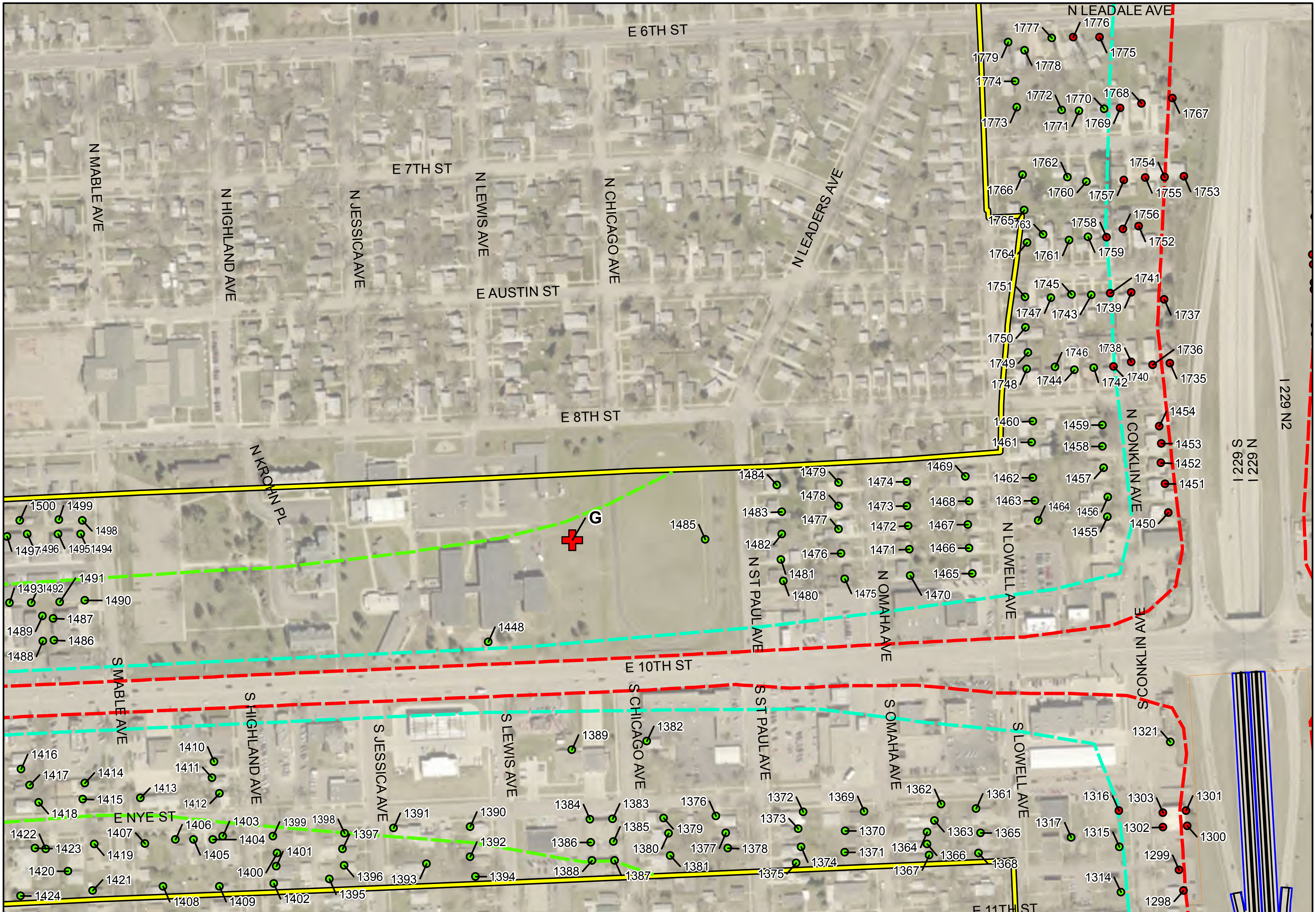

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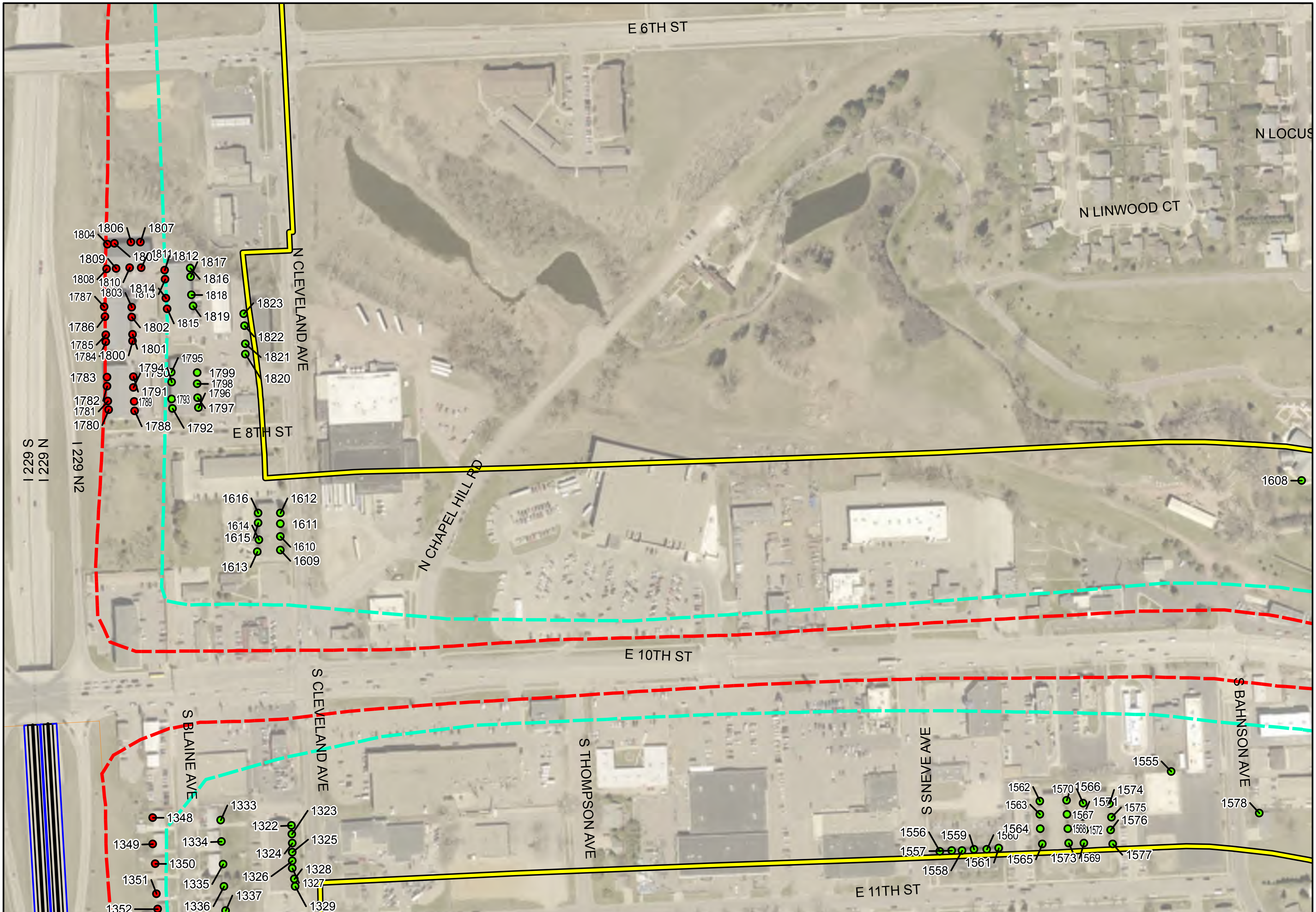

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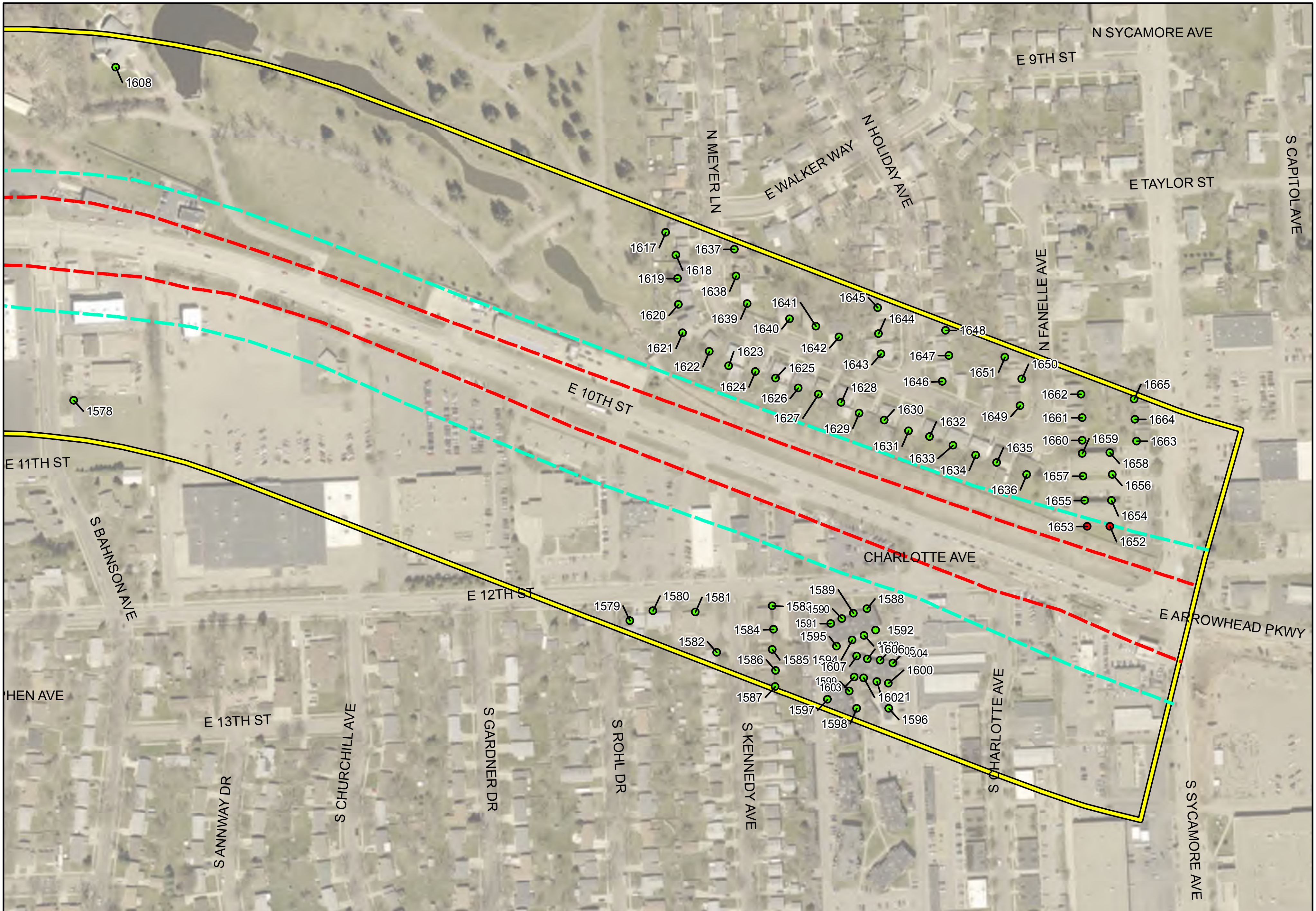

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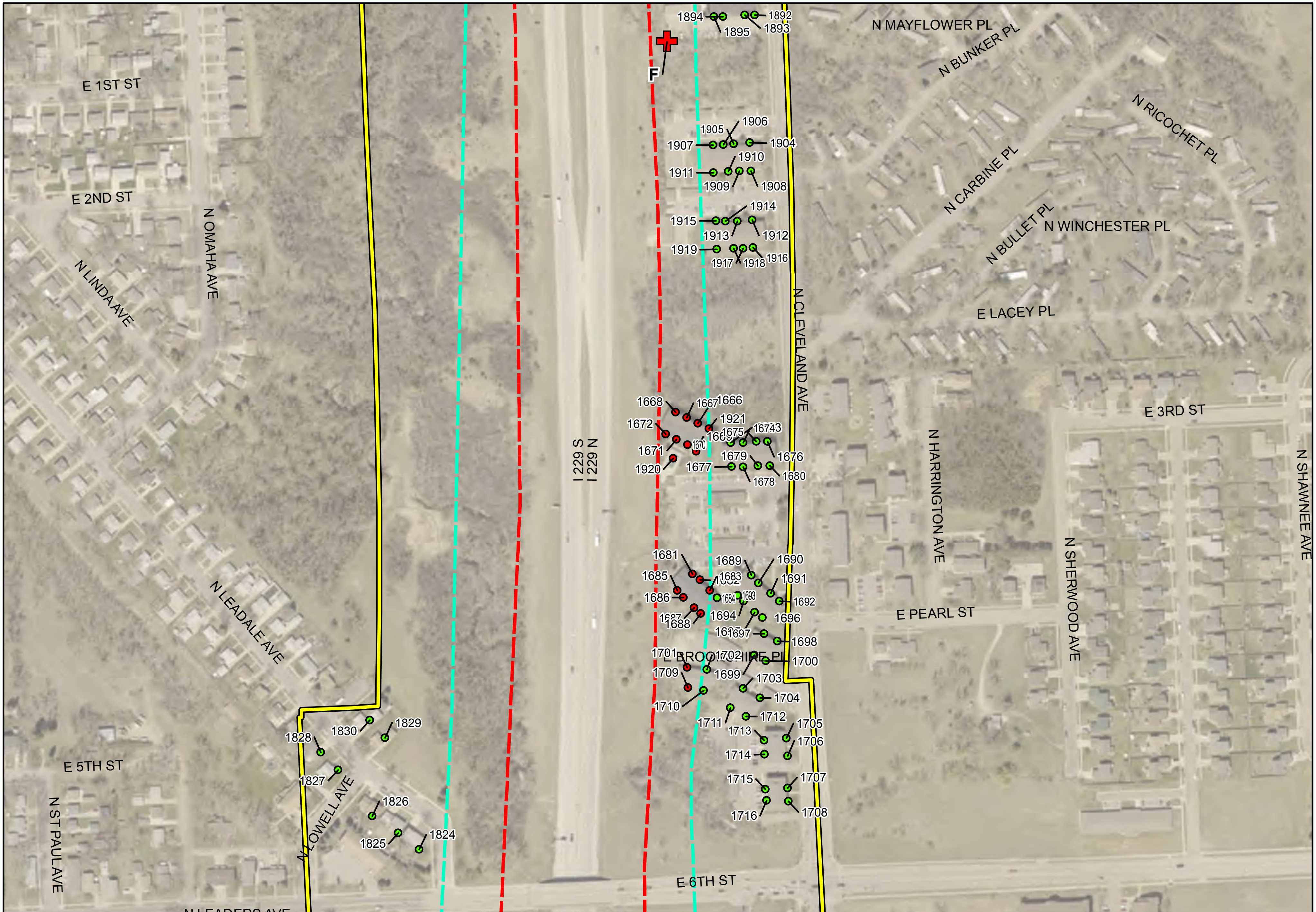

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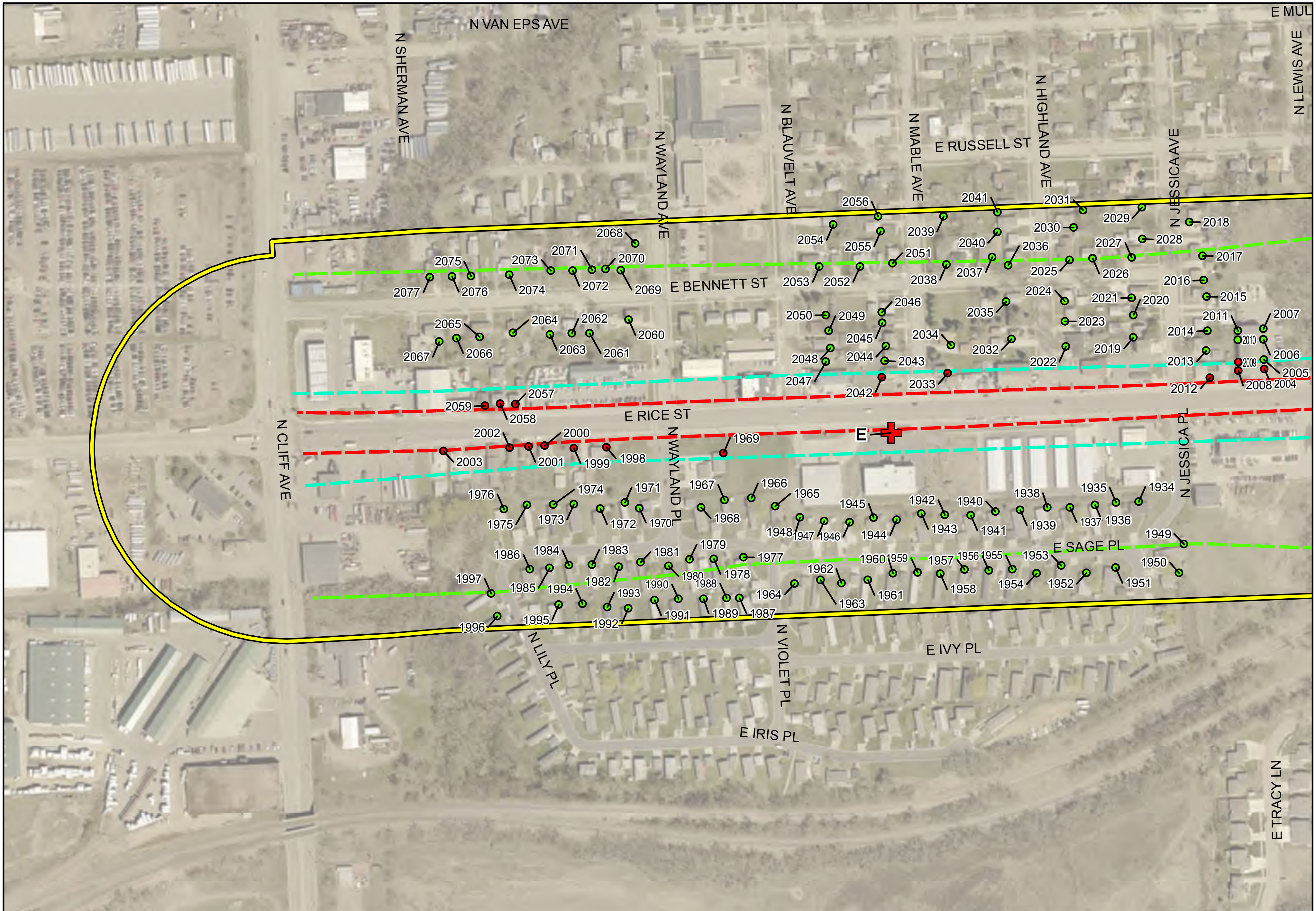

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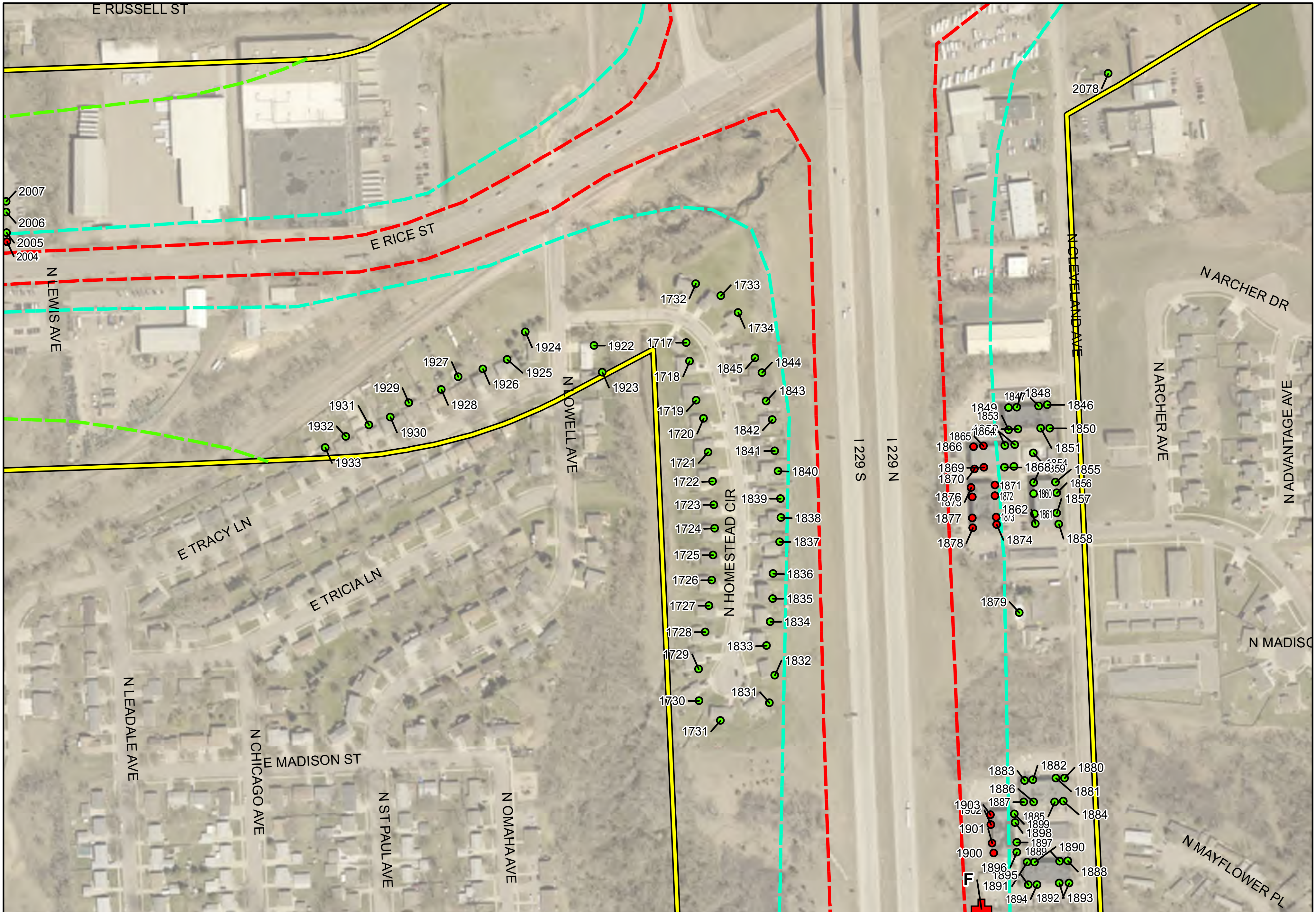

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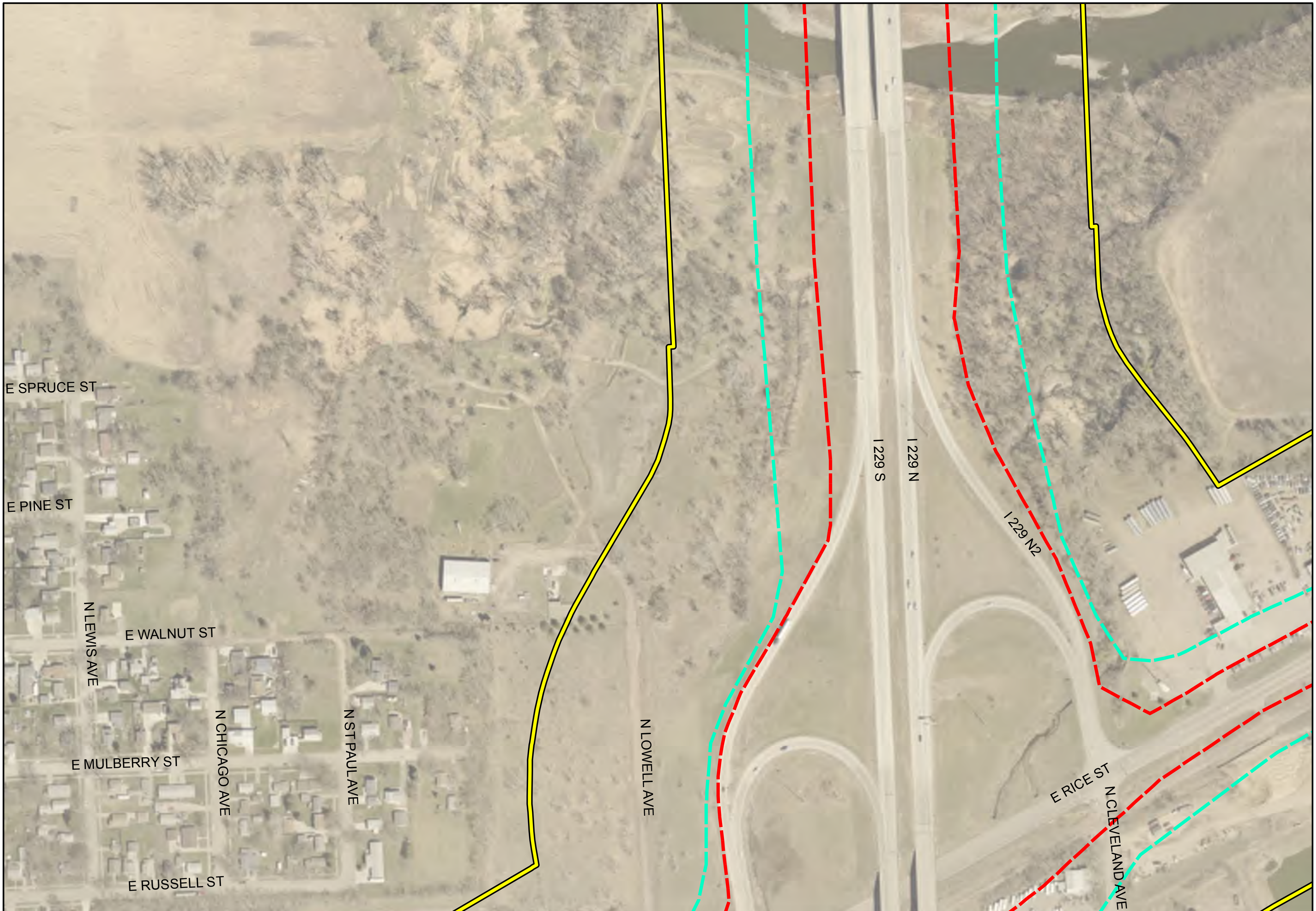

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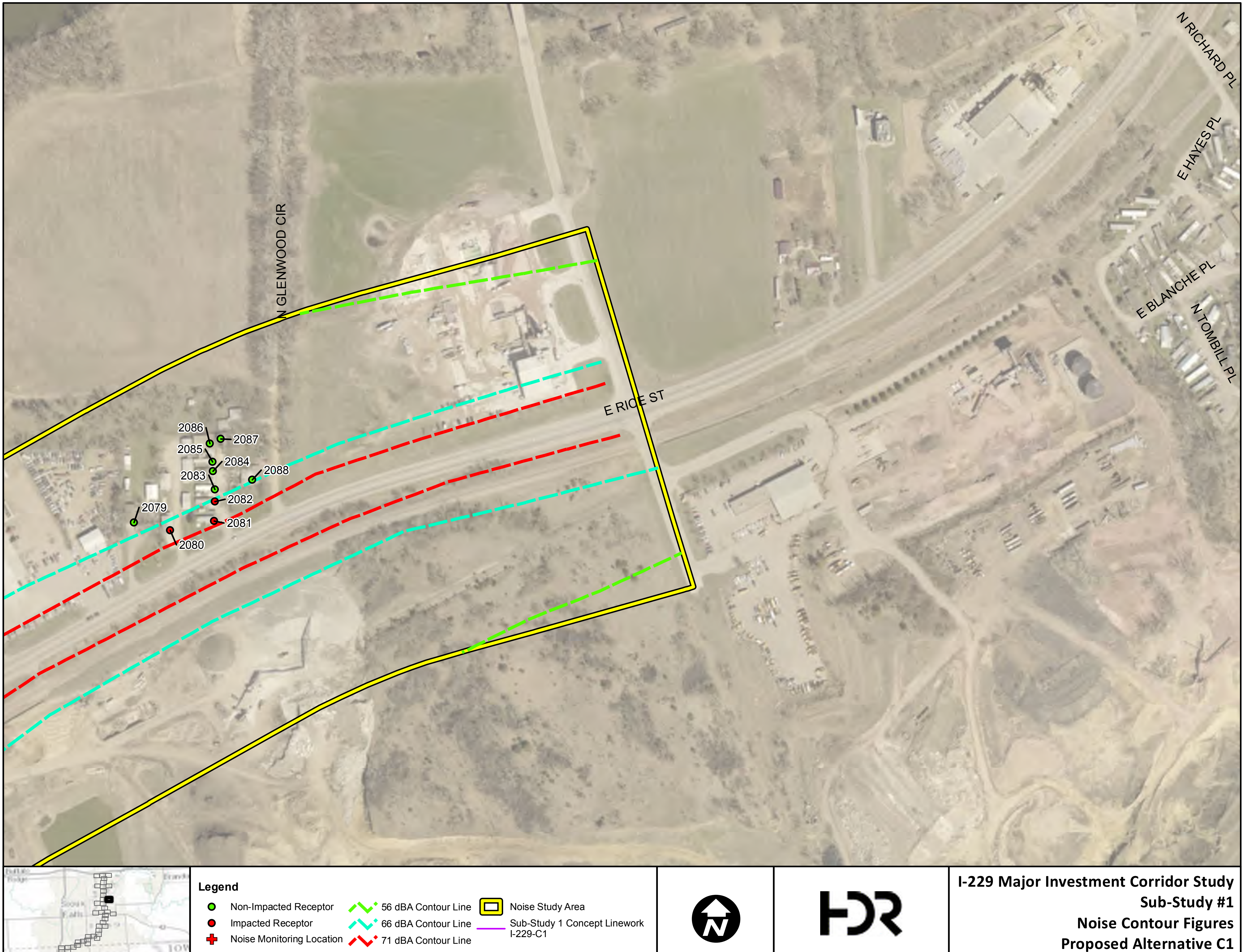

I-229 Major Investment Corridor Study
Sub-Study #1
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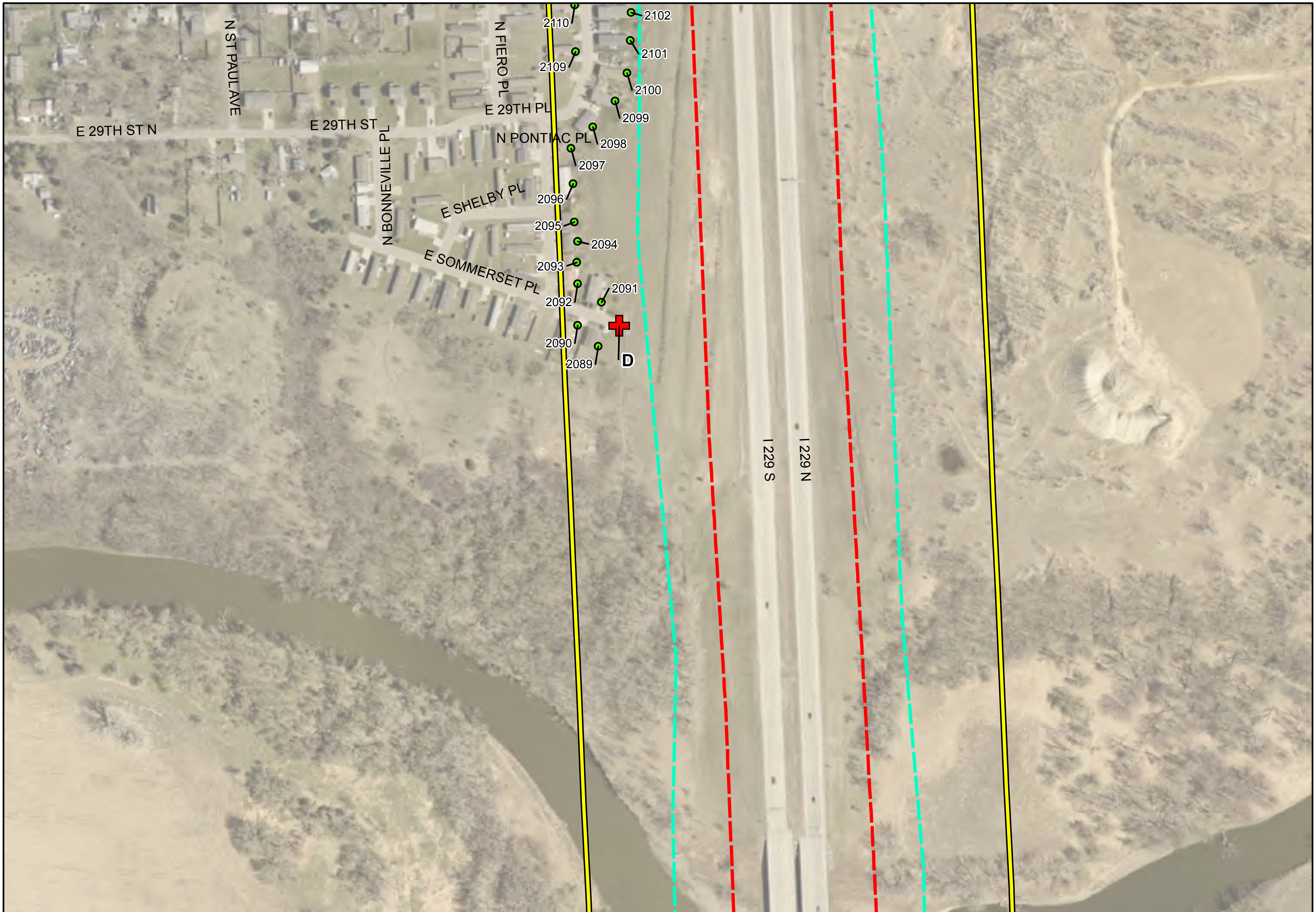

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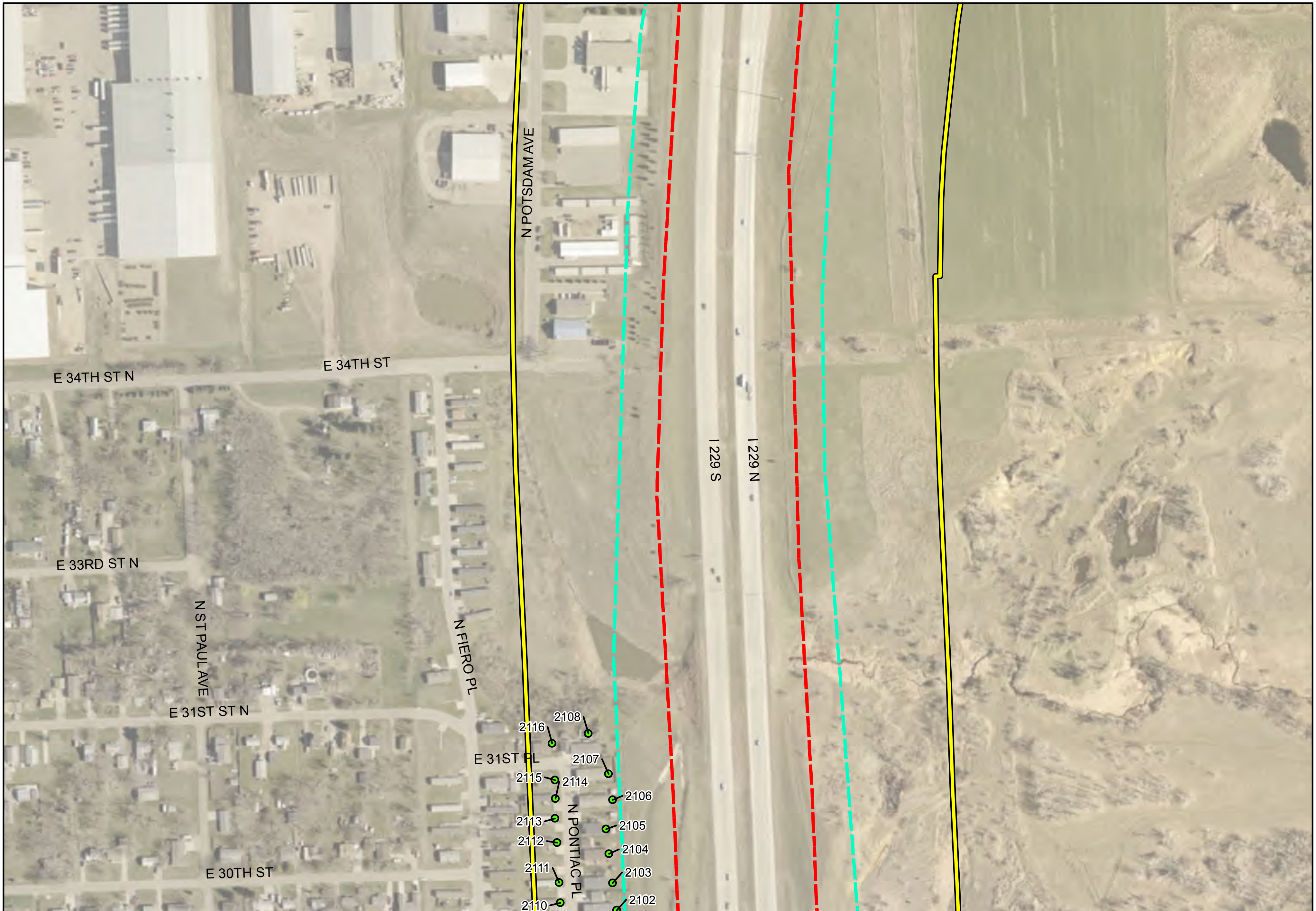

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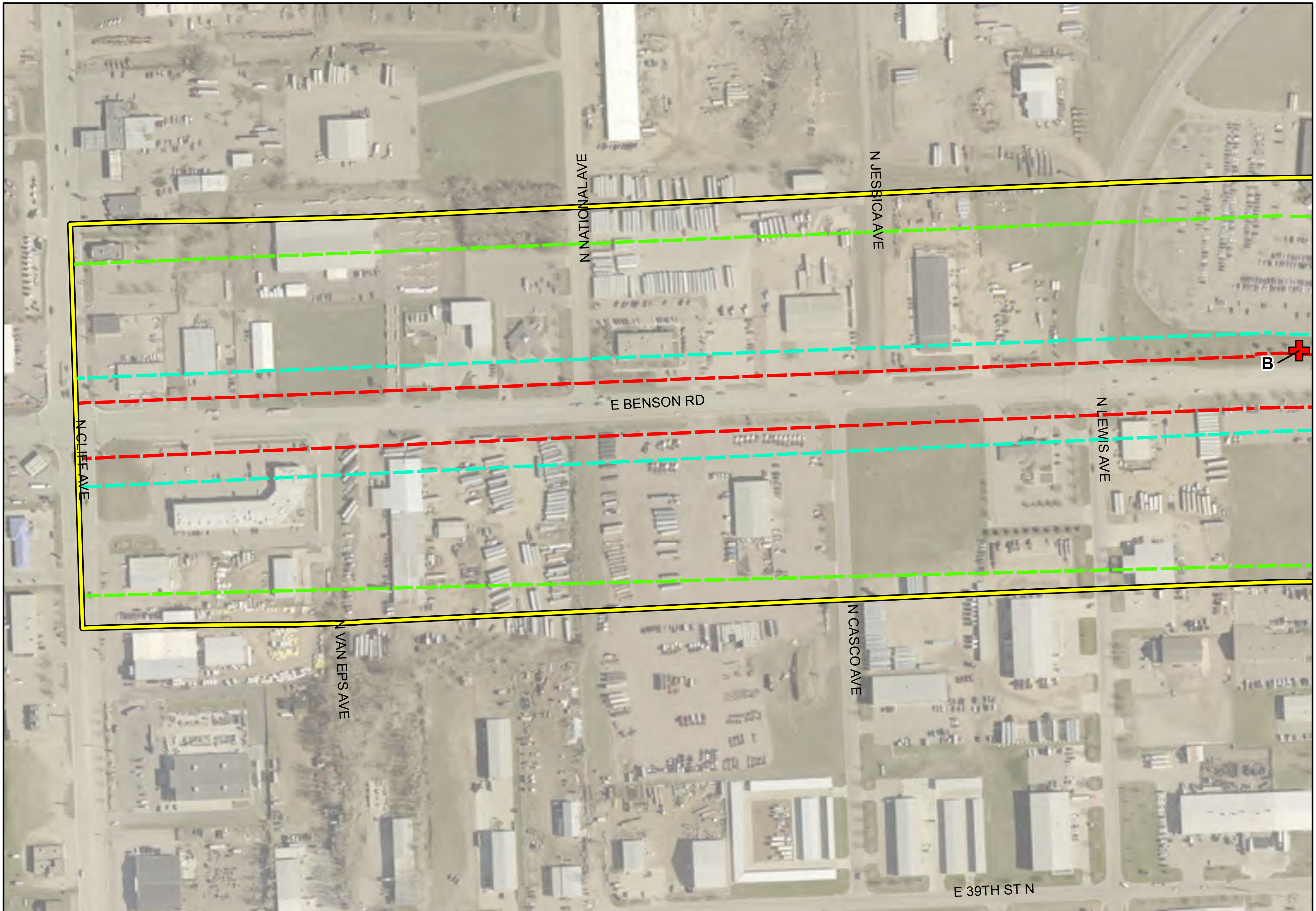

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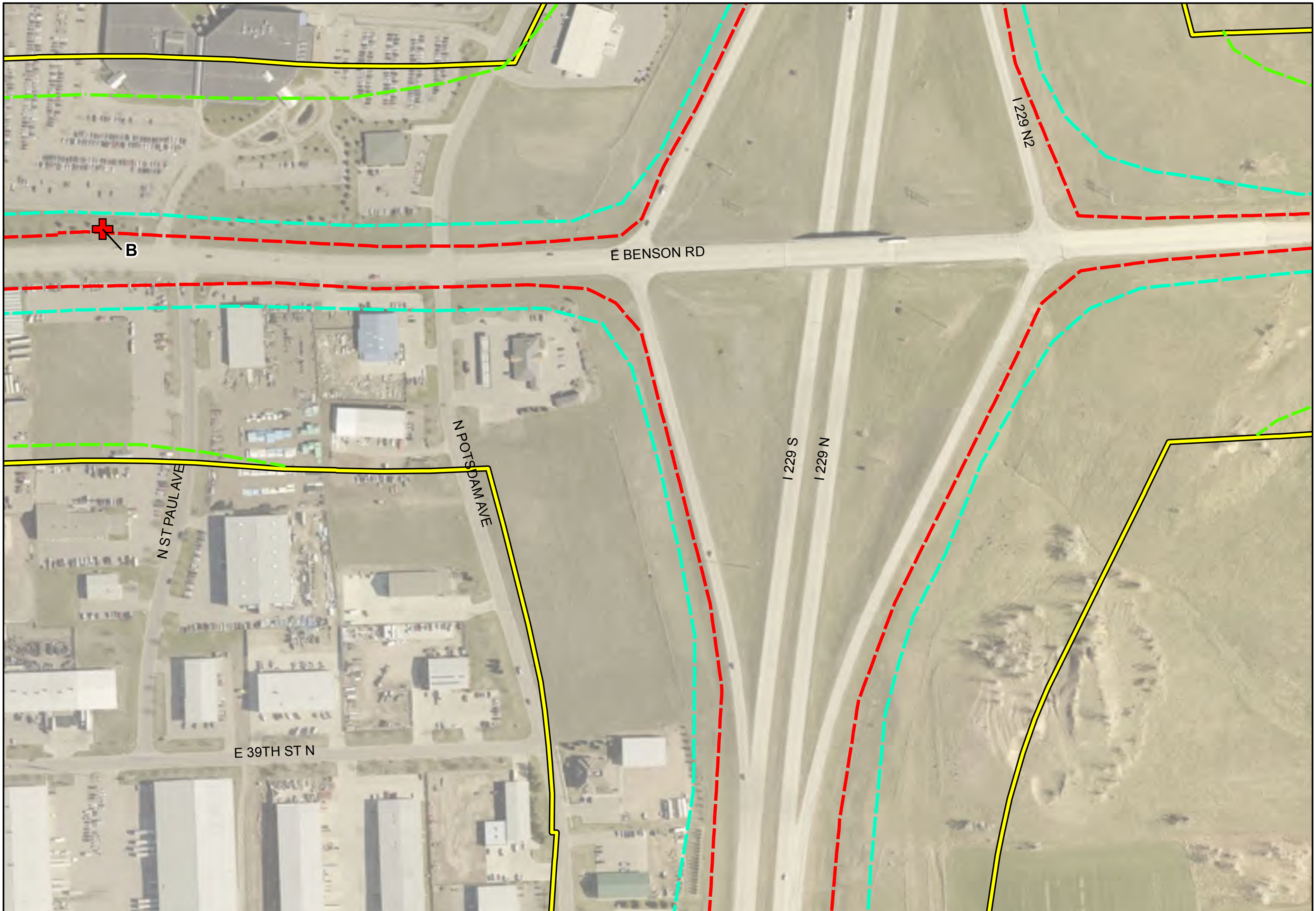

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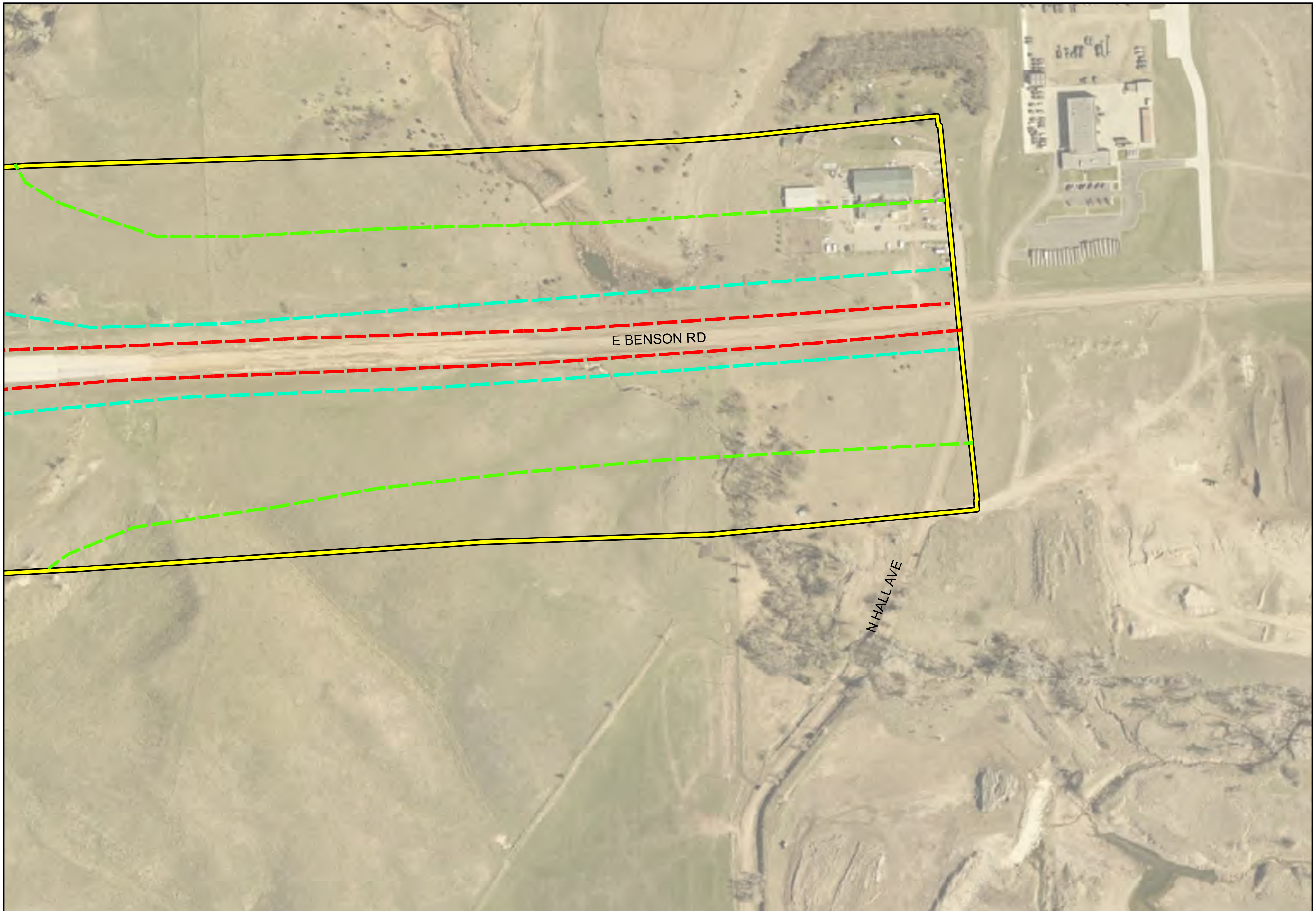

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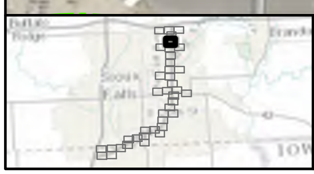

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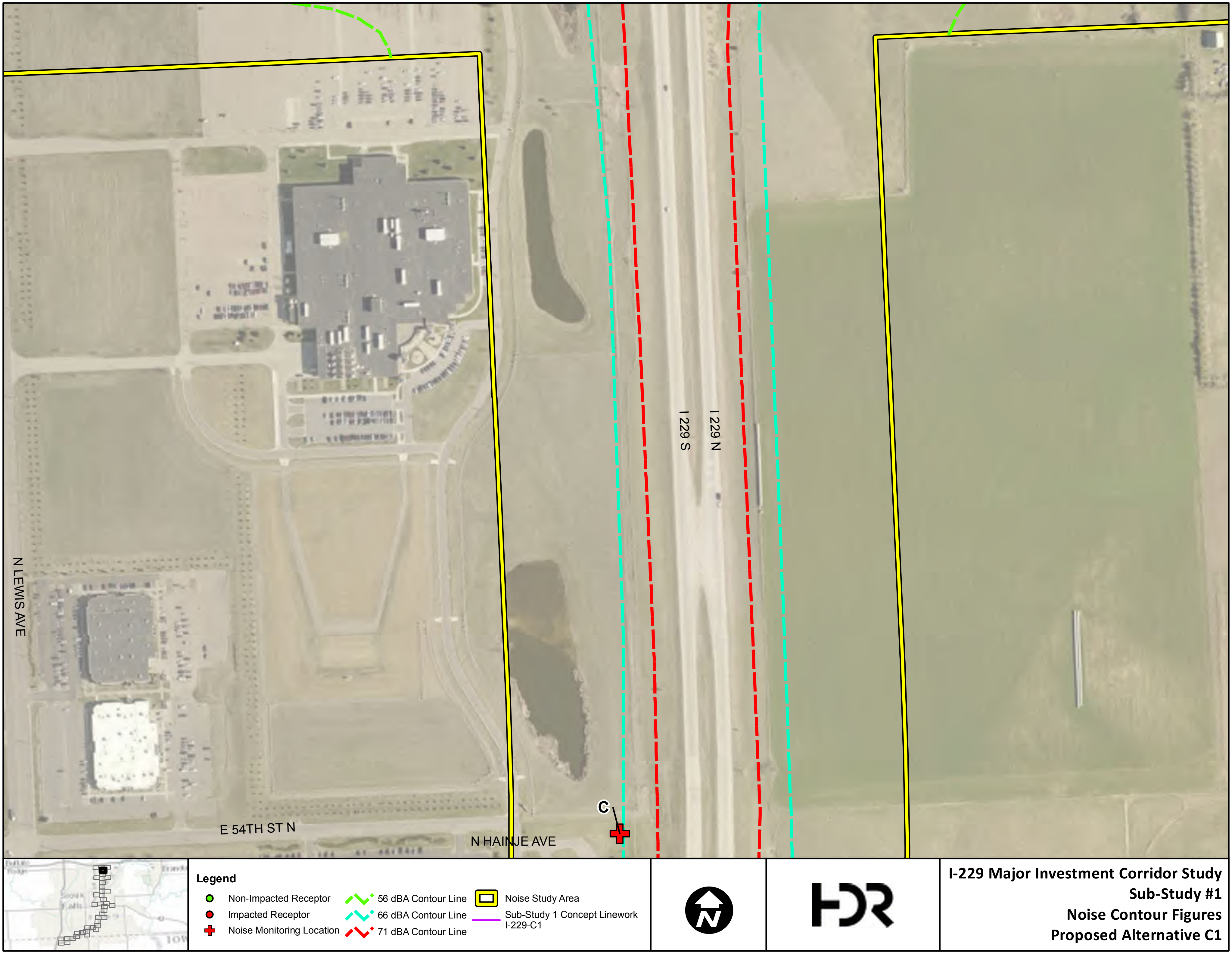

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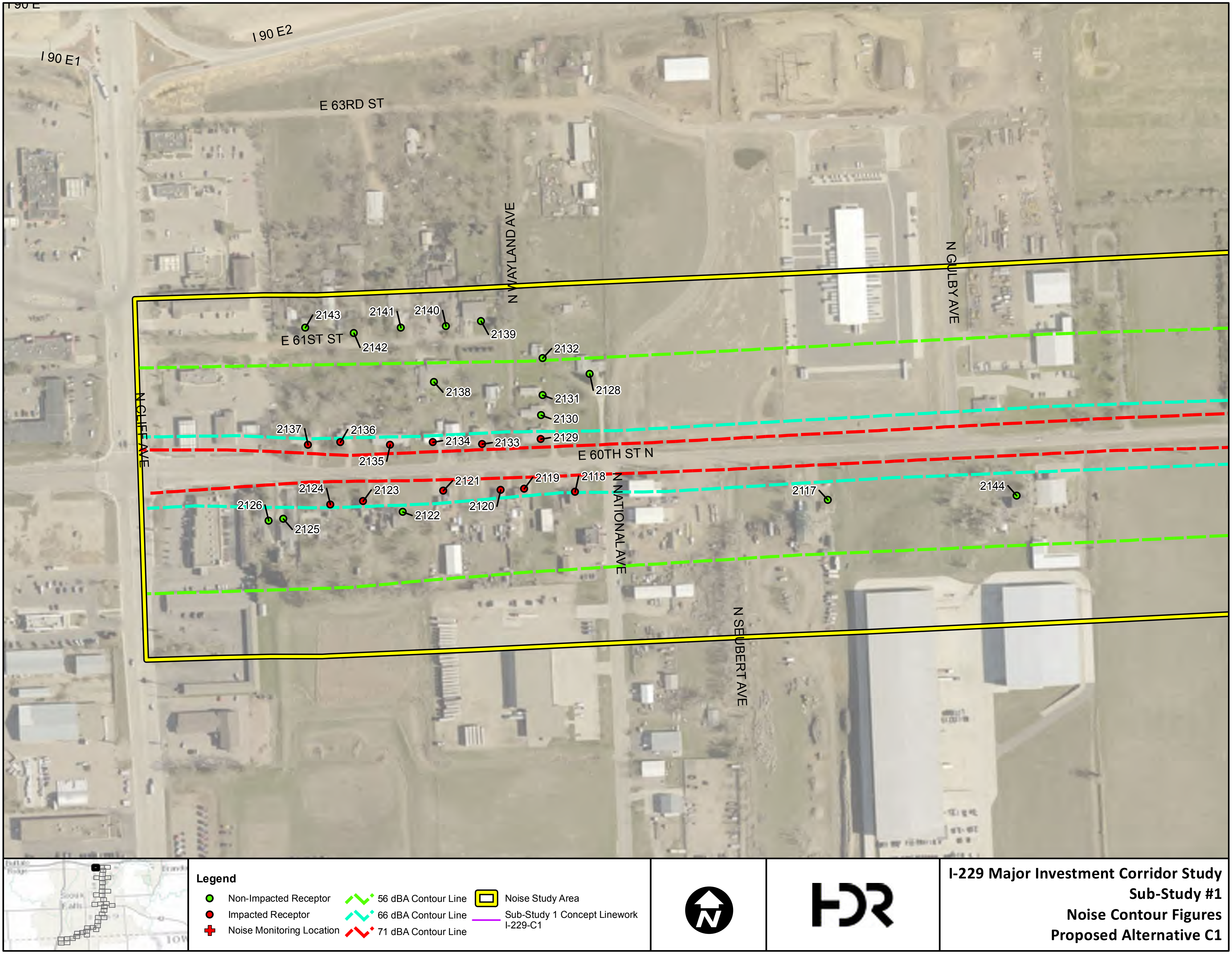

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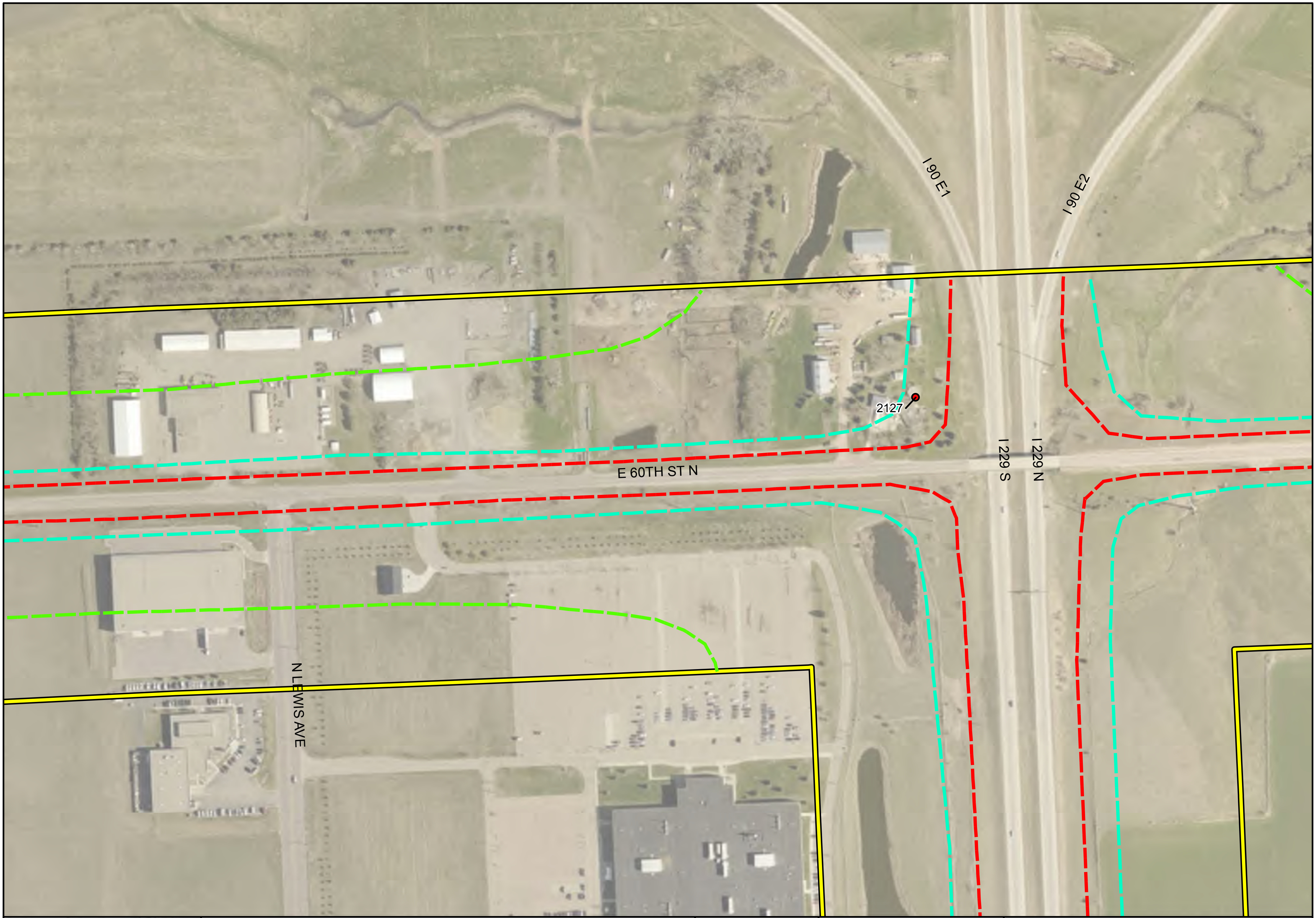
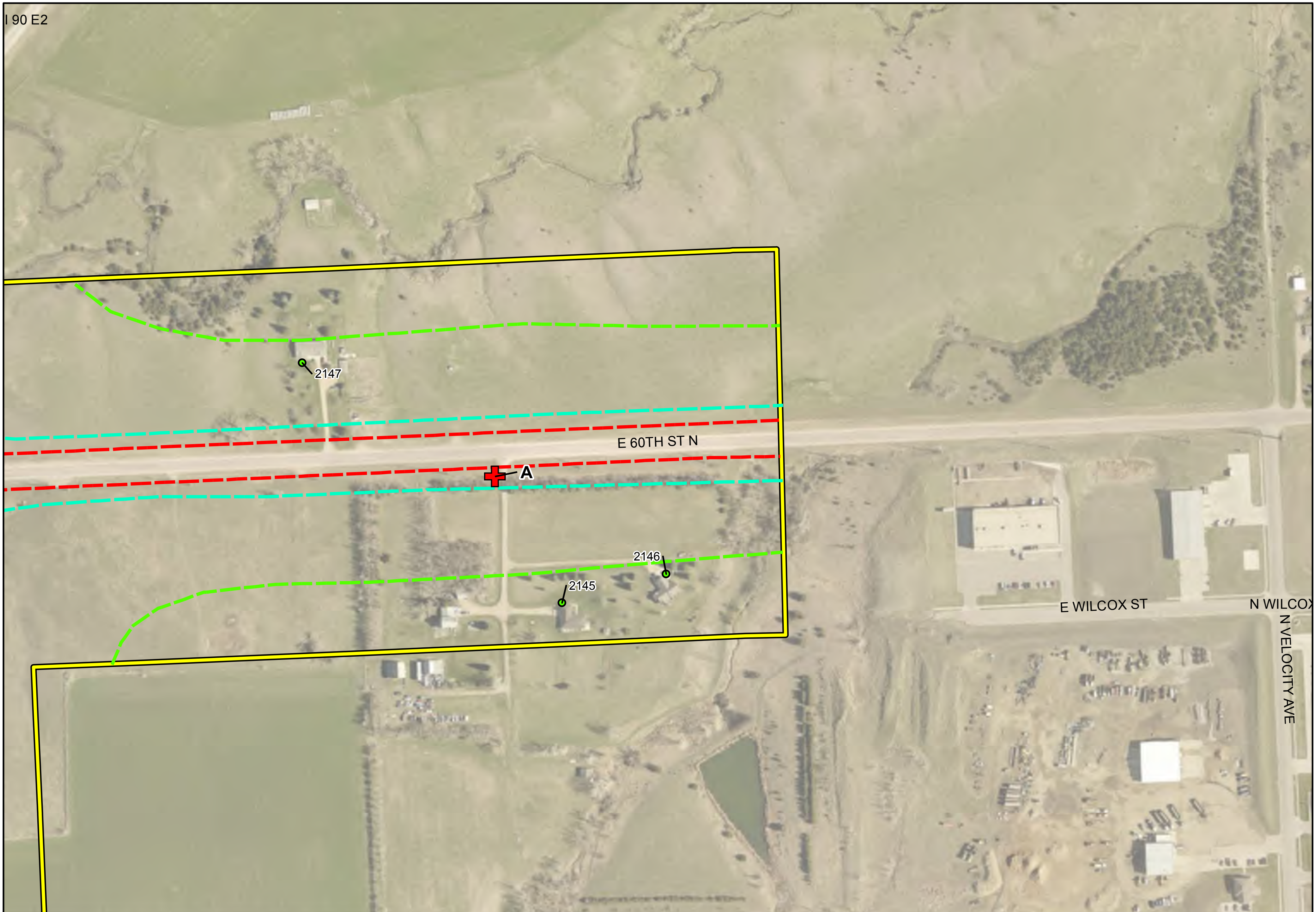
Noise Contour Figures
Proposed Alternative C1



Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 1 Concept Linework I-229-C1

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C1

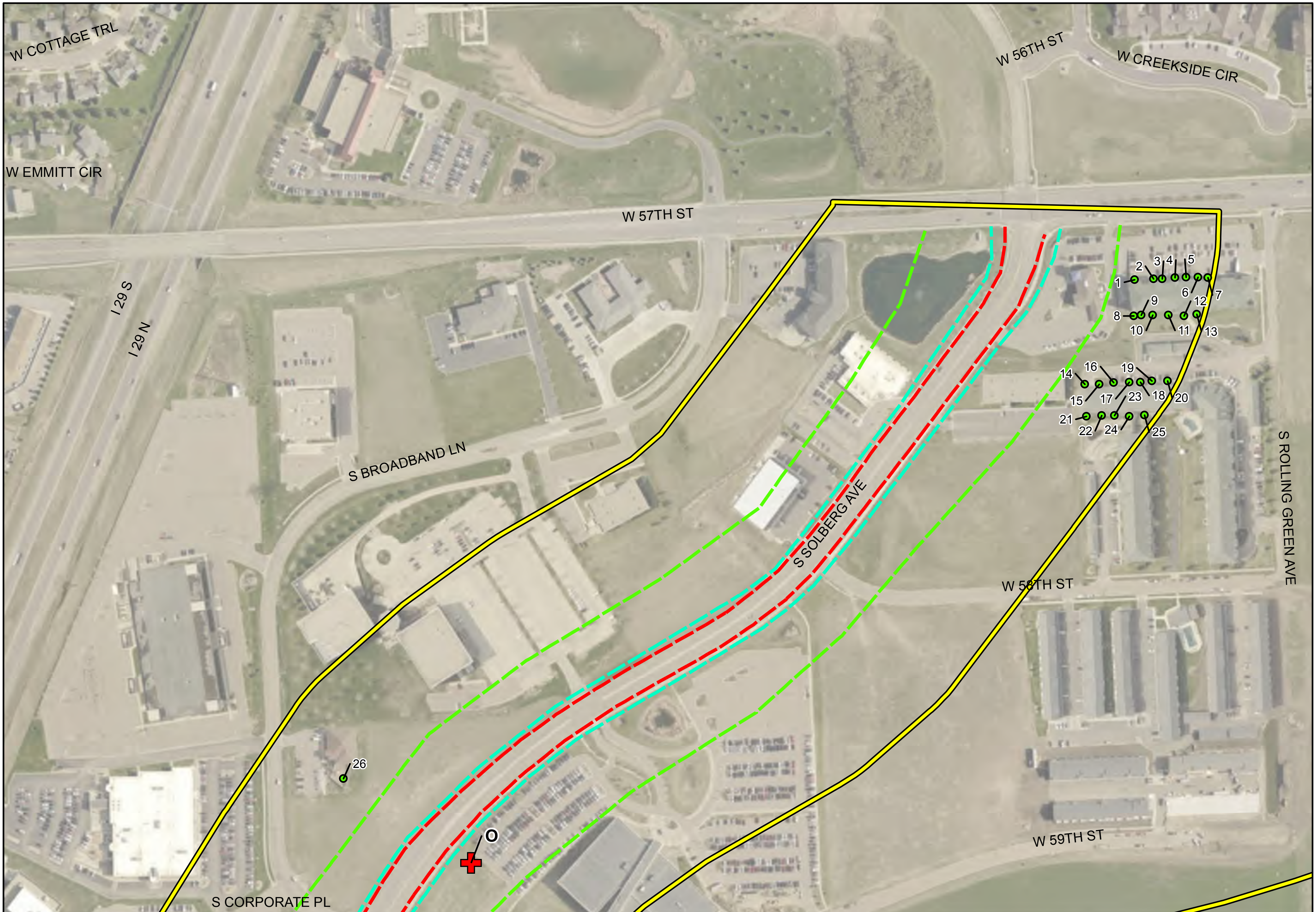


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 1 Concept Linework I-229-C1

HDR

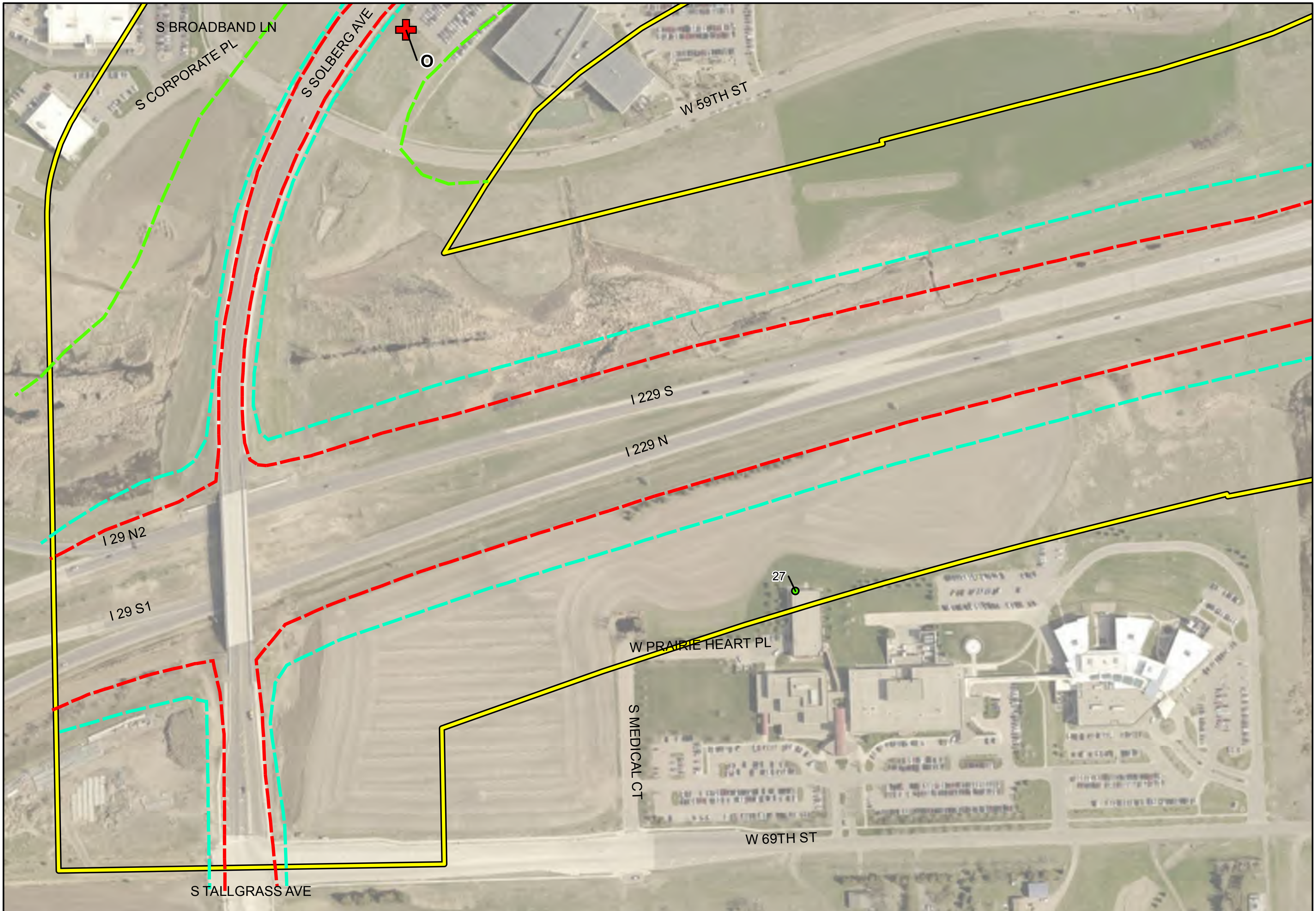
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C1



Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 1 Concept Linework I-229-C2

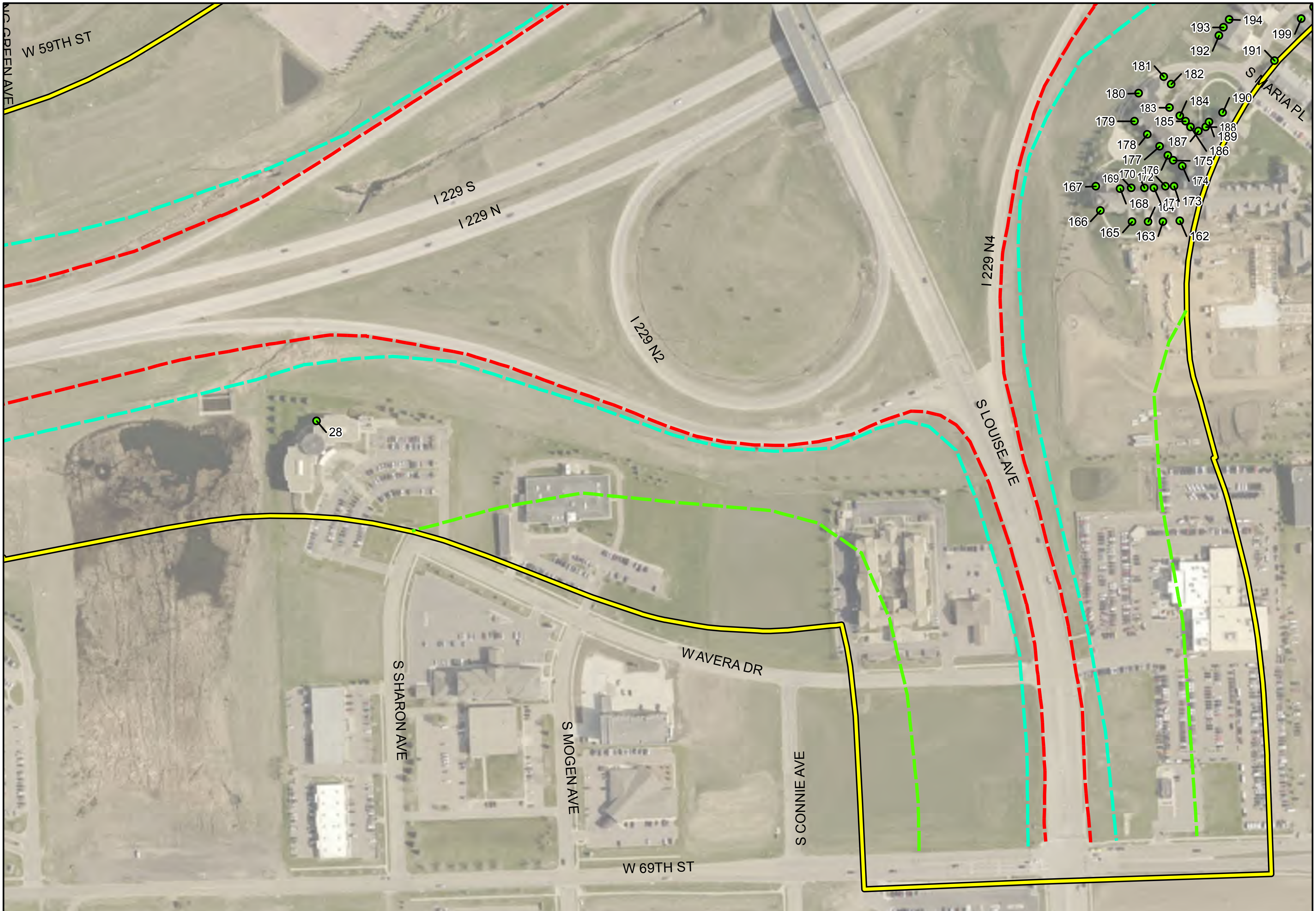
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 1 Concept Linework I-229-C2

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



Legend

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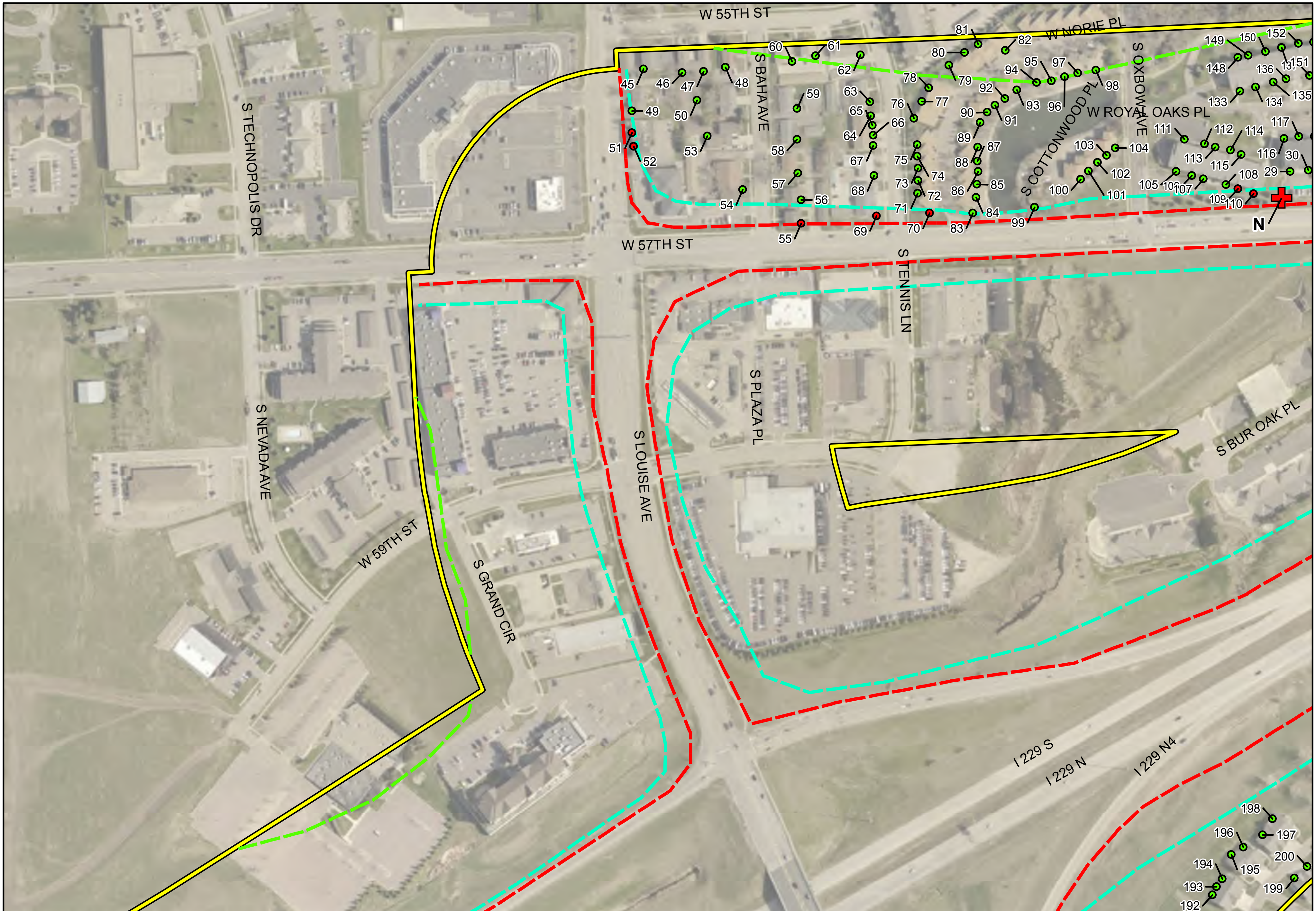
- Sub-Study 1 Concept Linework I-229-C2

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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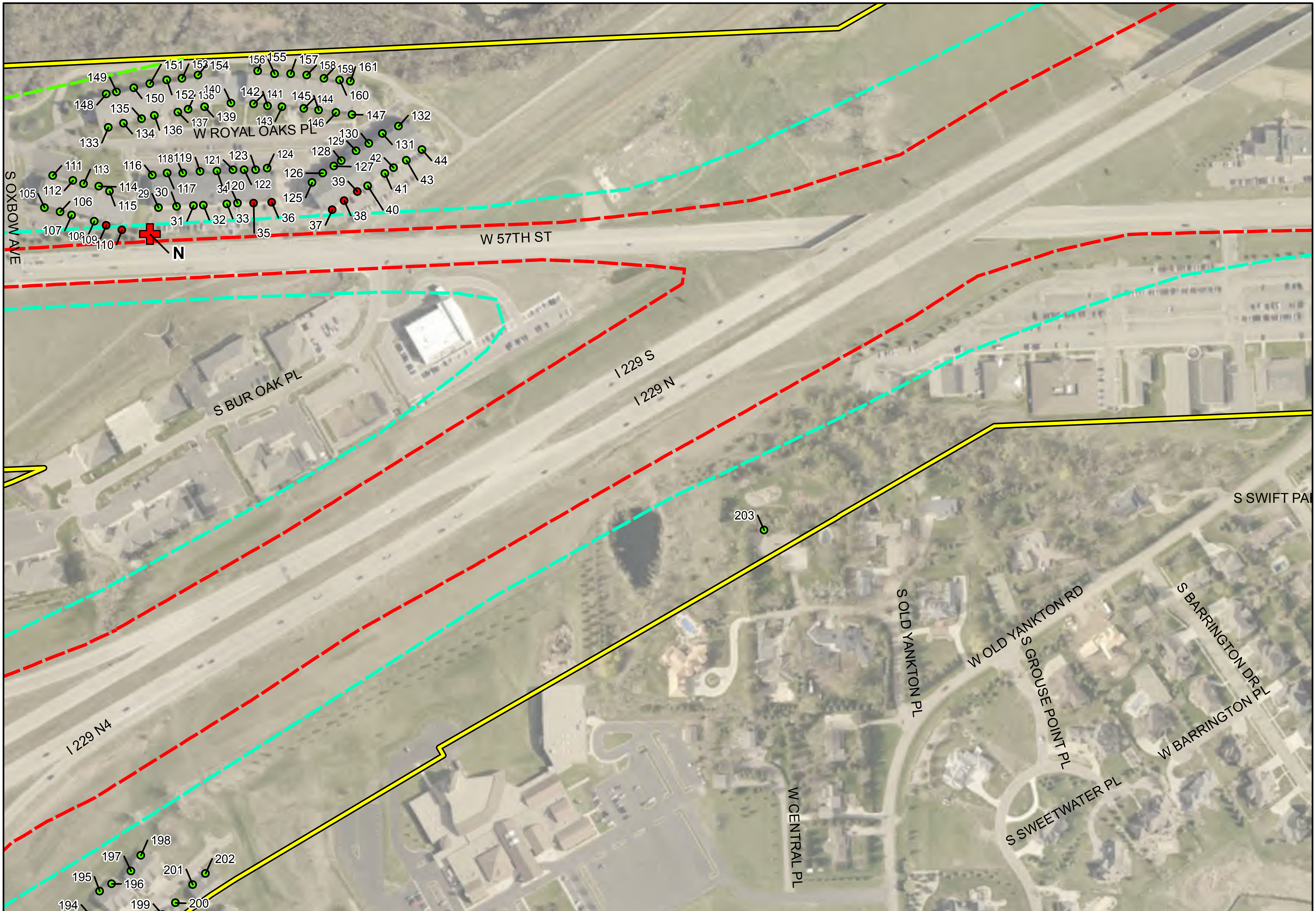
HDR

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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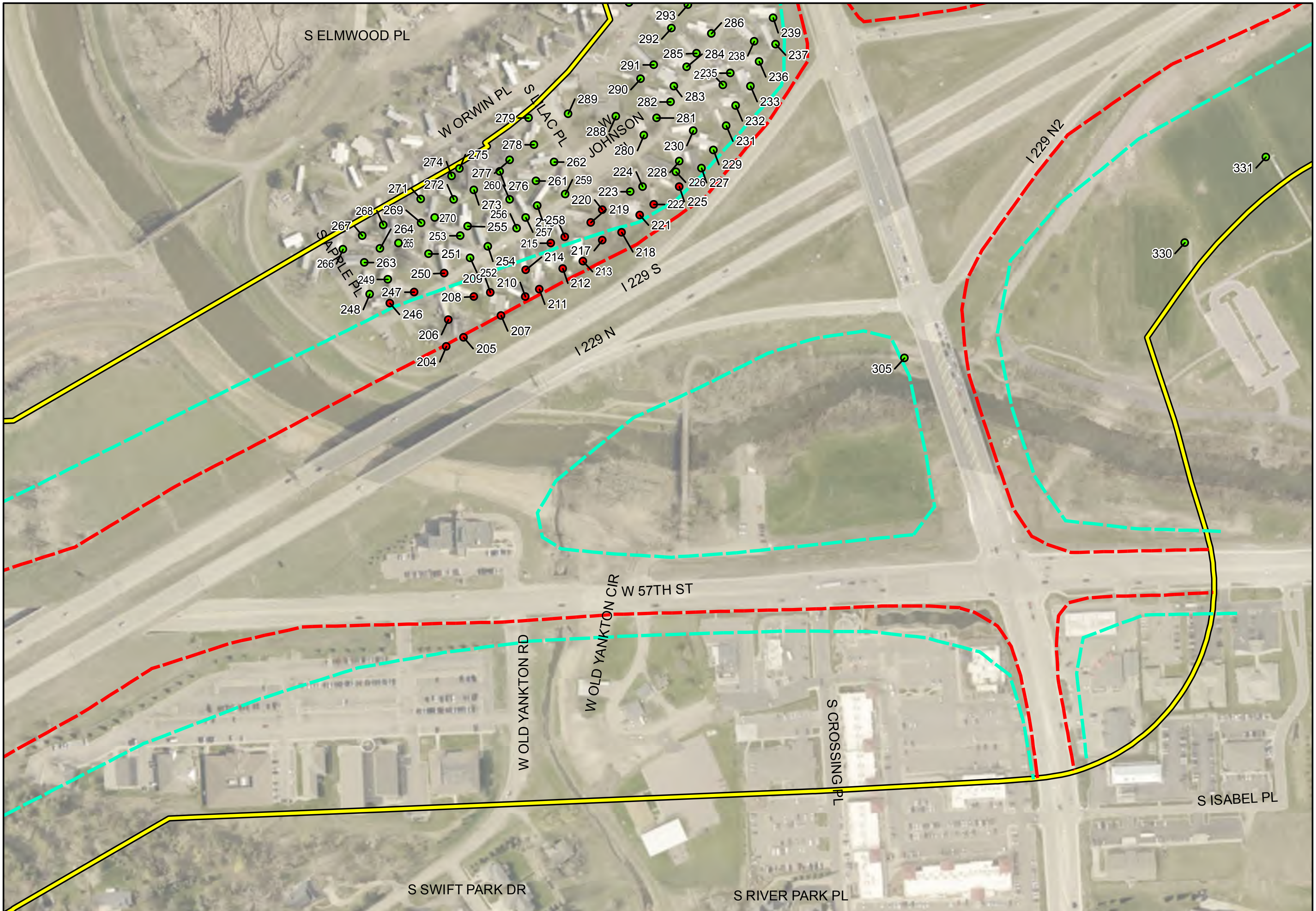
HDR

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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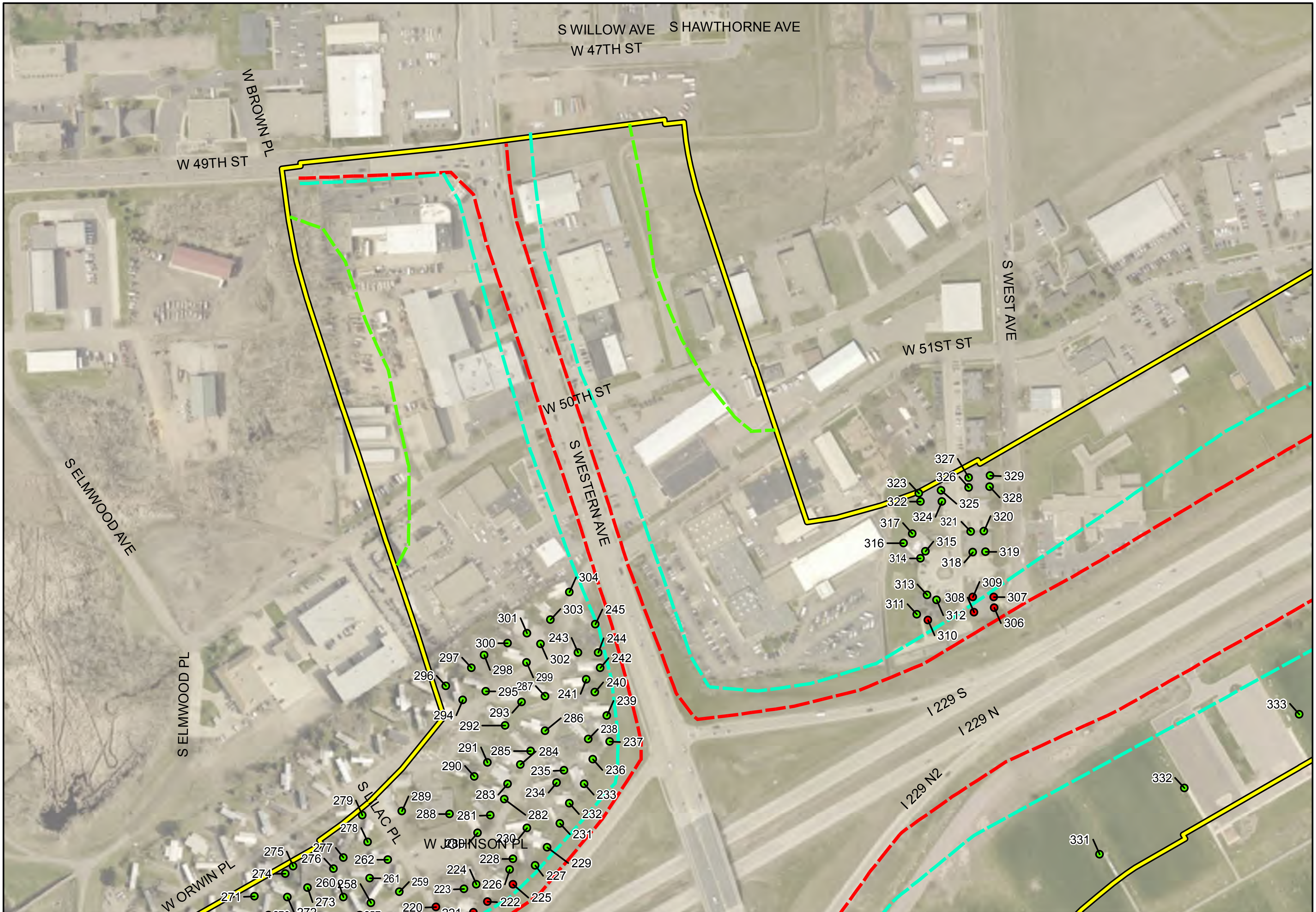
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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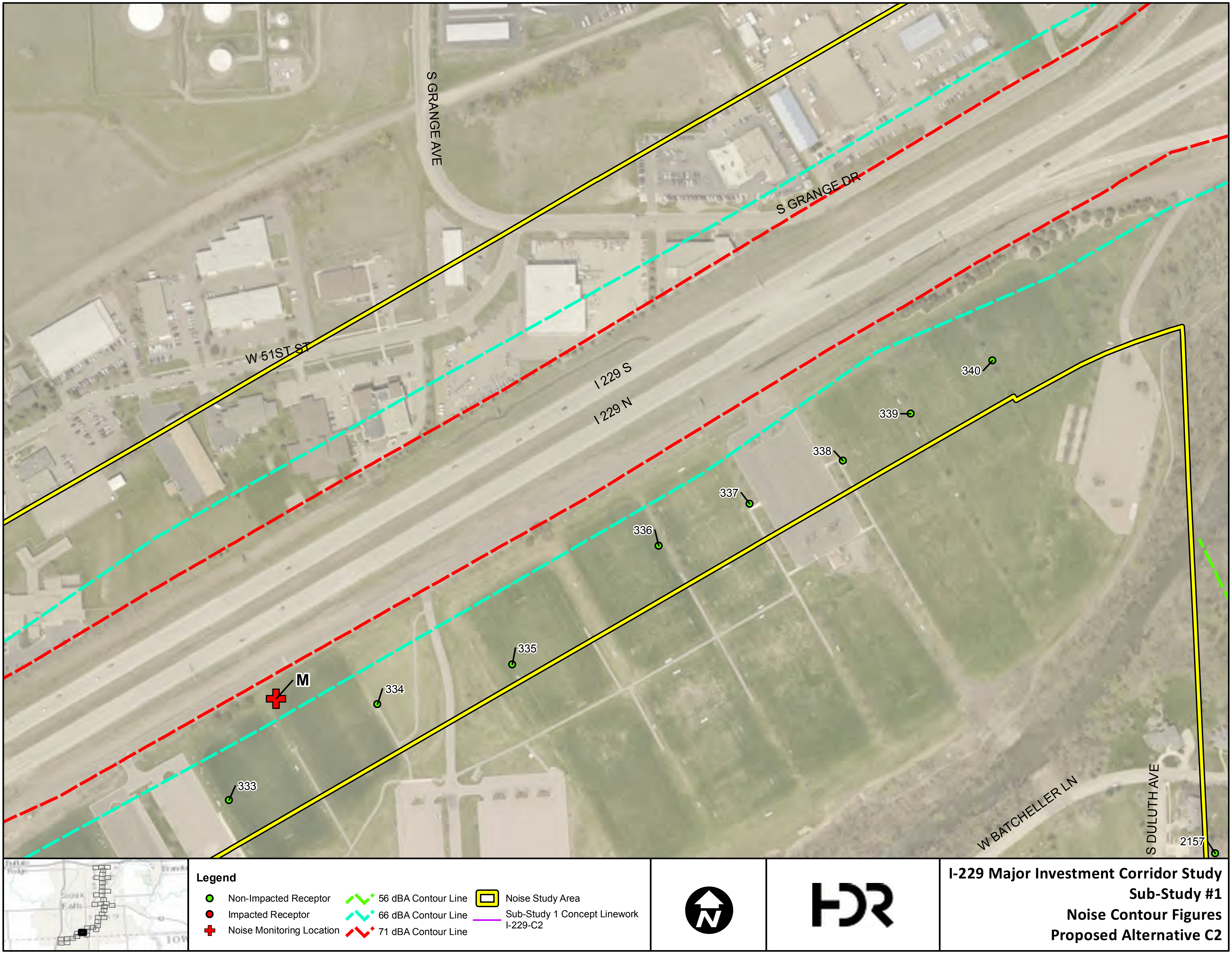
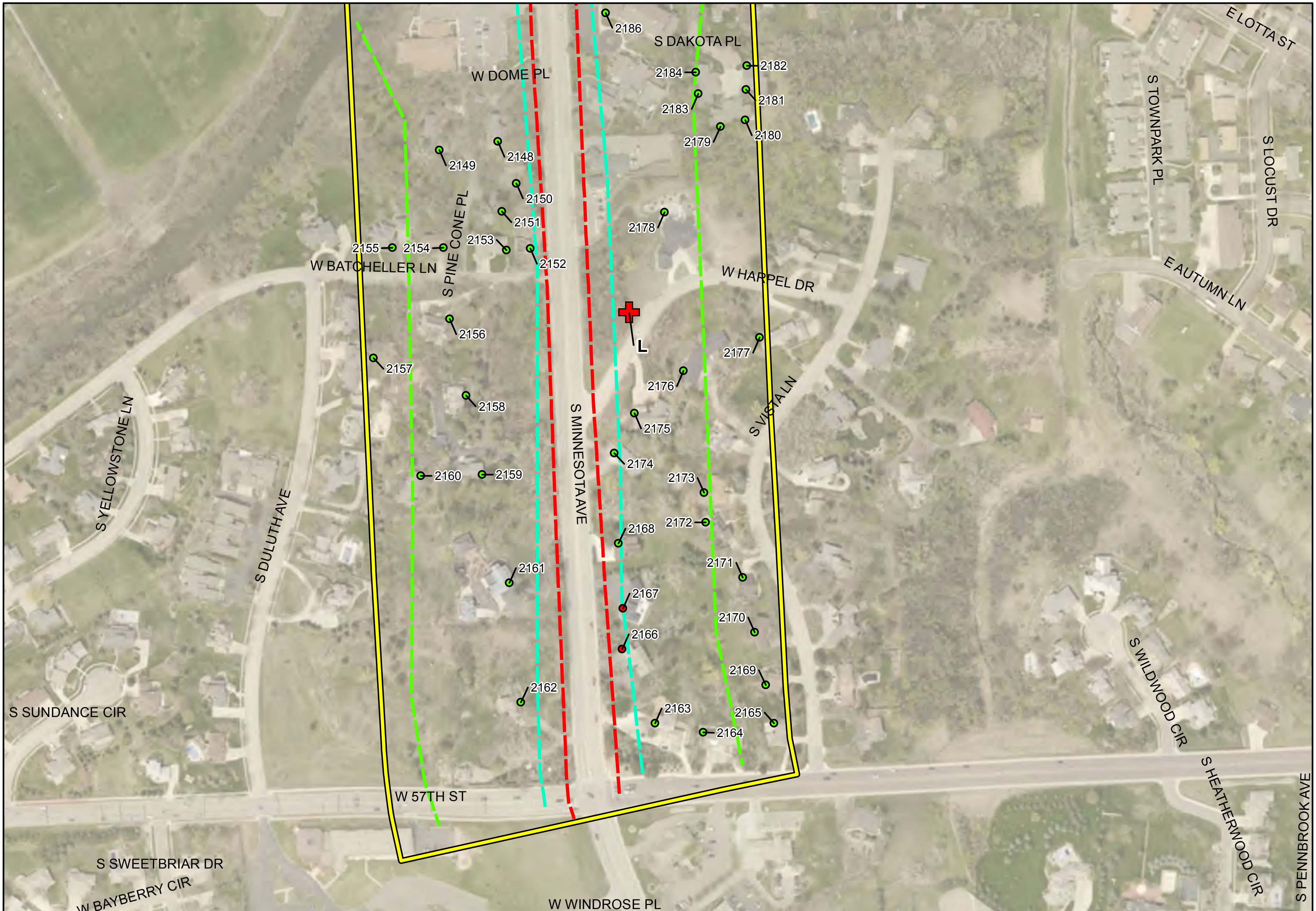
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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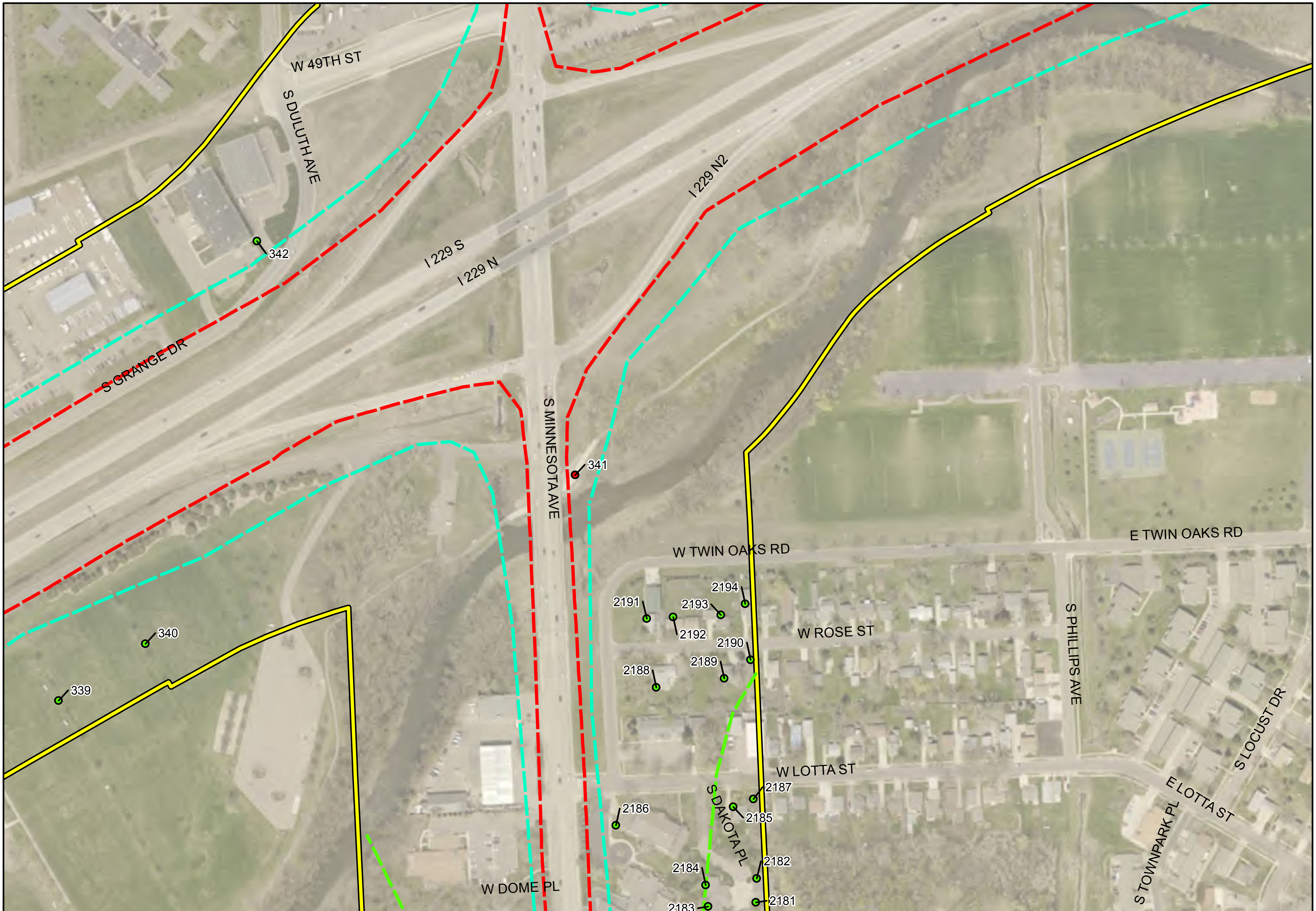
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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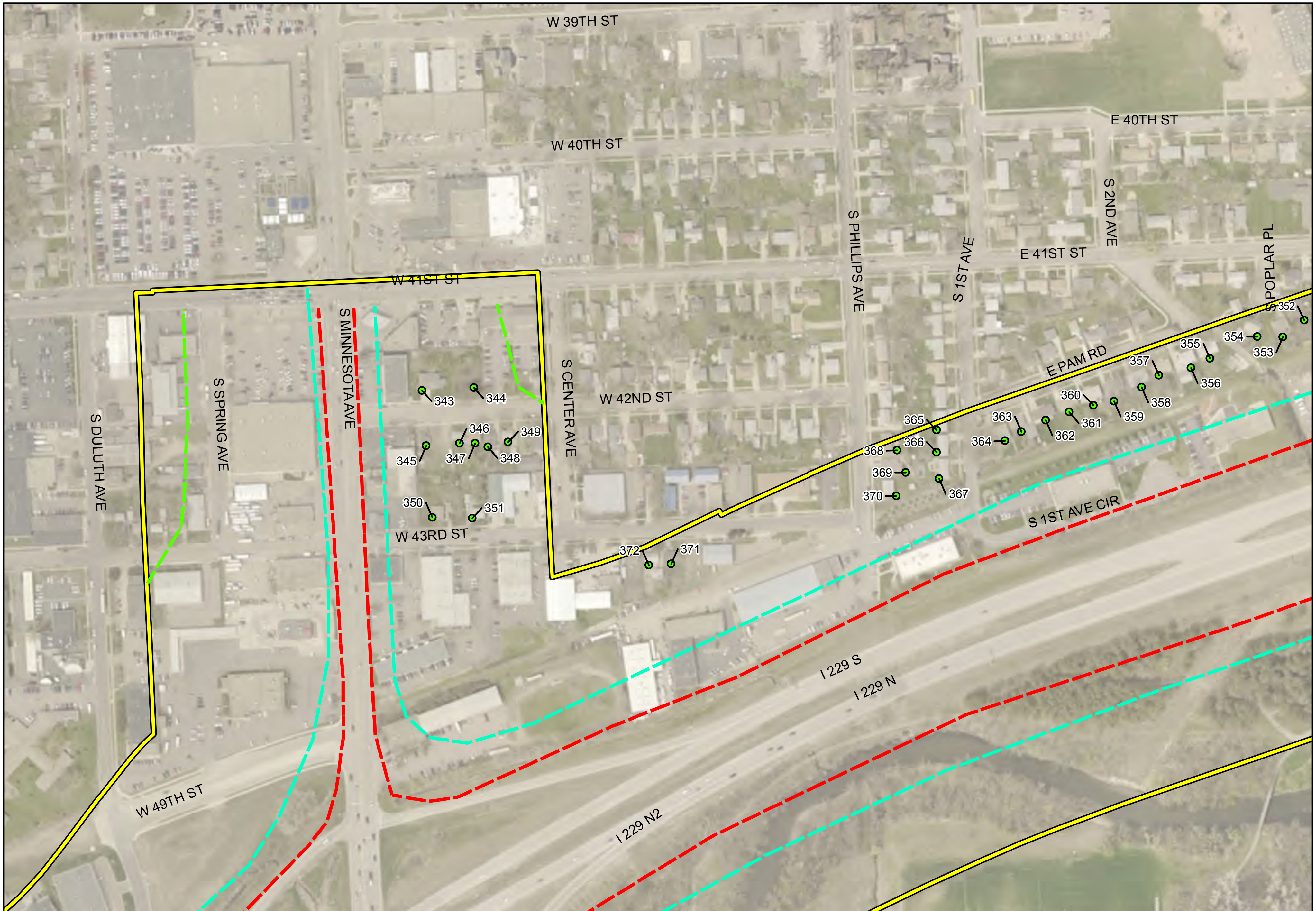
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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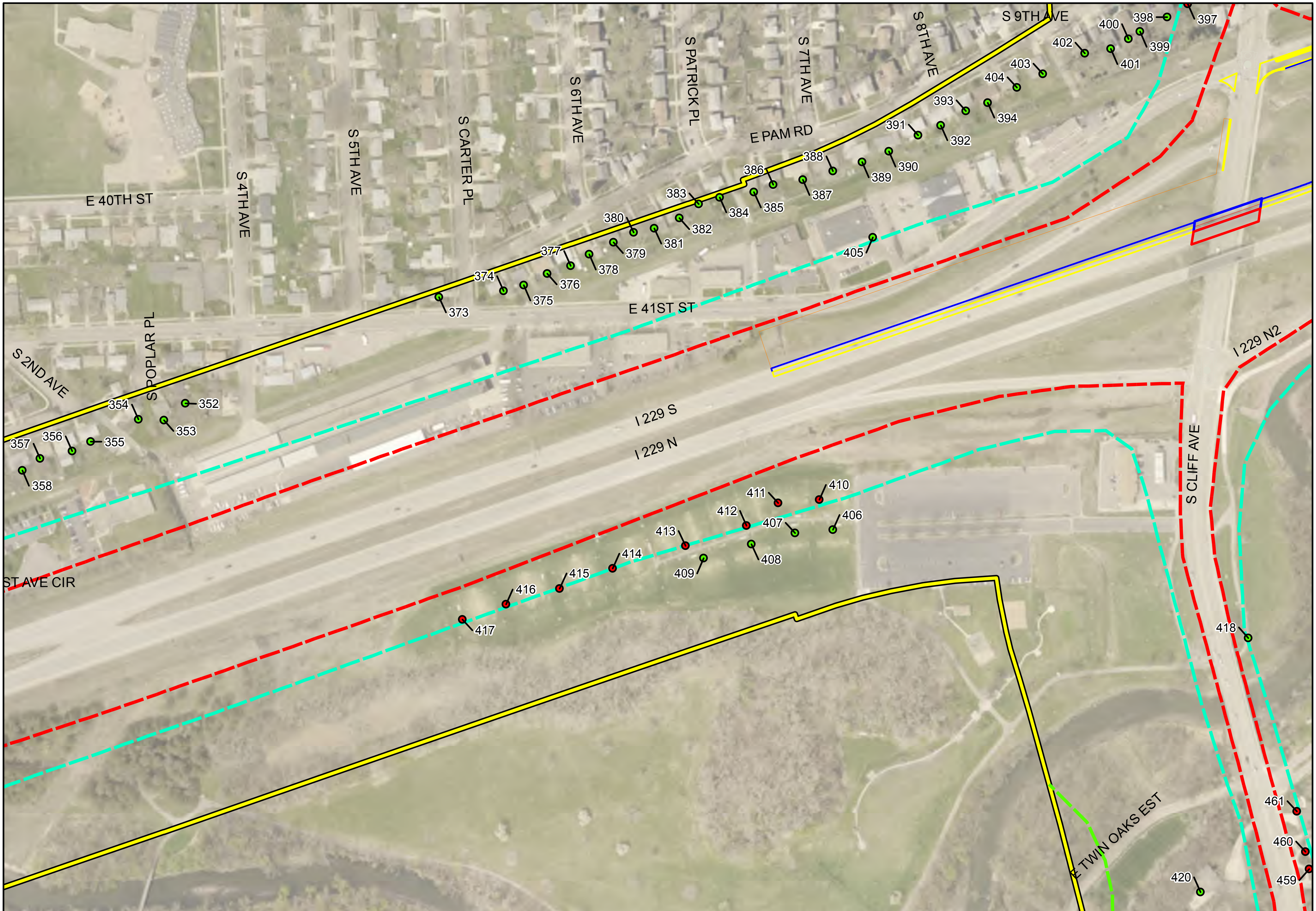
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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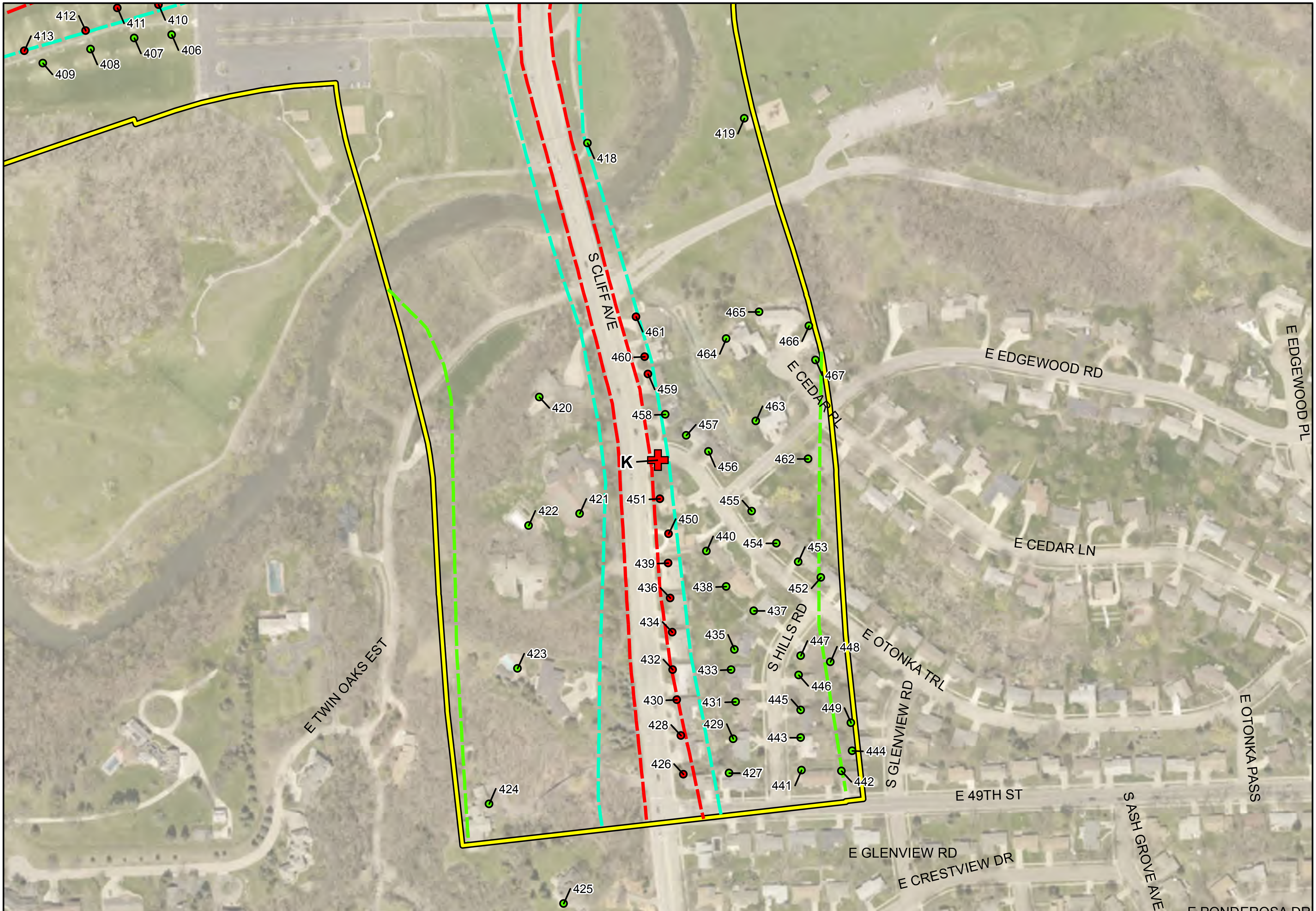
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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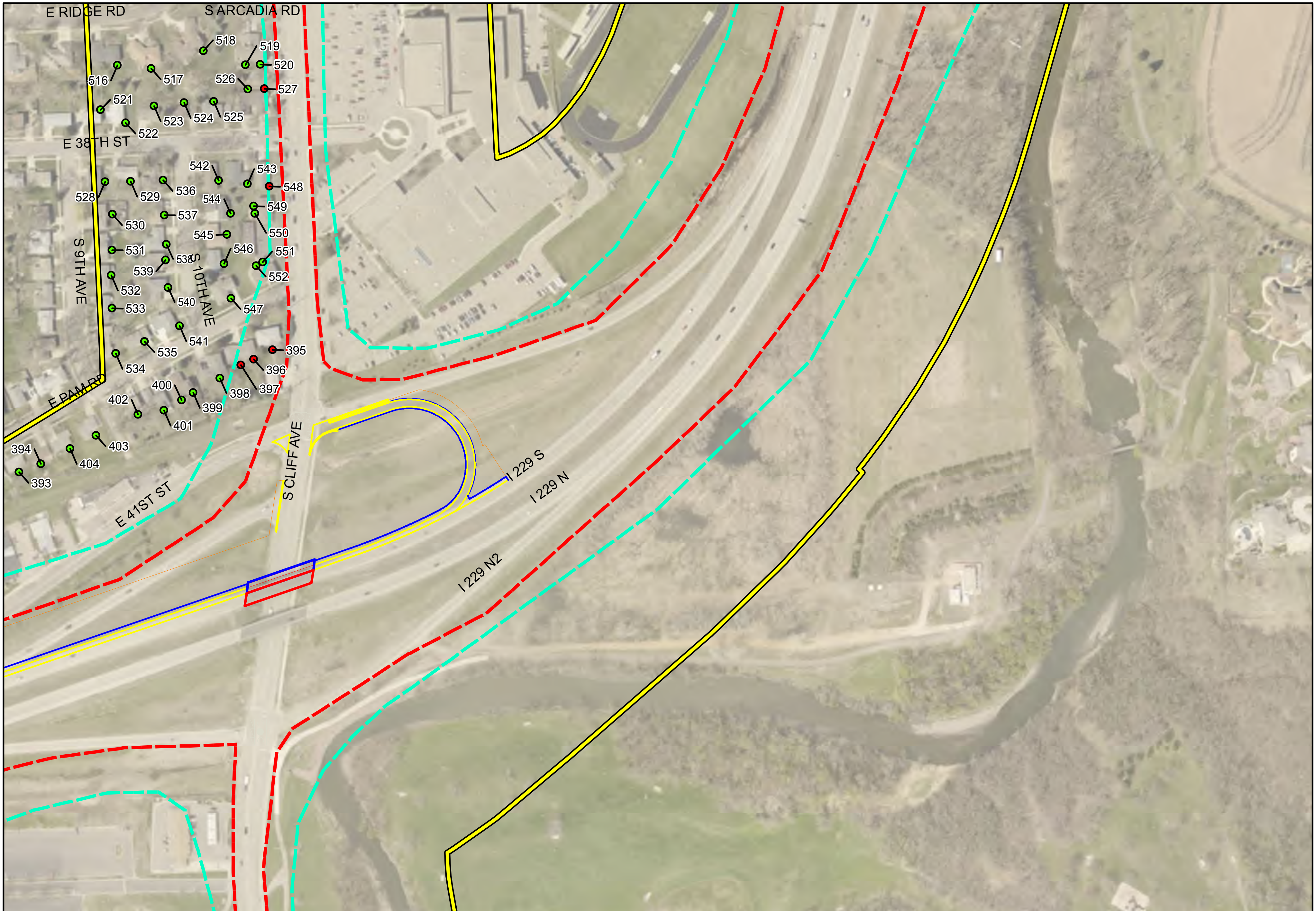
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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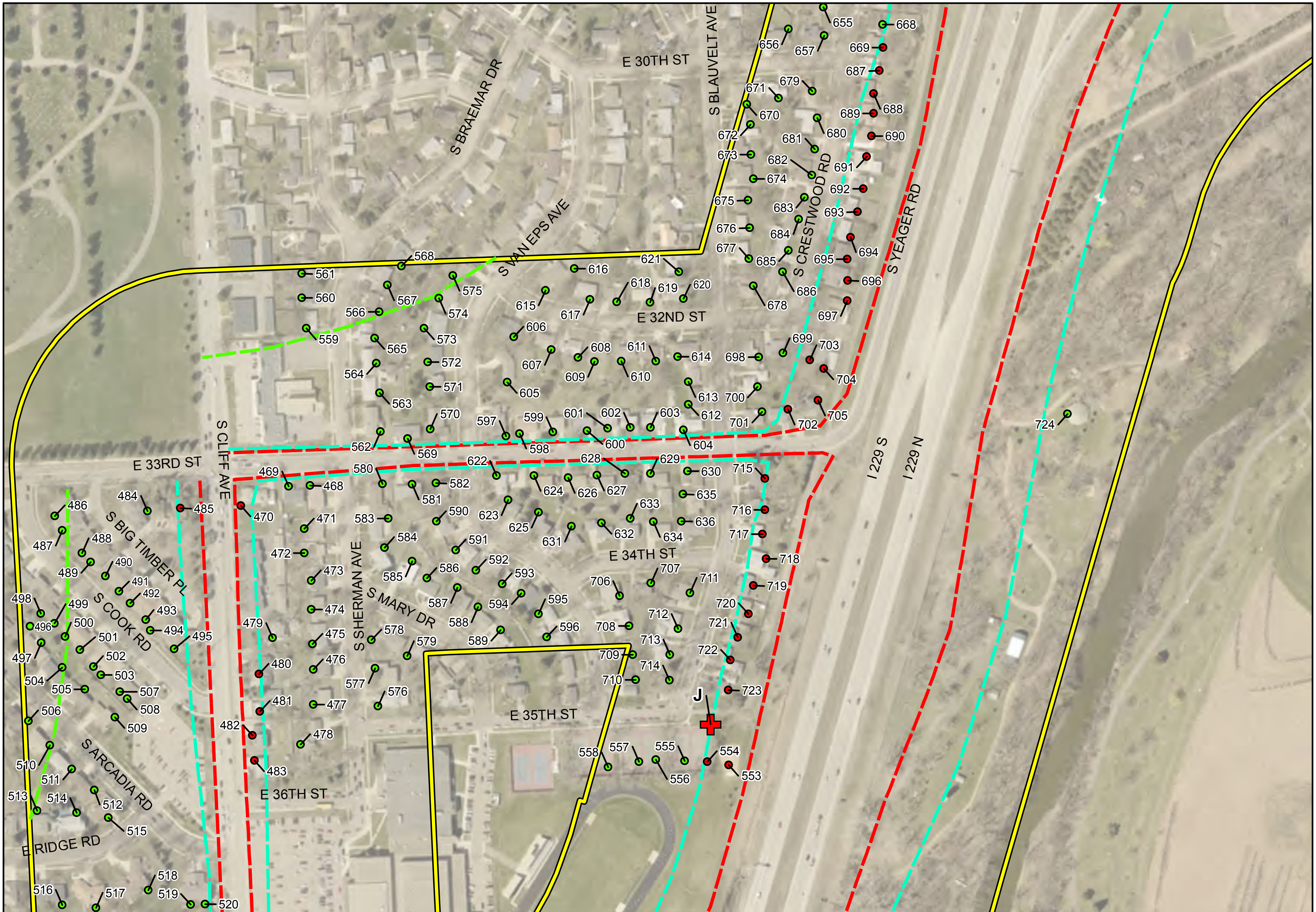
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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Sub-Study #1
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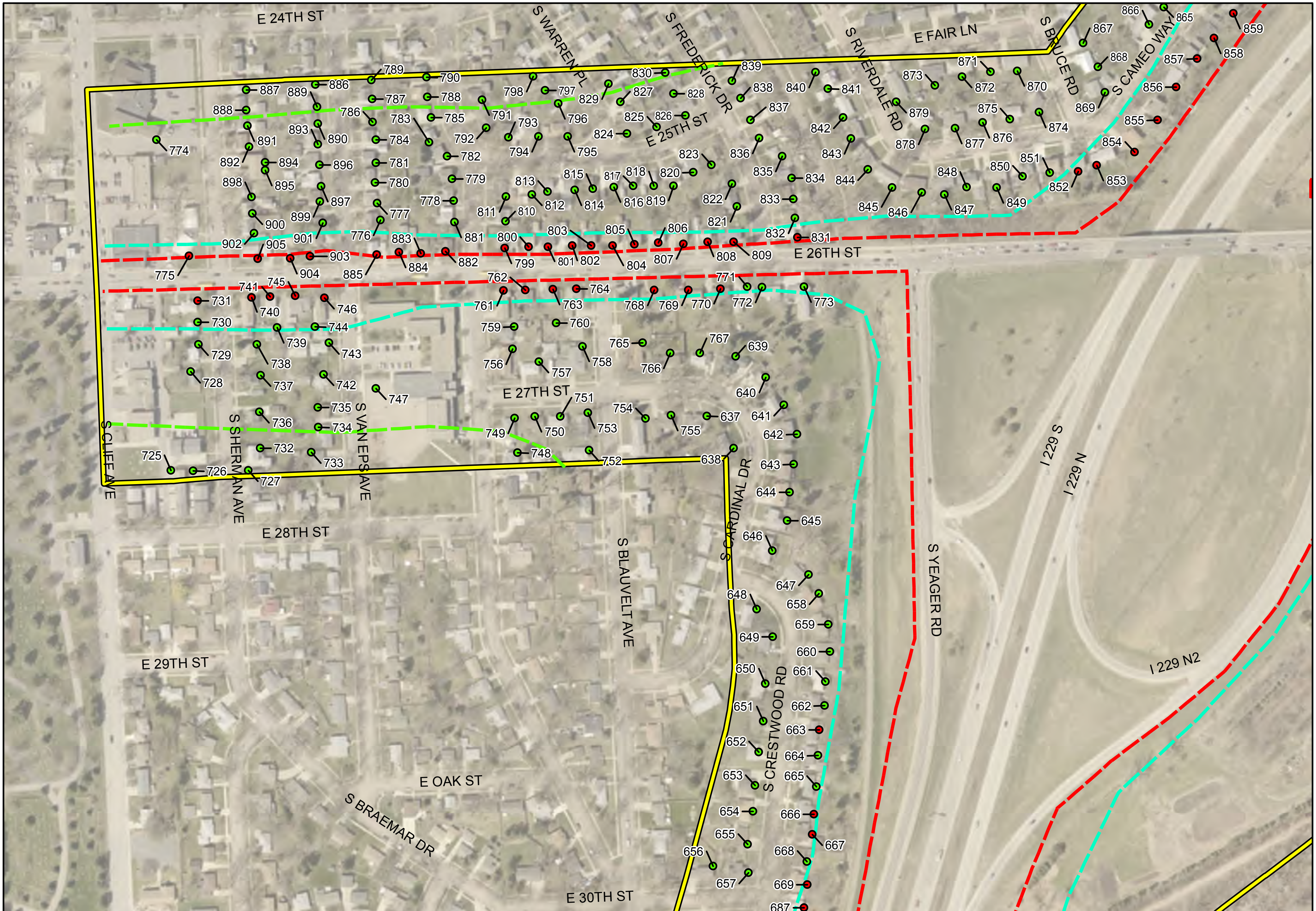
Proposed Alternative C2



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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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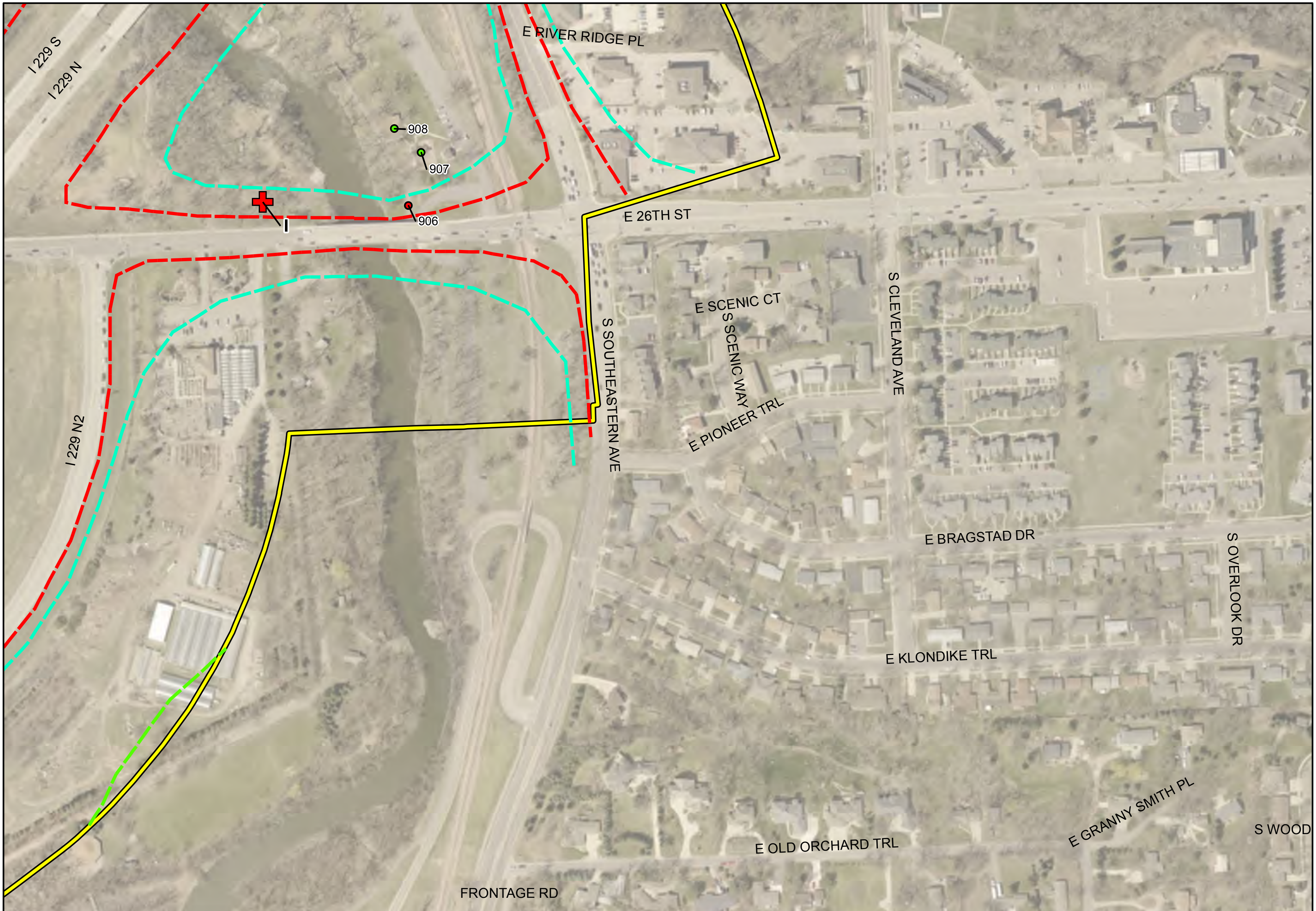

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I-229 Major Investment Corridor Study
Sub-Study #1
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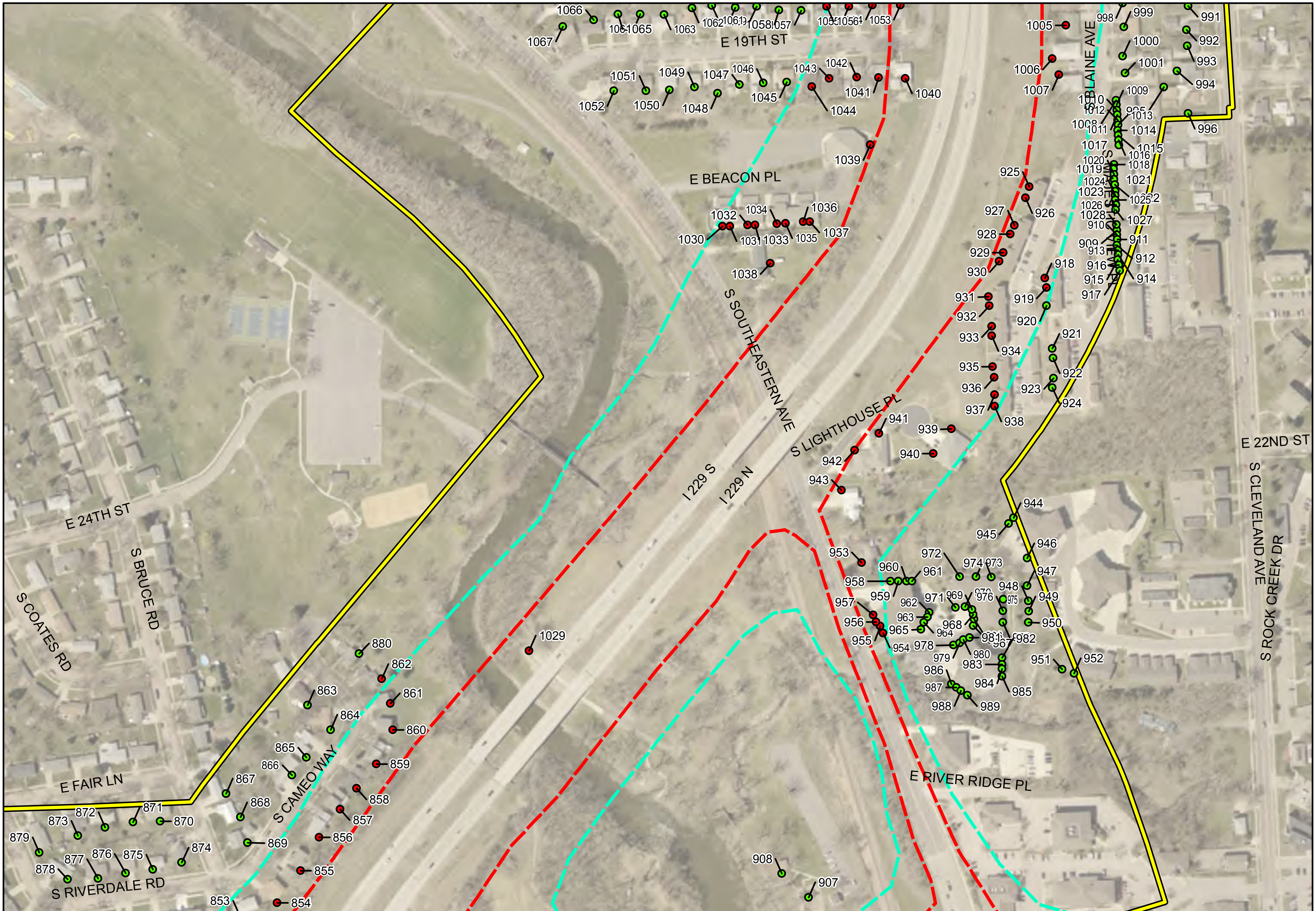
Proposed Alternative C2



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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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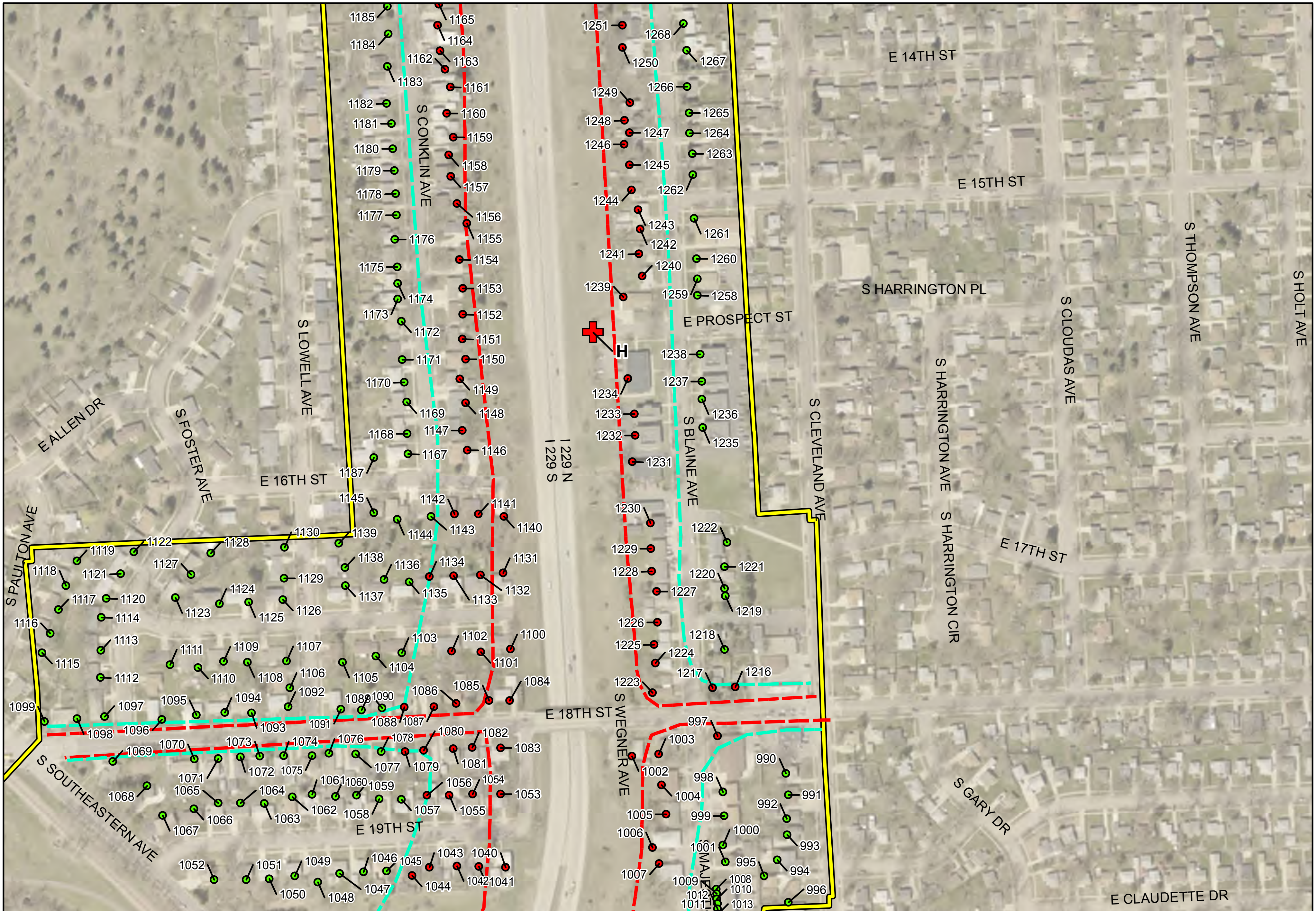

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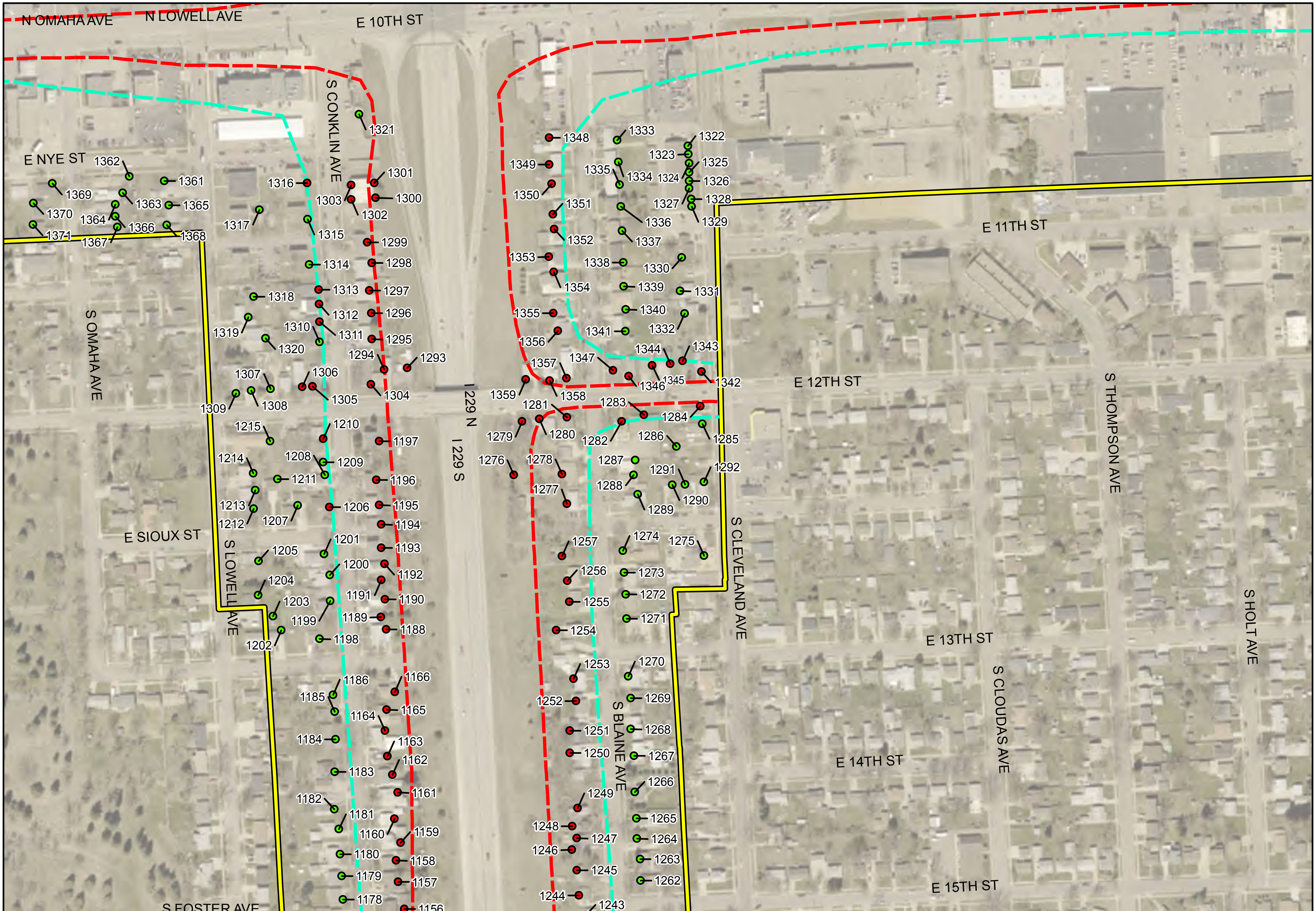
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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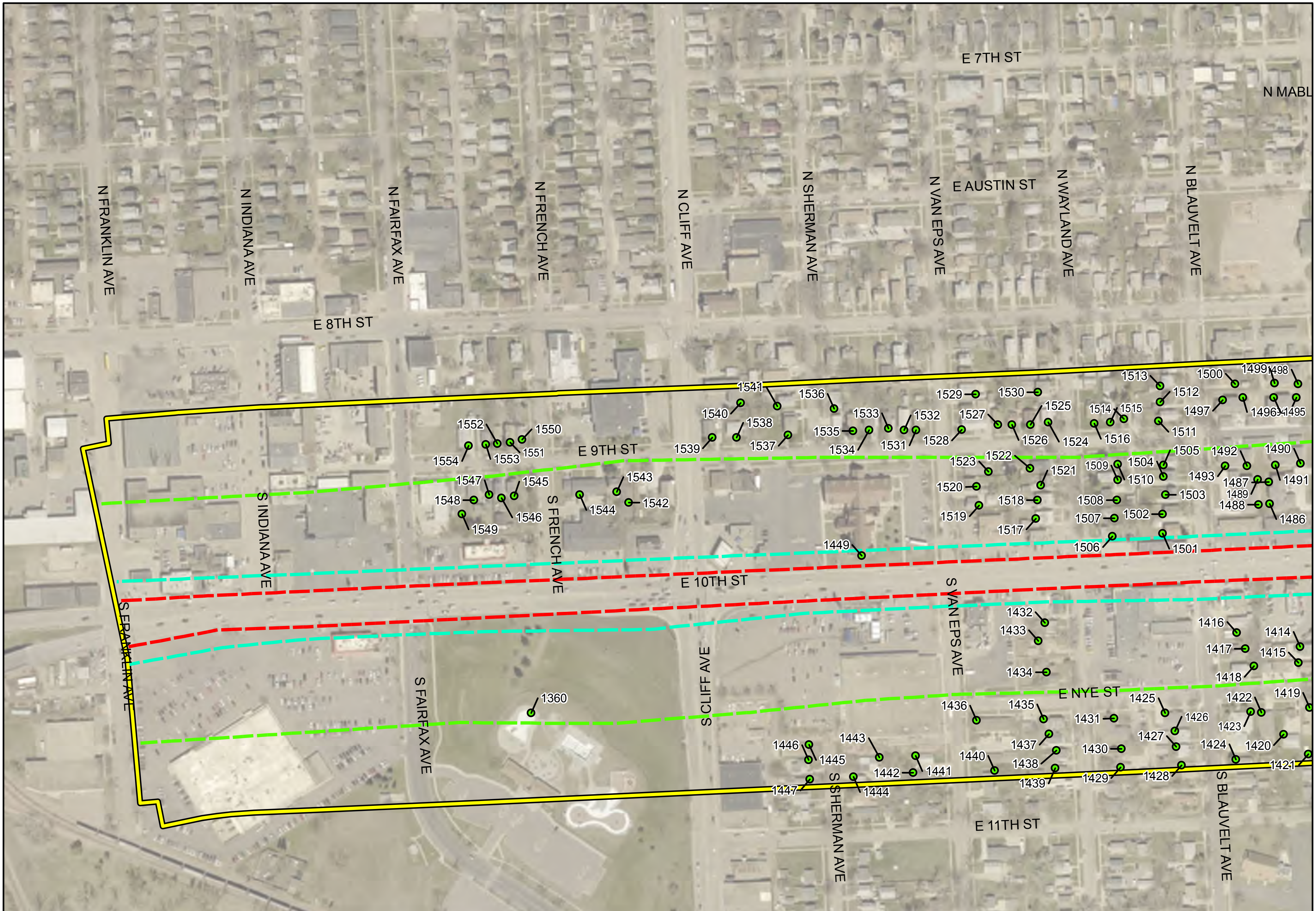

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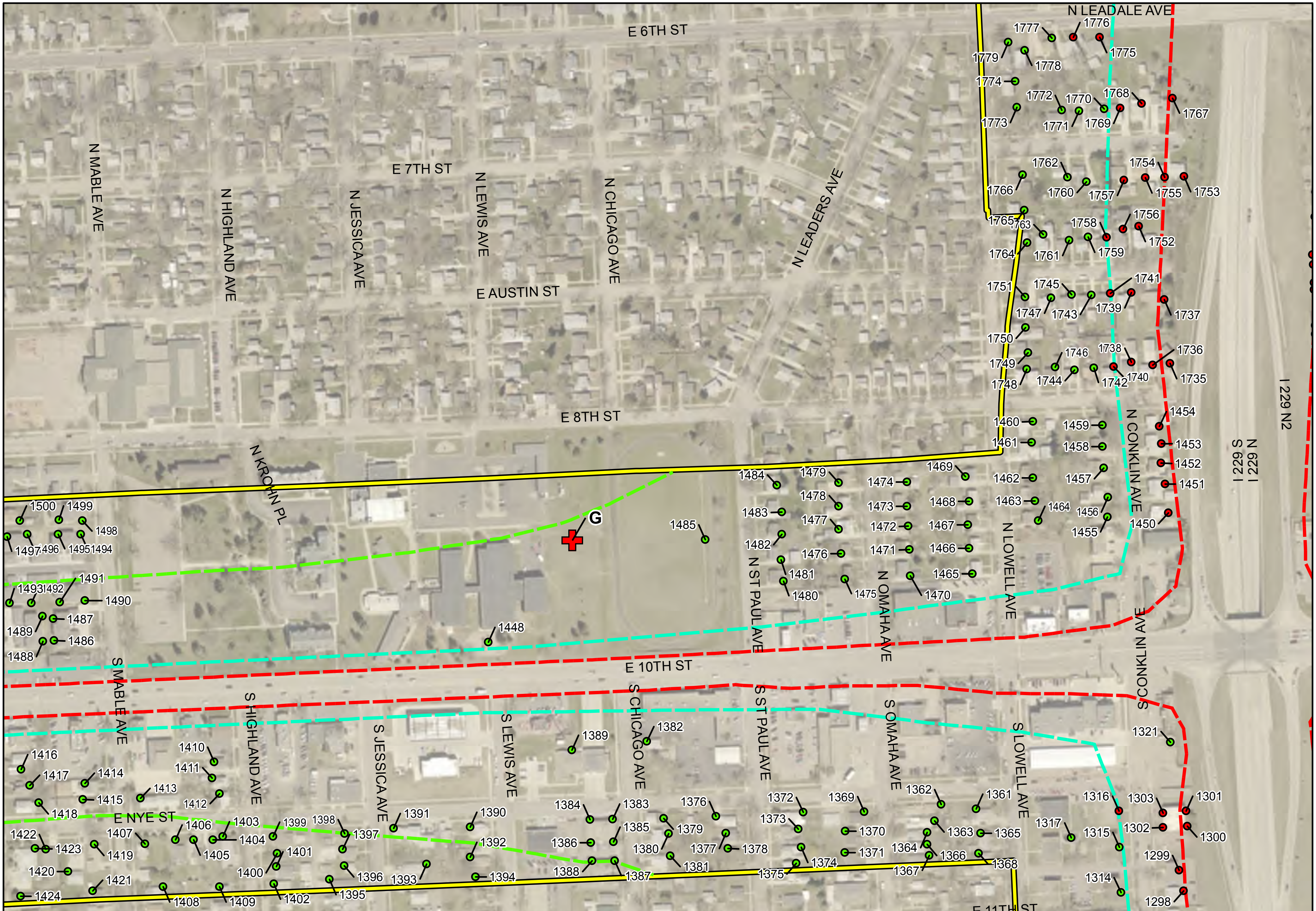
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



Legend

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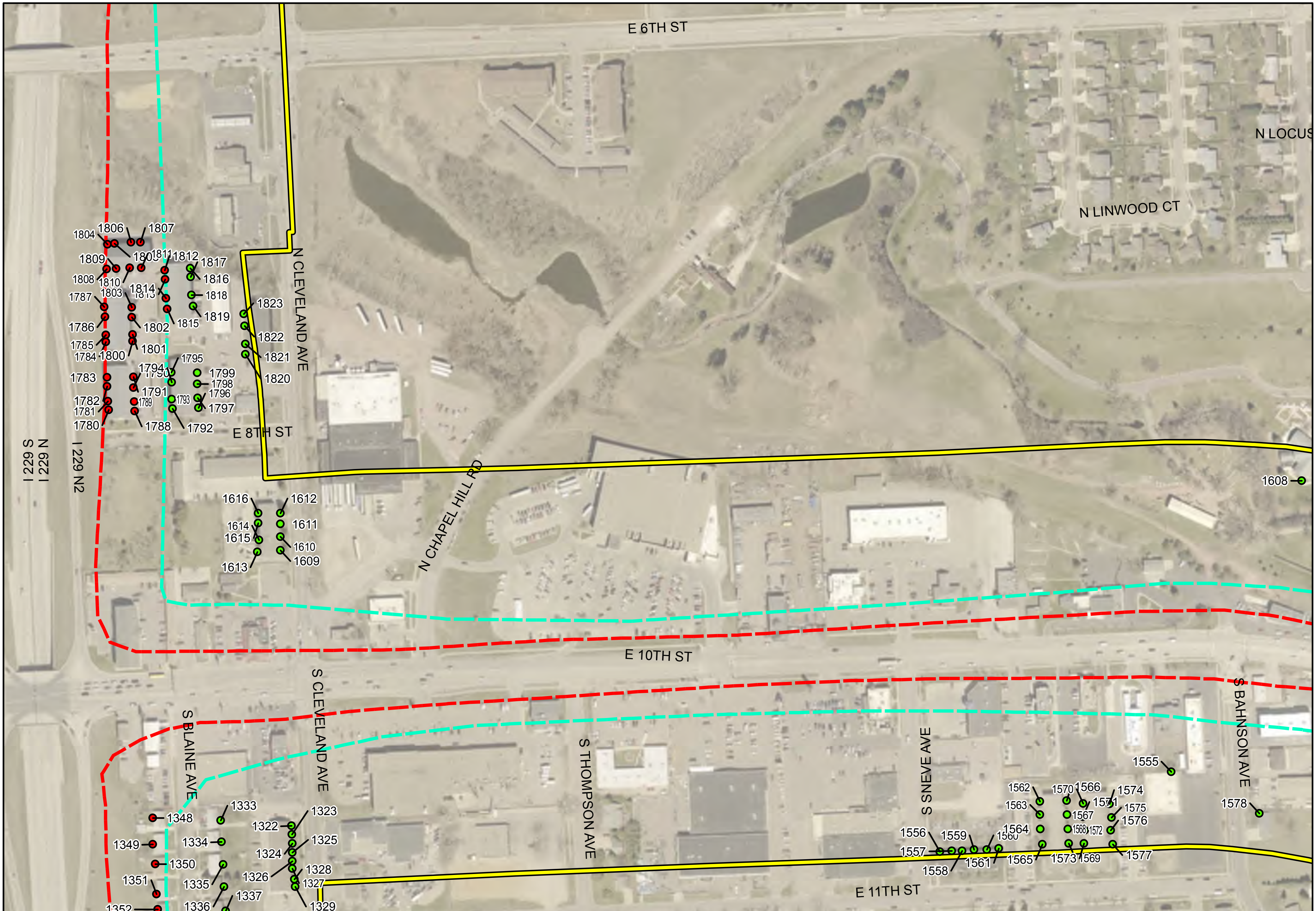
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



Legend

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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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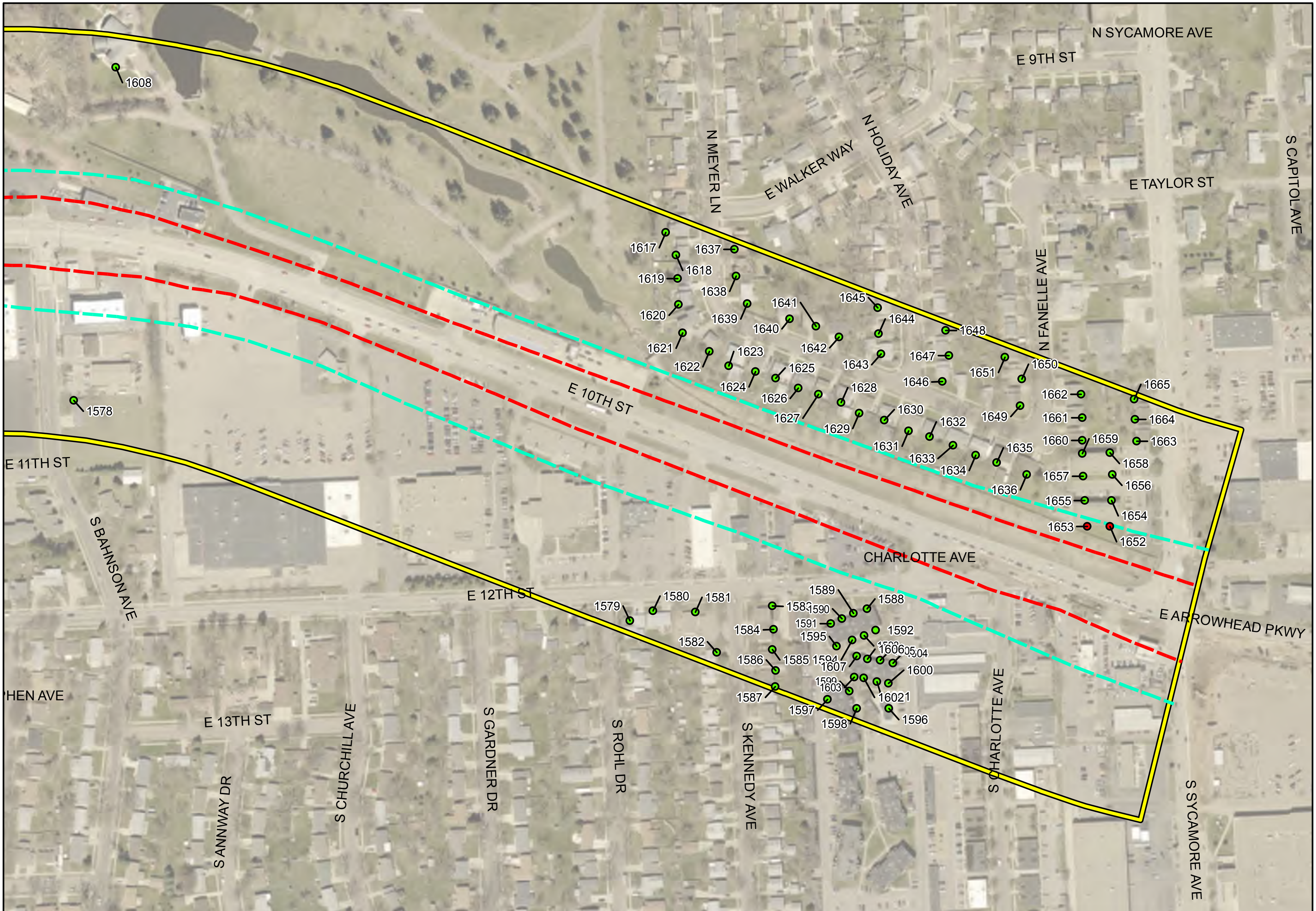

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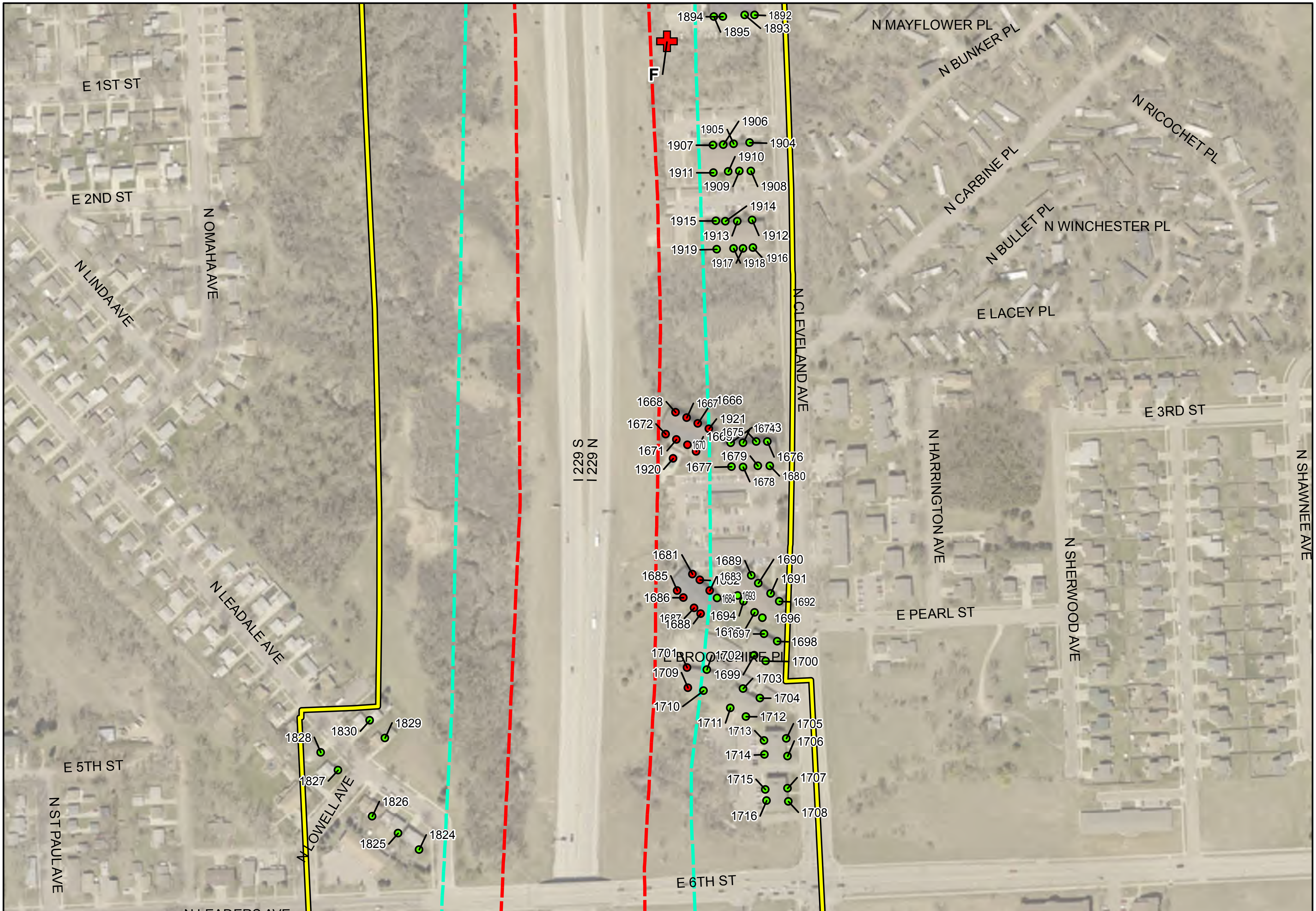
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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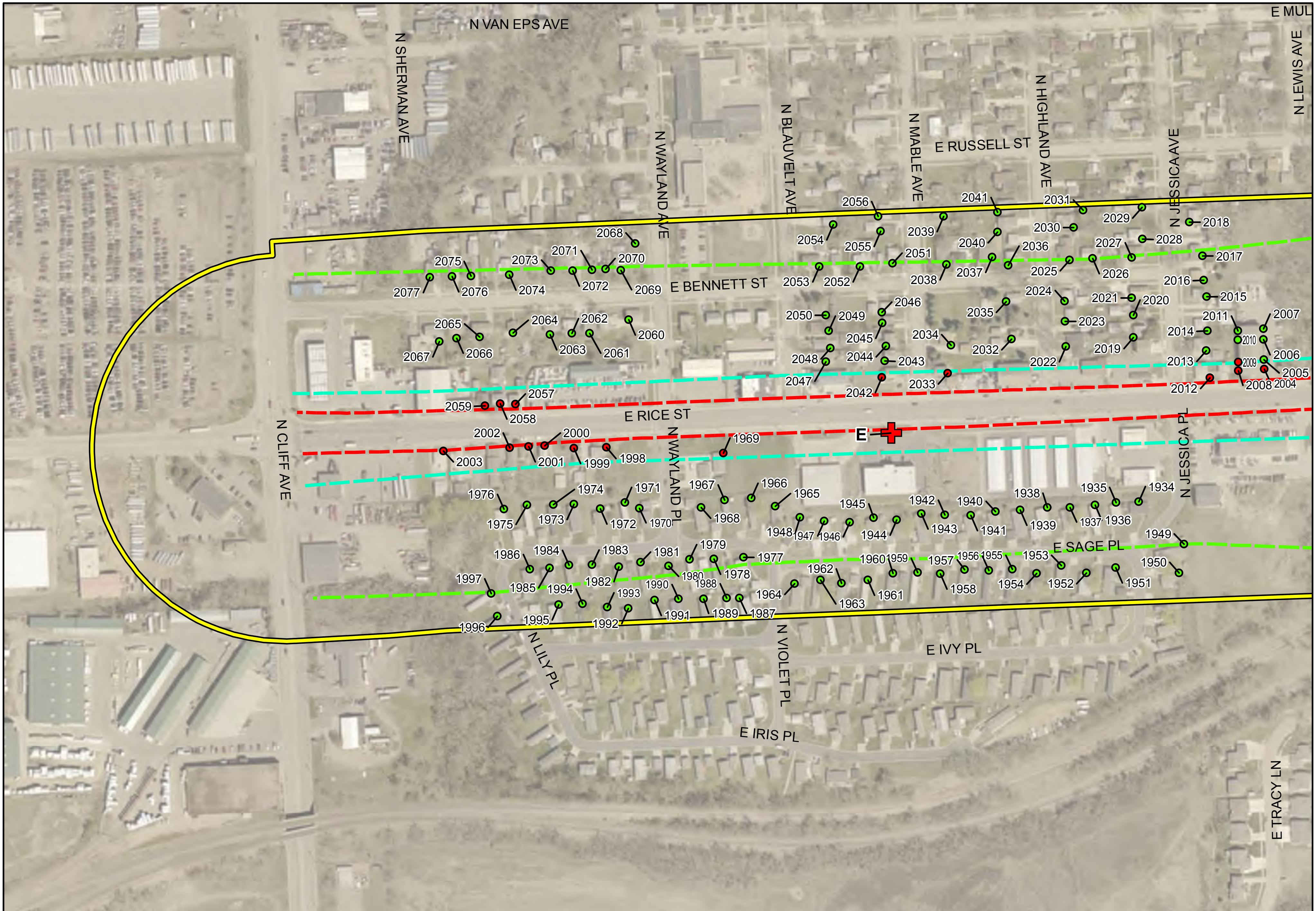

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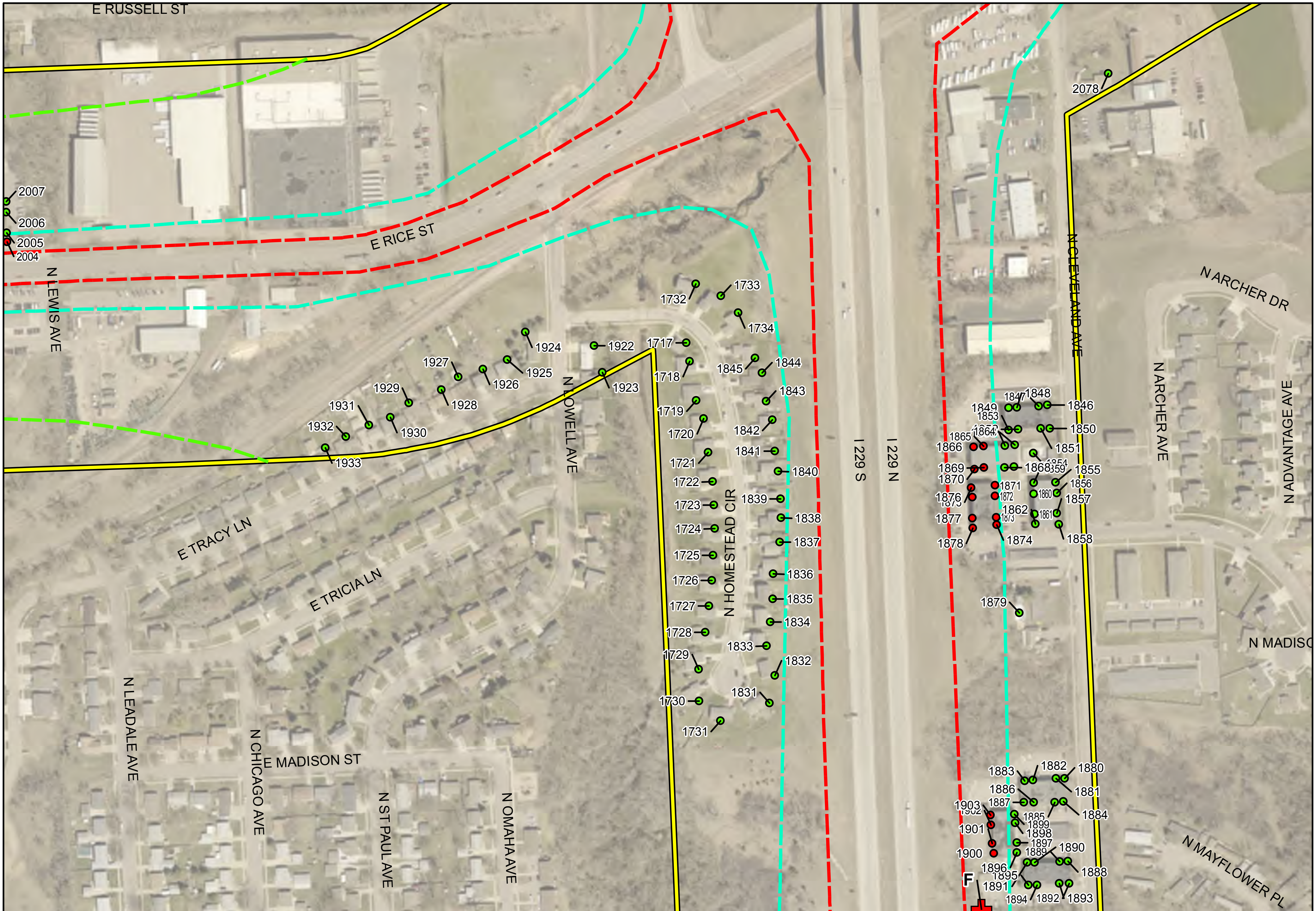
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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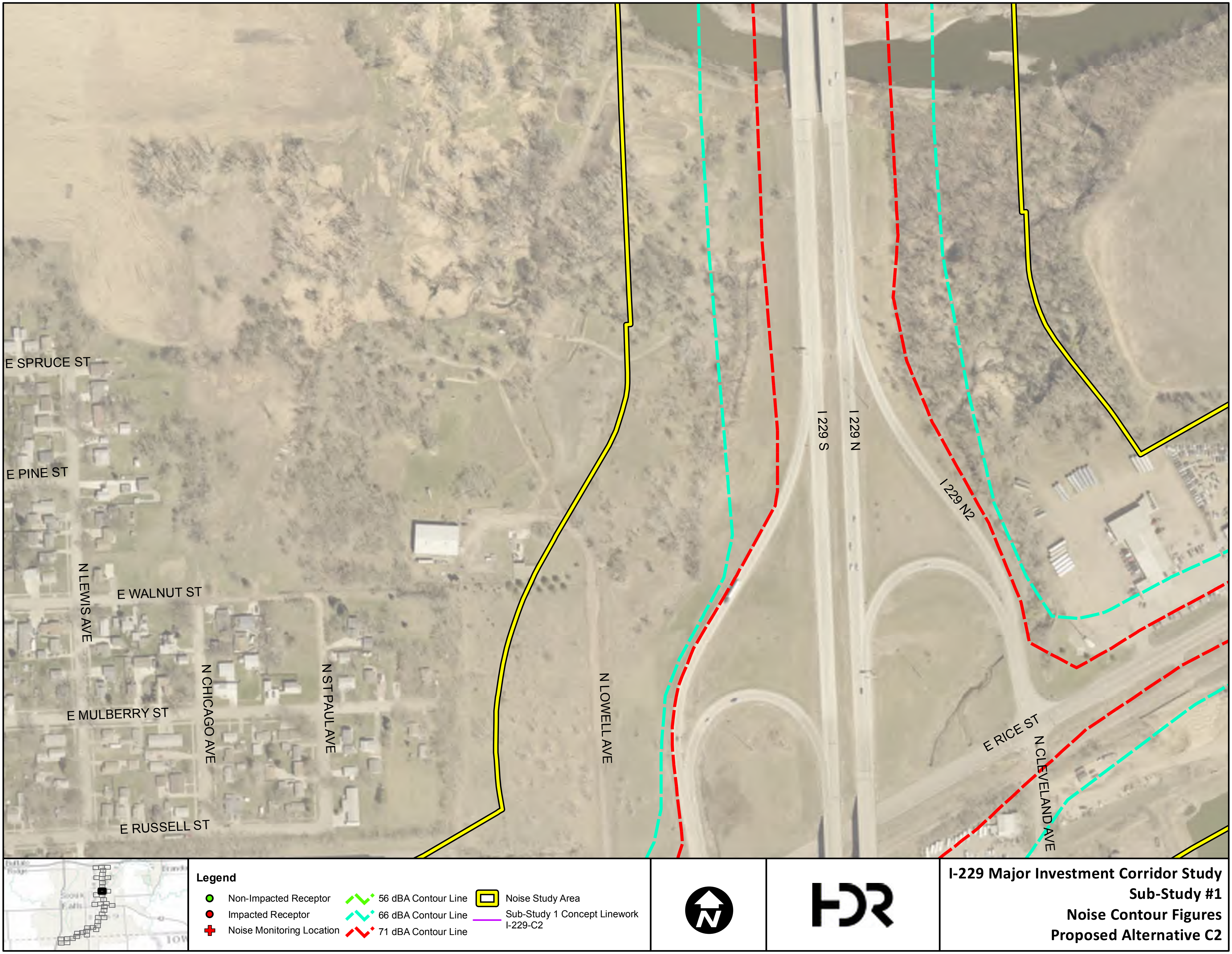
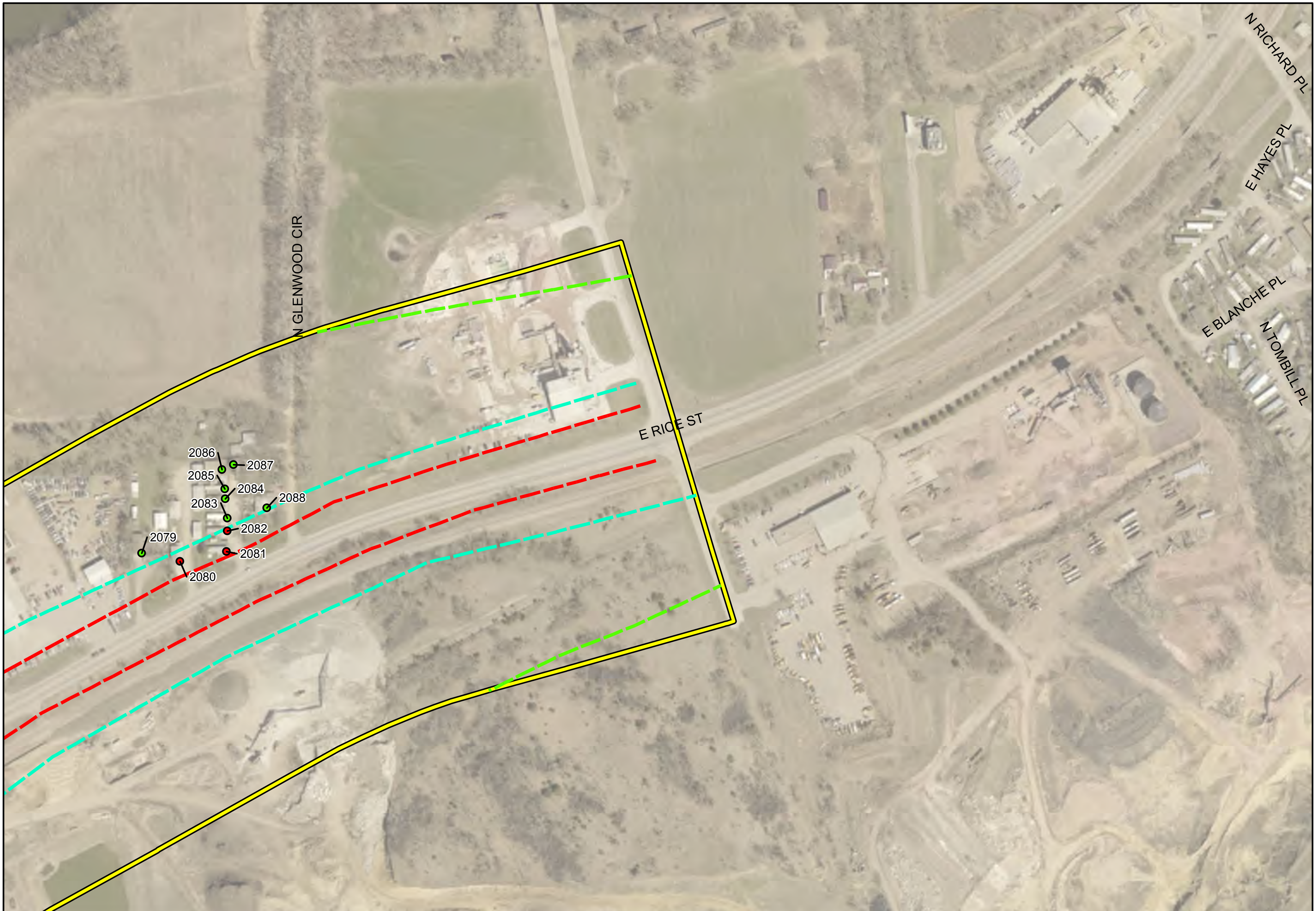


I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



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Sub-Study #1
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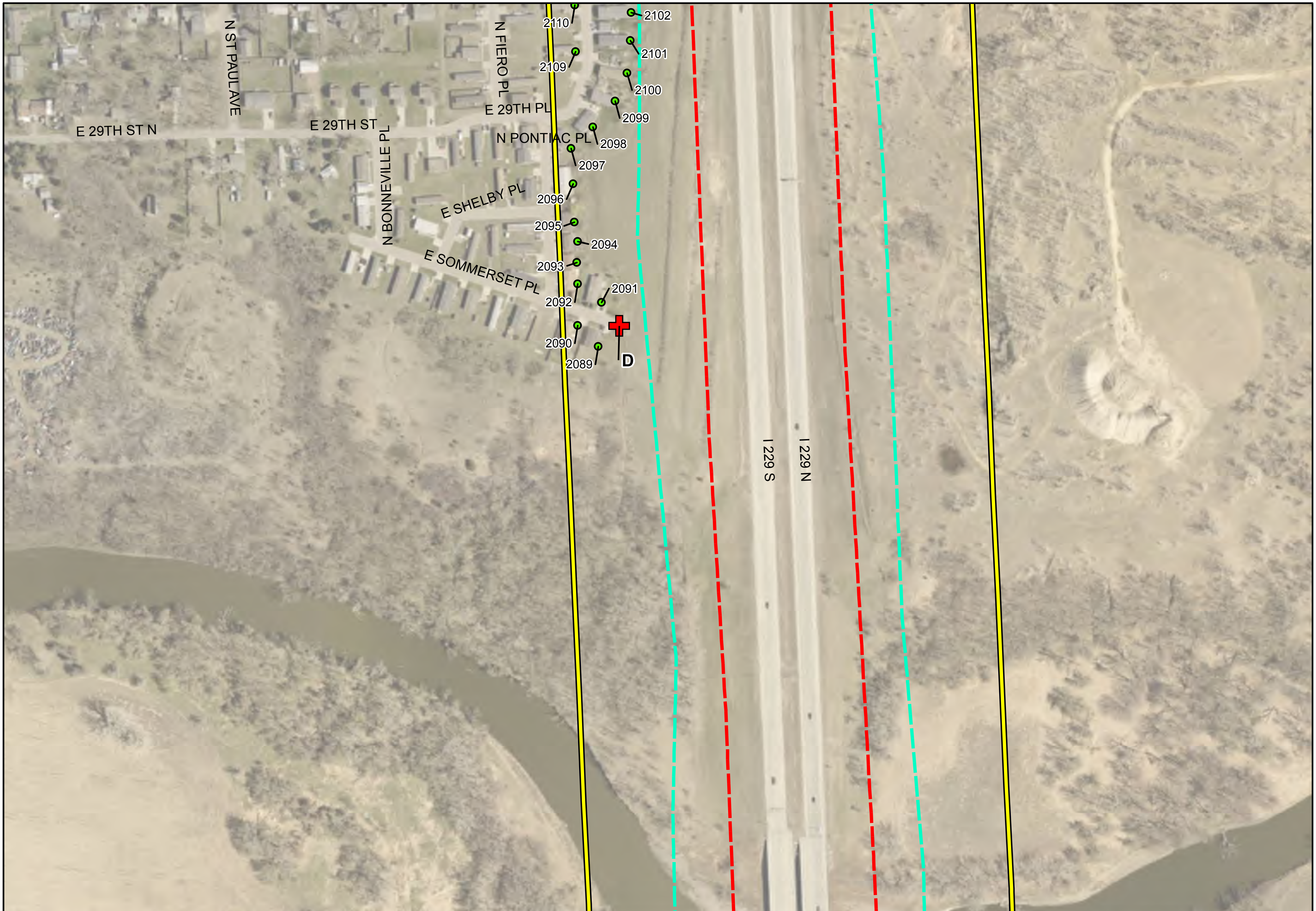

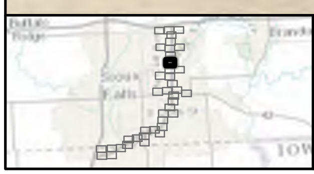

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Sub-Study #1
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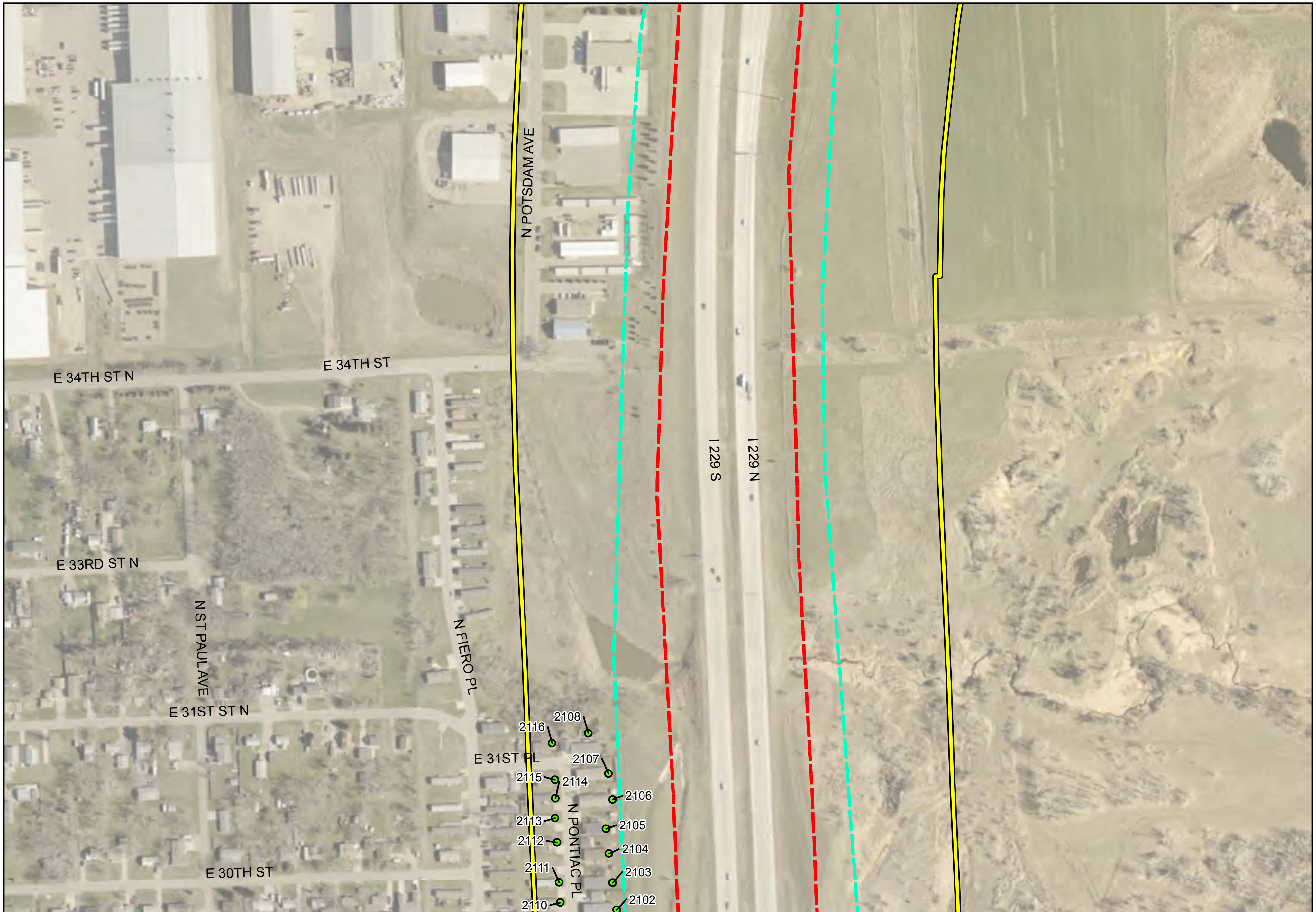

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Sub-Study #1
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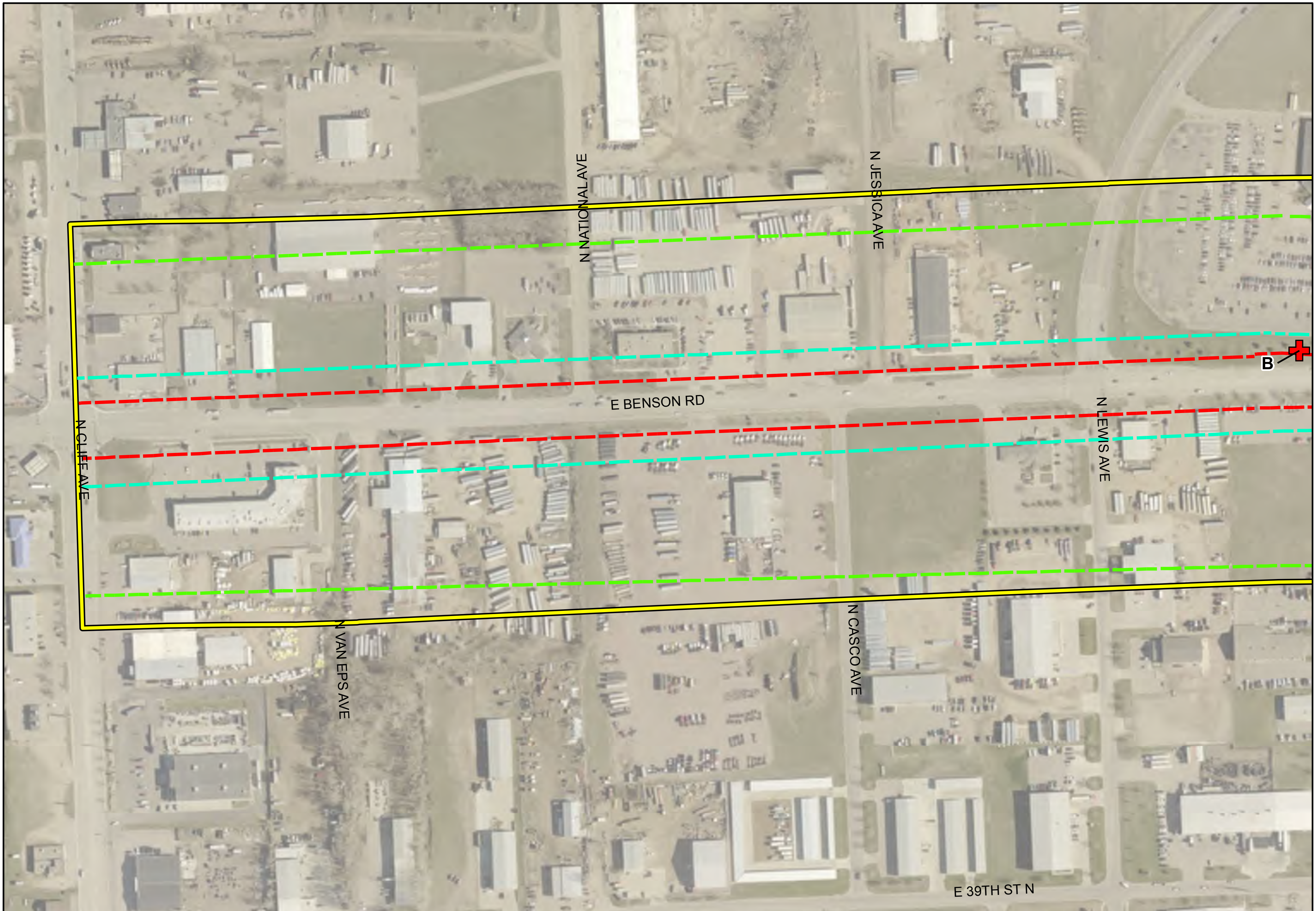

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Sub-Study #1
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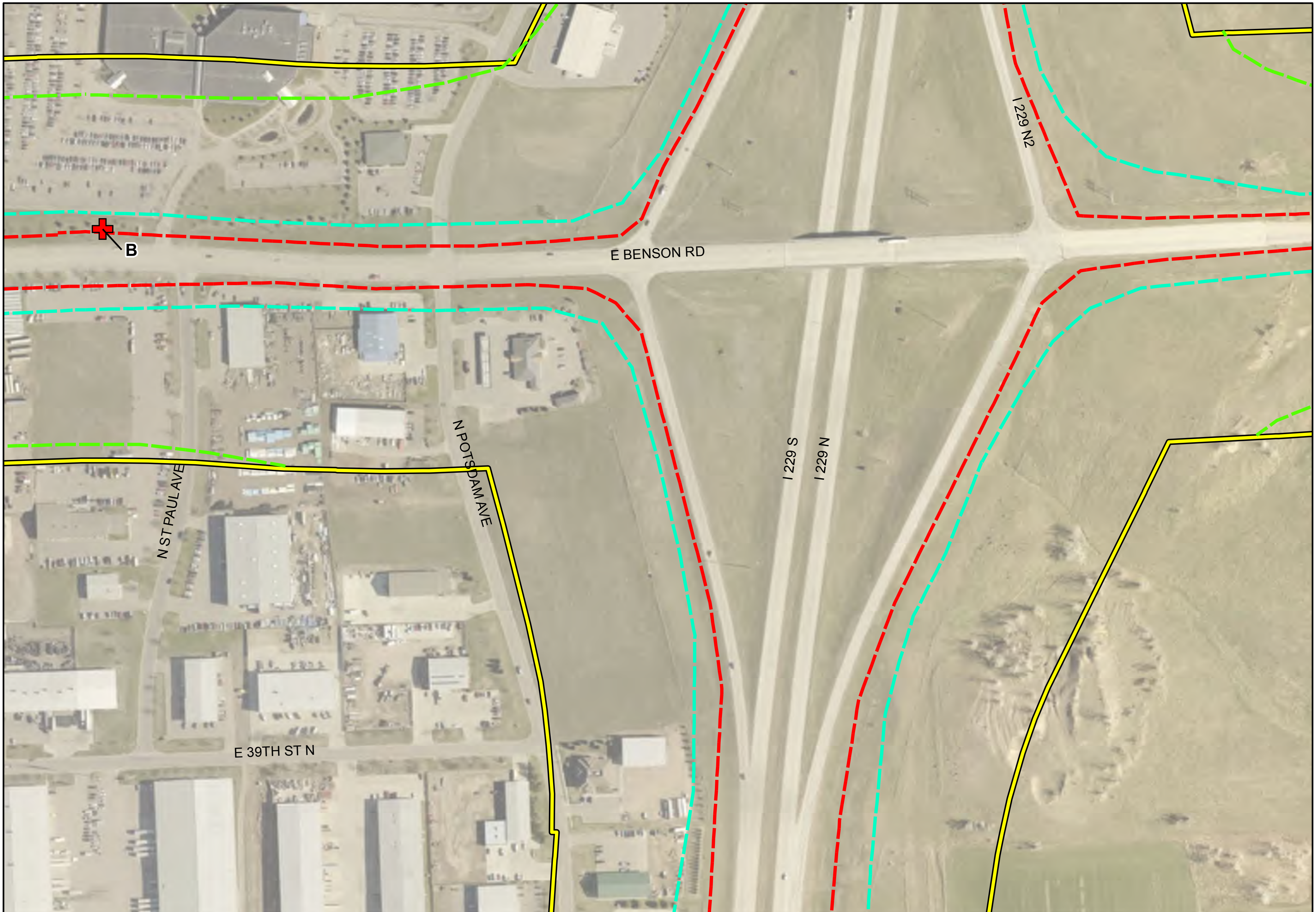

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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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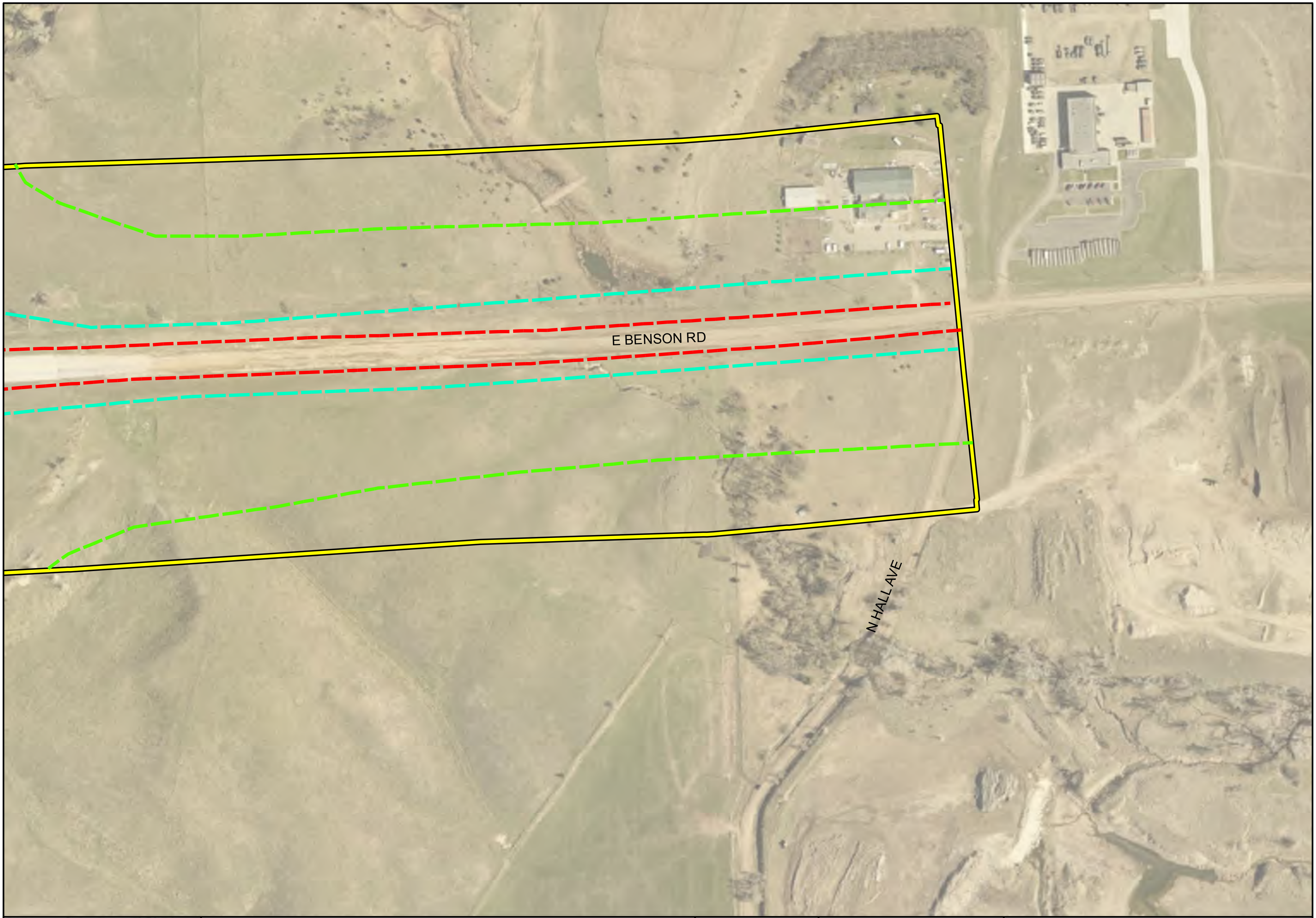

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Sub-Study #1
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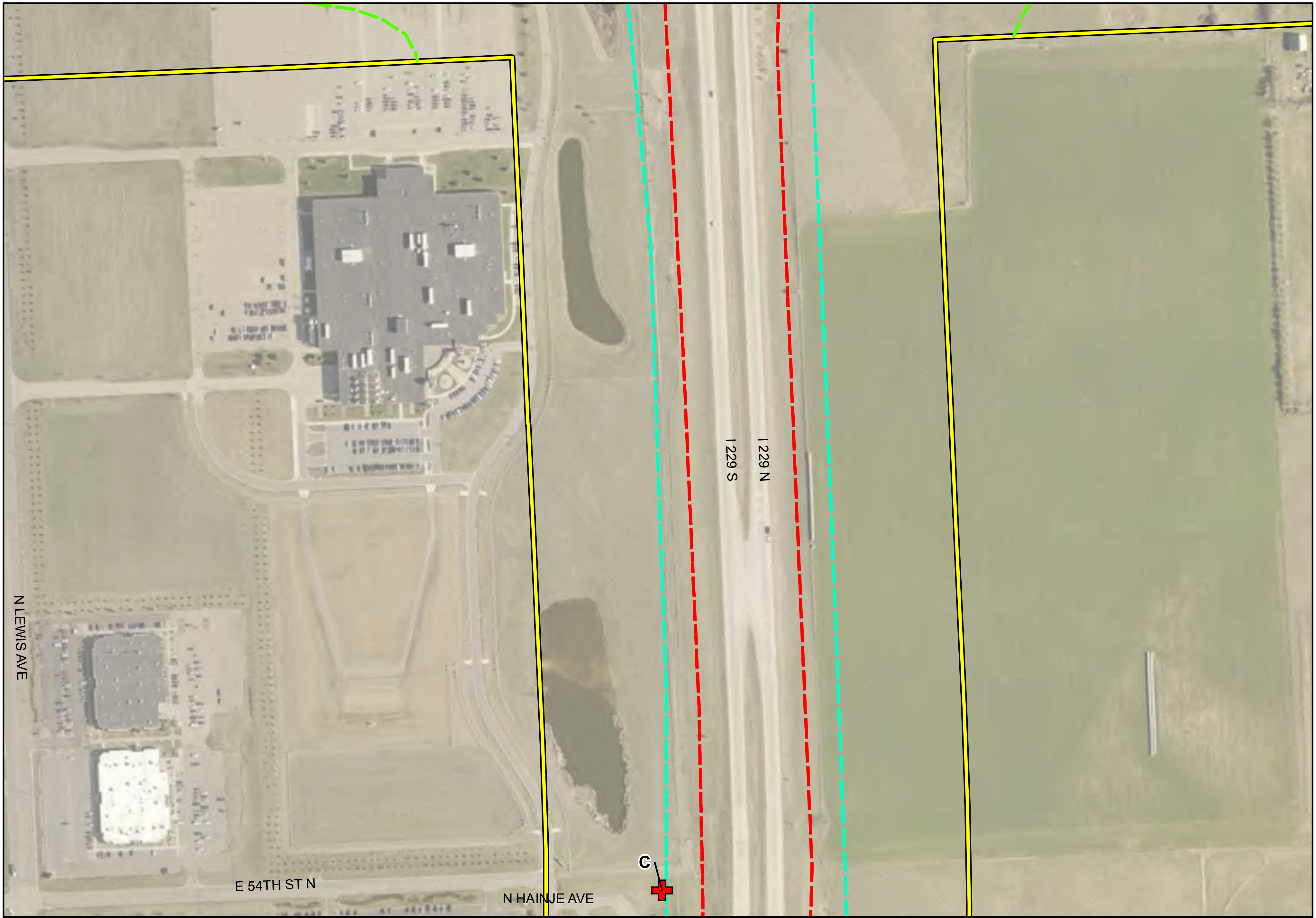

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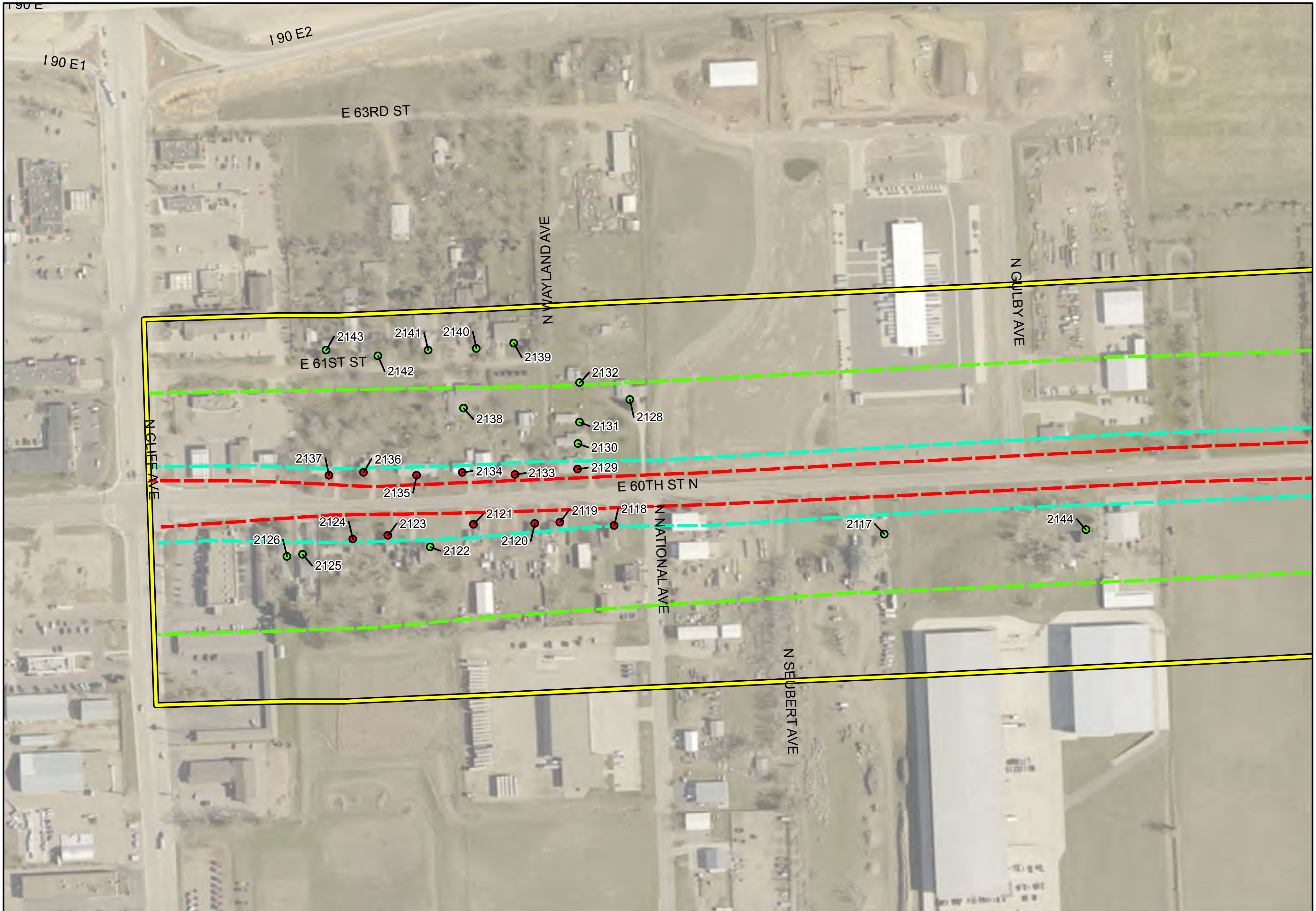

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- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 1 Concept Linework I-229-C2

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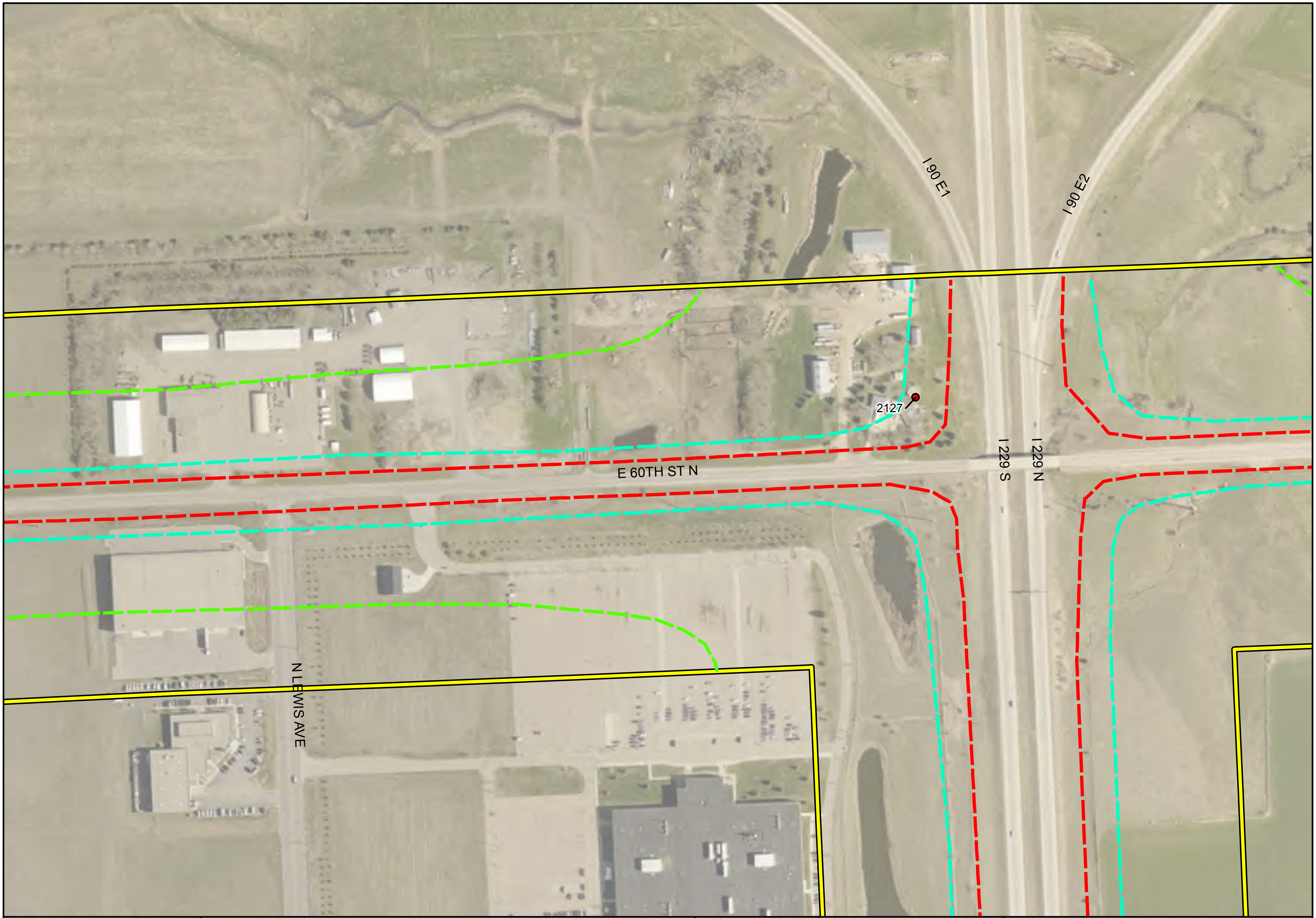
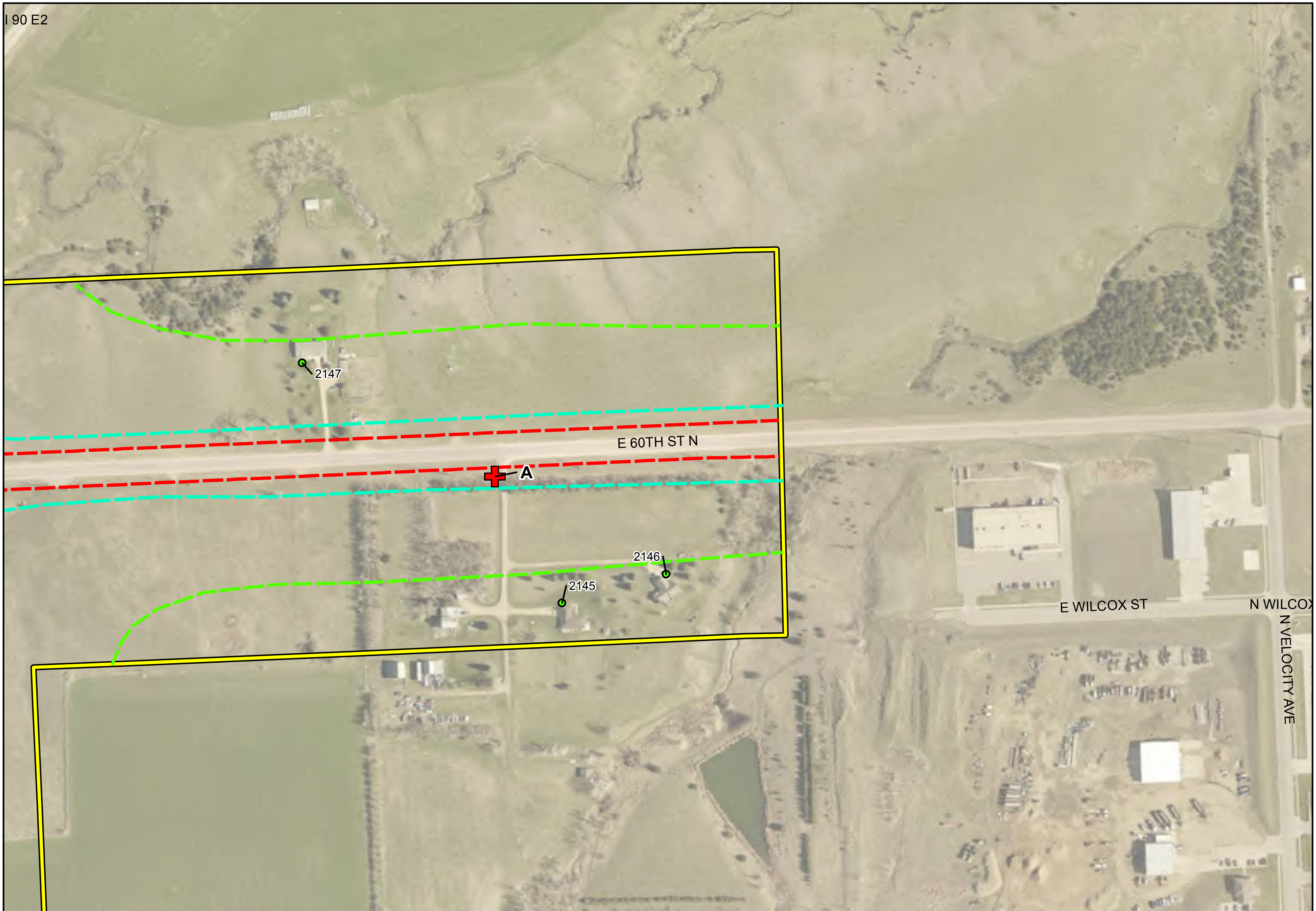
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 1 Concept Linework I-229-C2

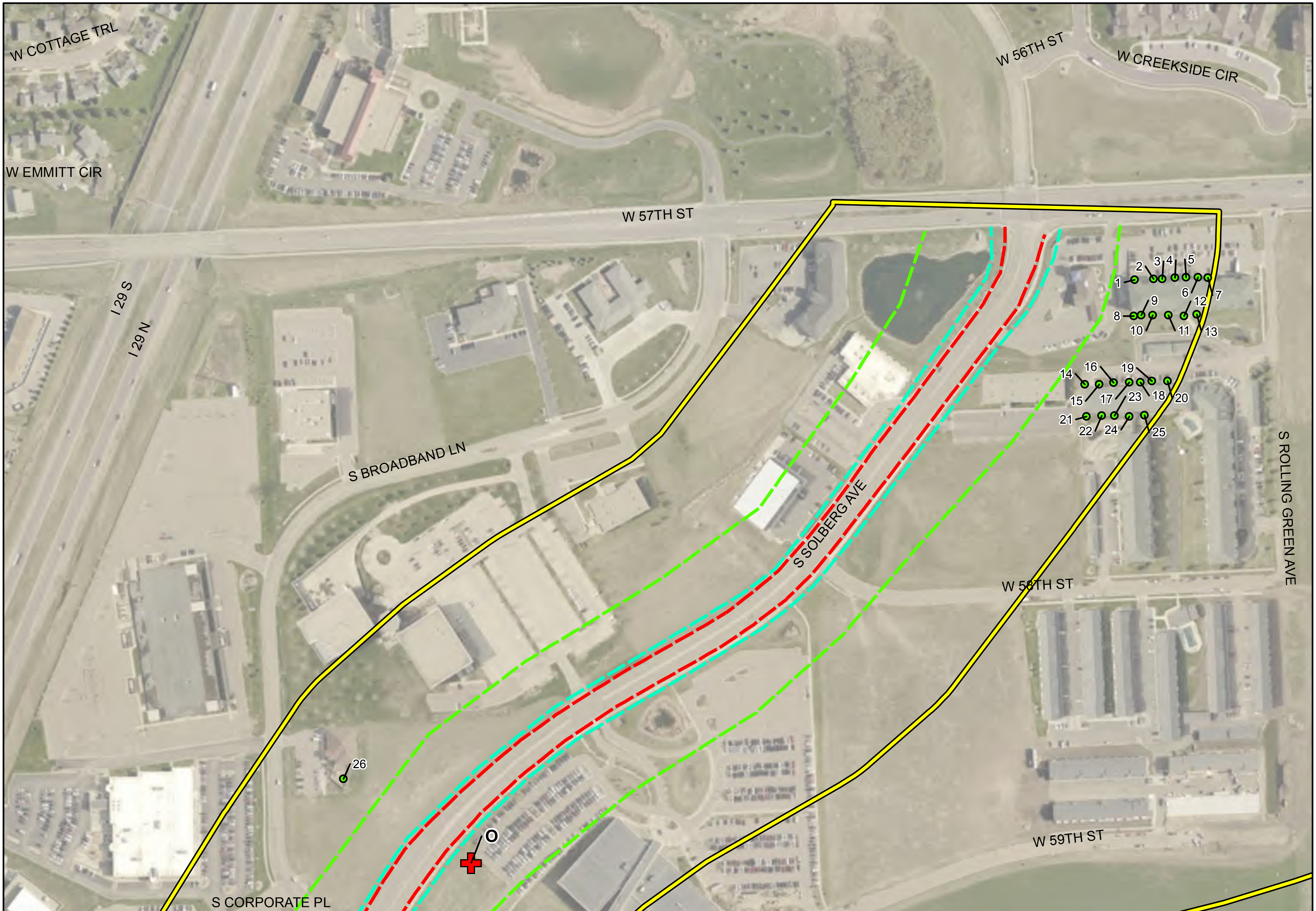
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 1 Concept Linework I-229-C2

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative C2



Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 1 Concept Linework Cliff-1

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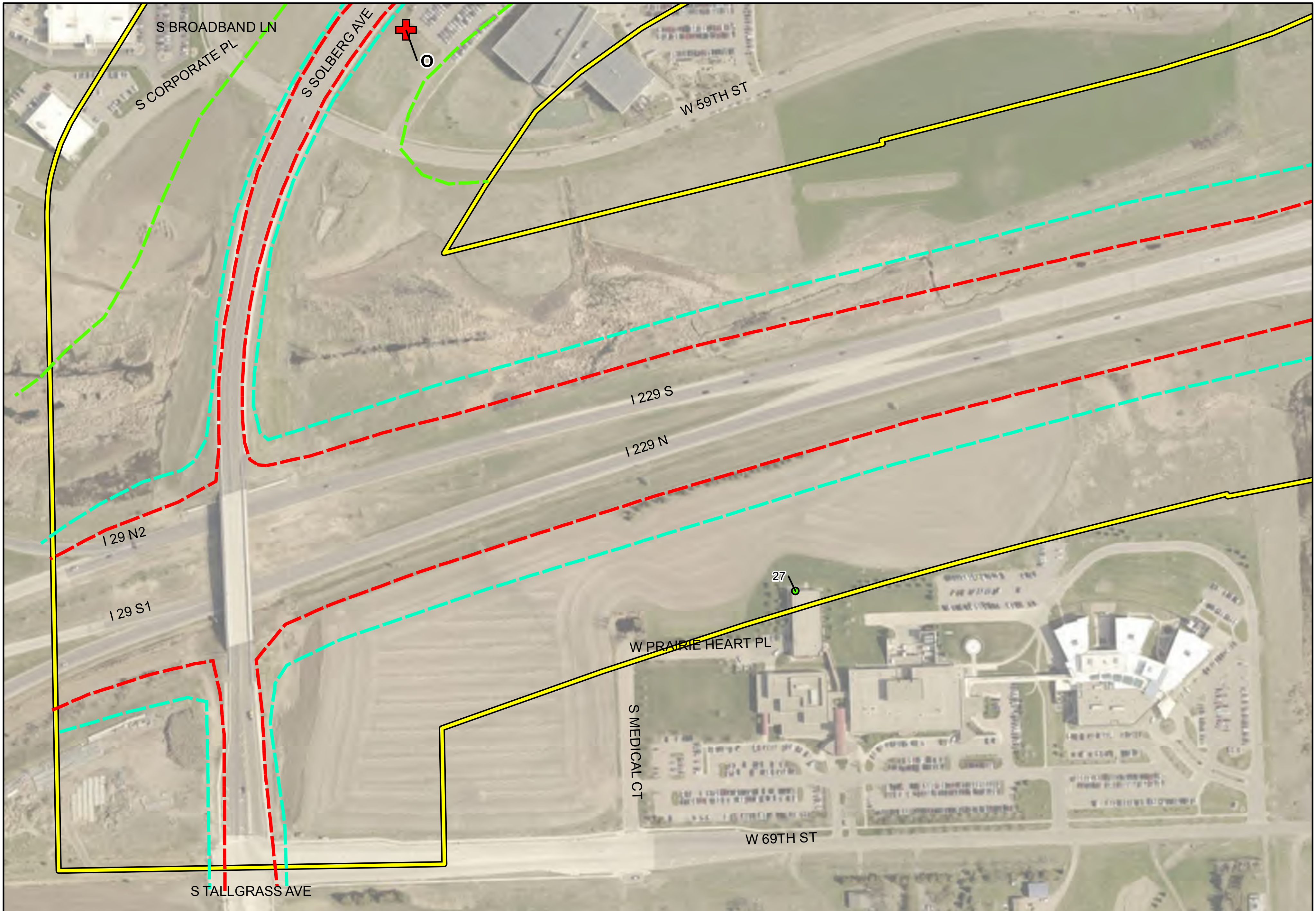
I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

Proposed Alternative Cliff-1



Legend

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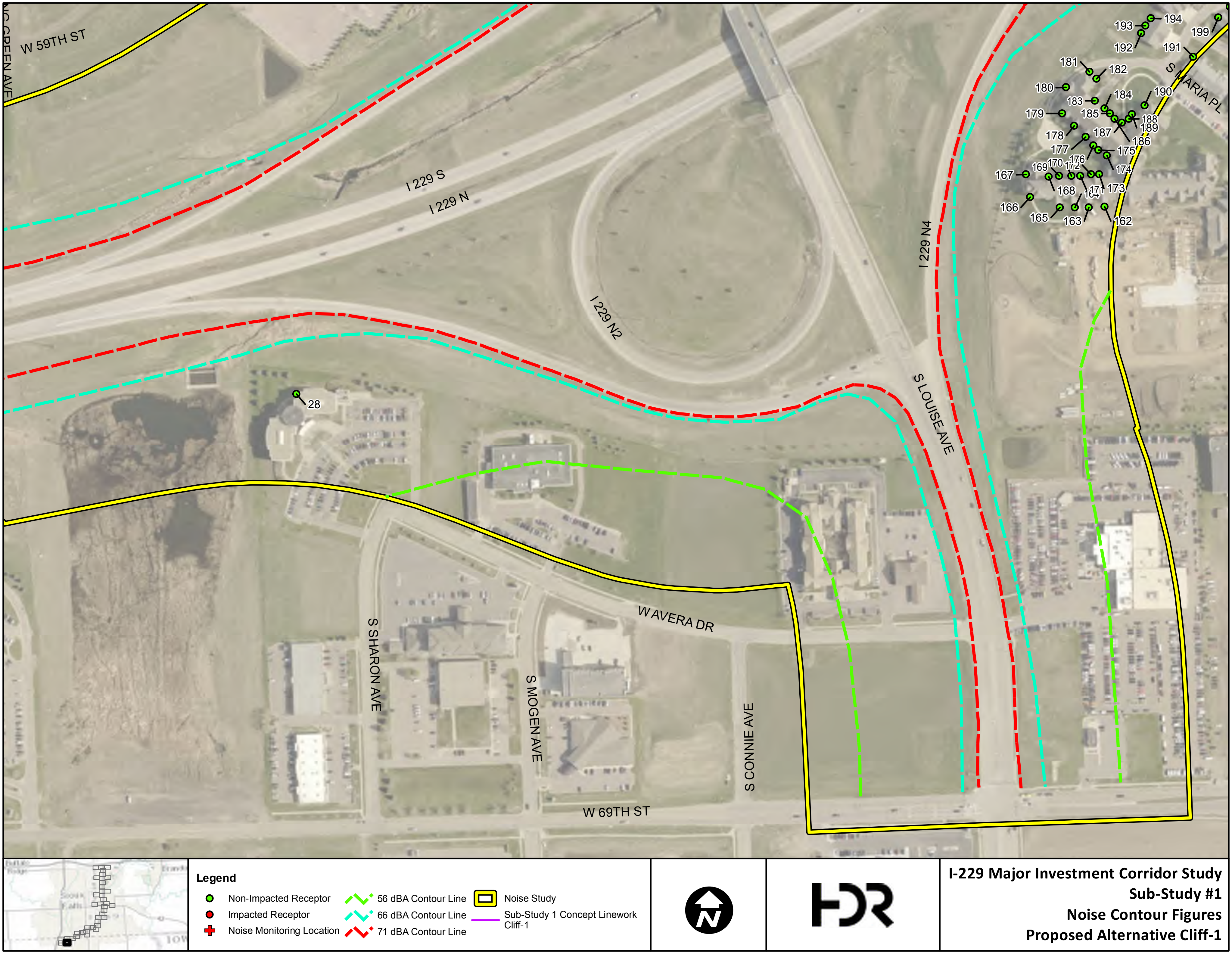
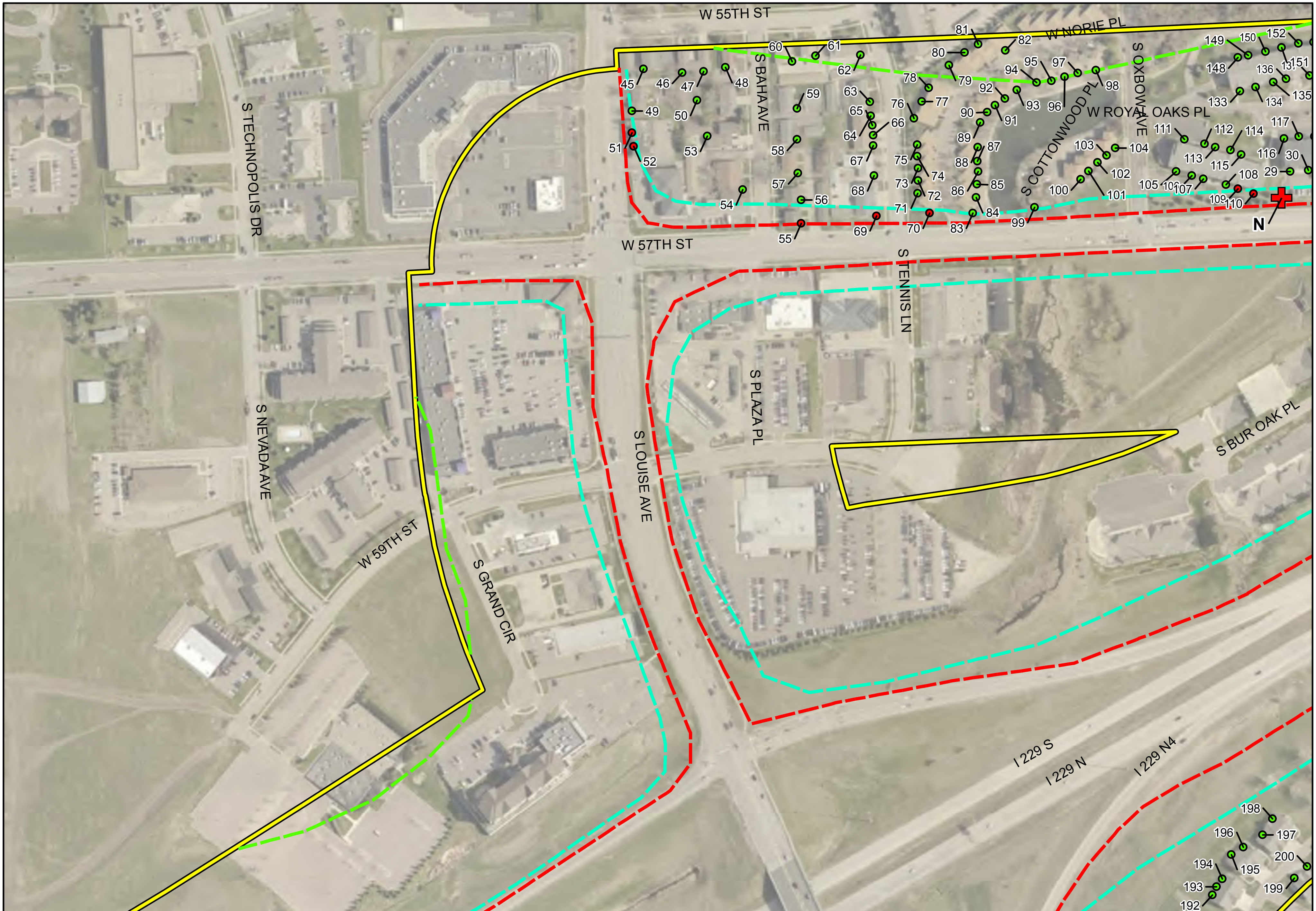
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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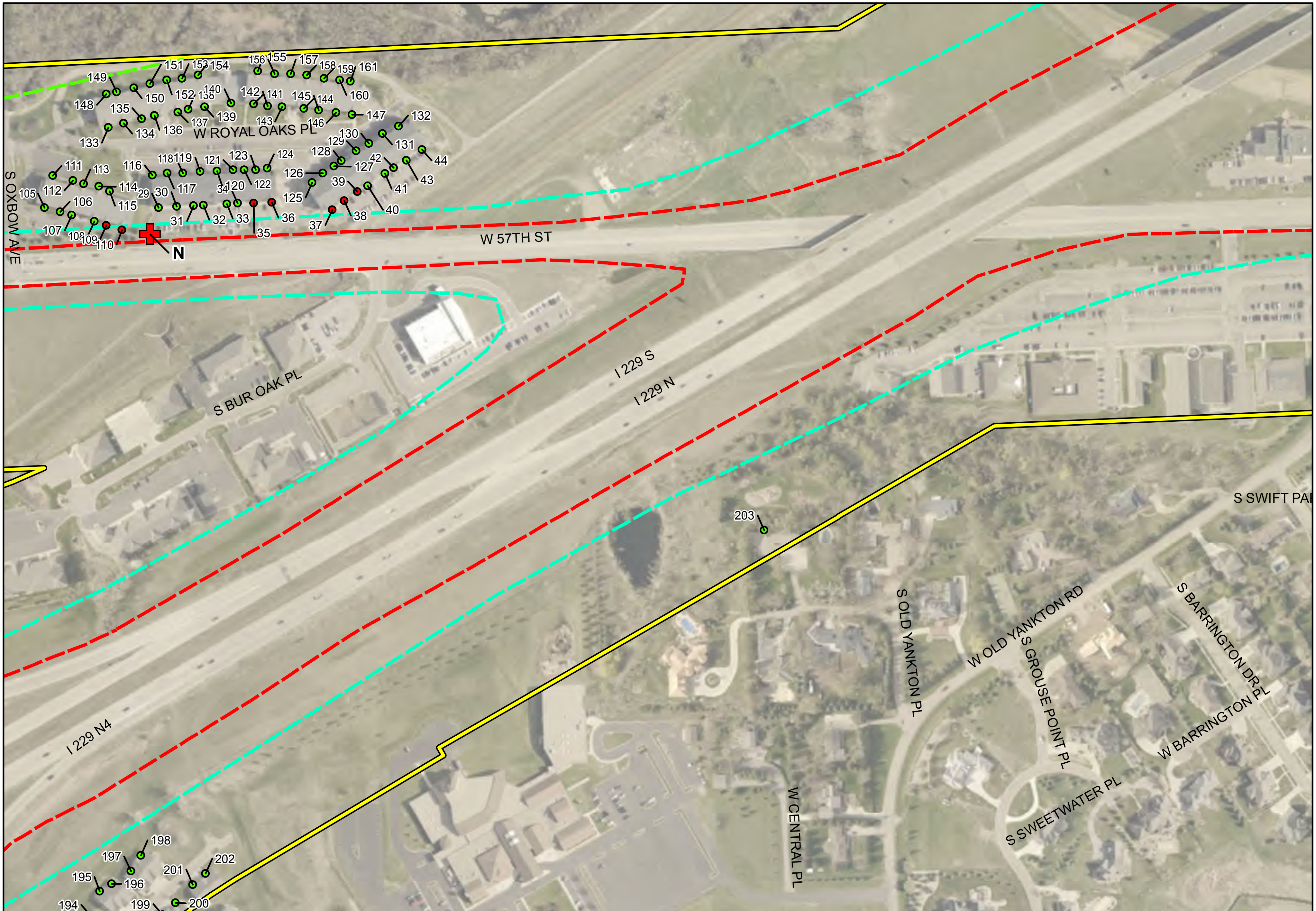
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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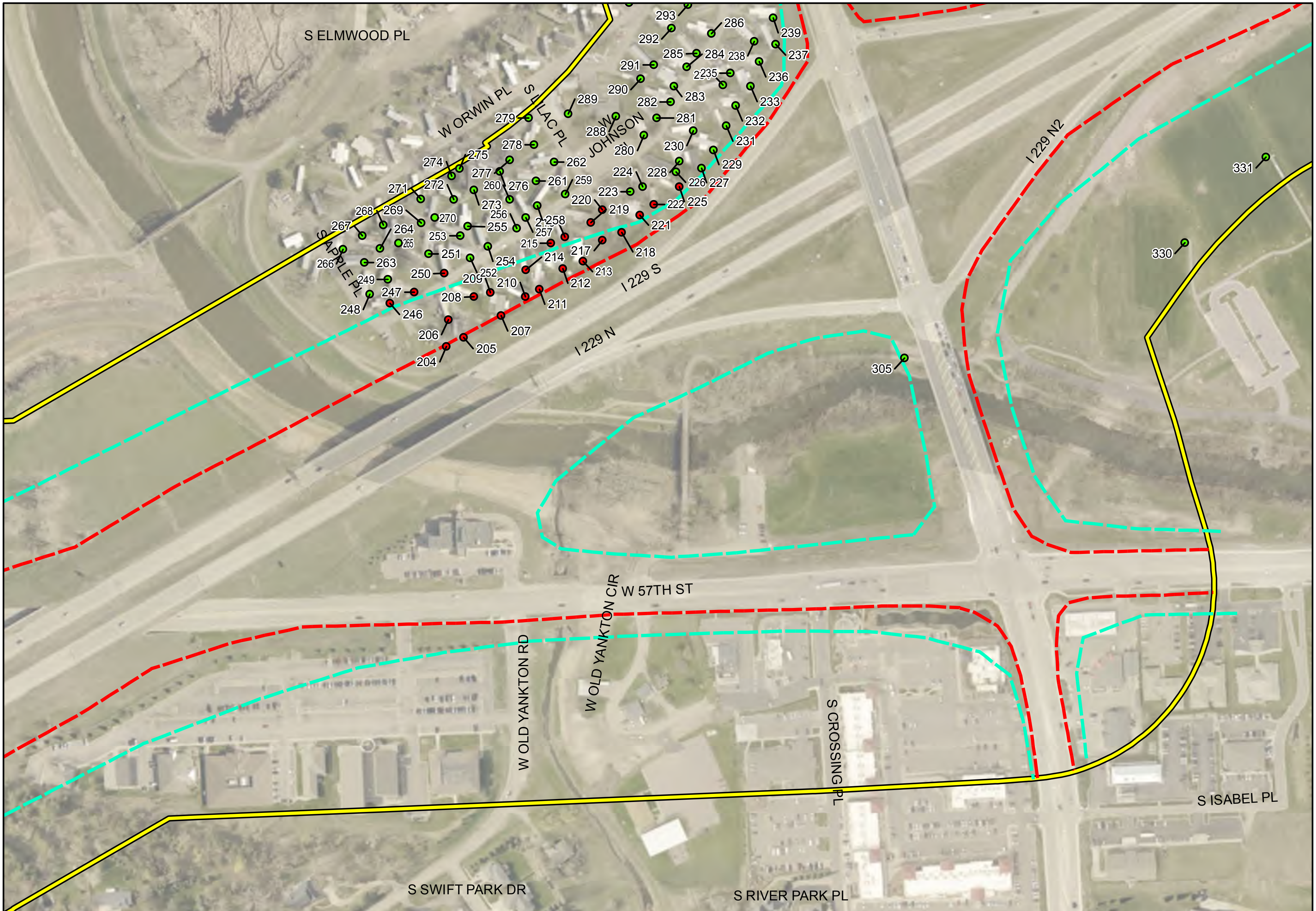
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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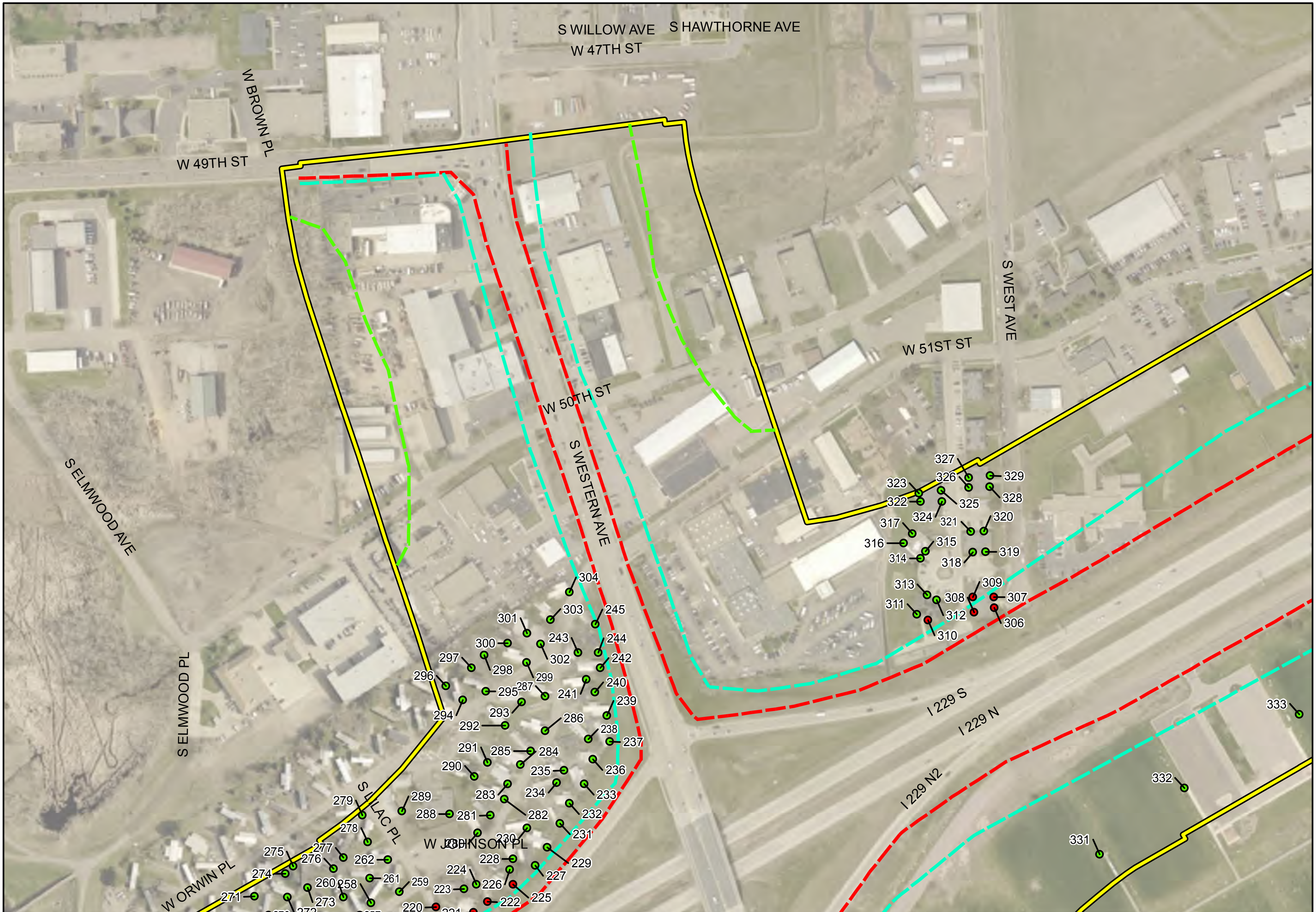
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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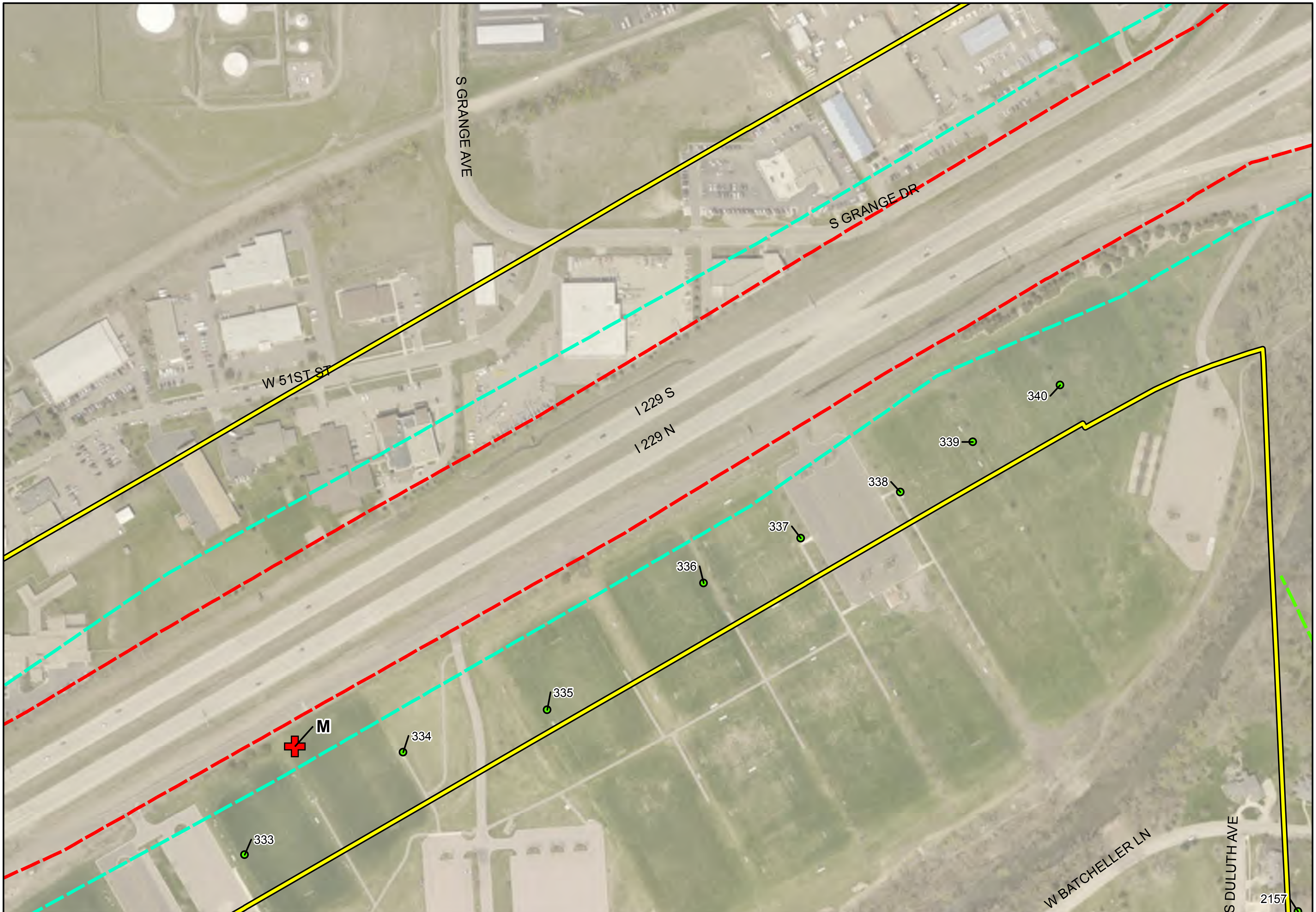

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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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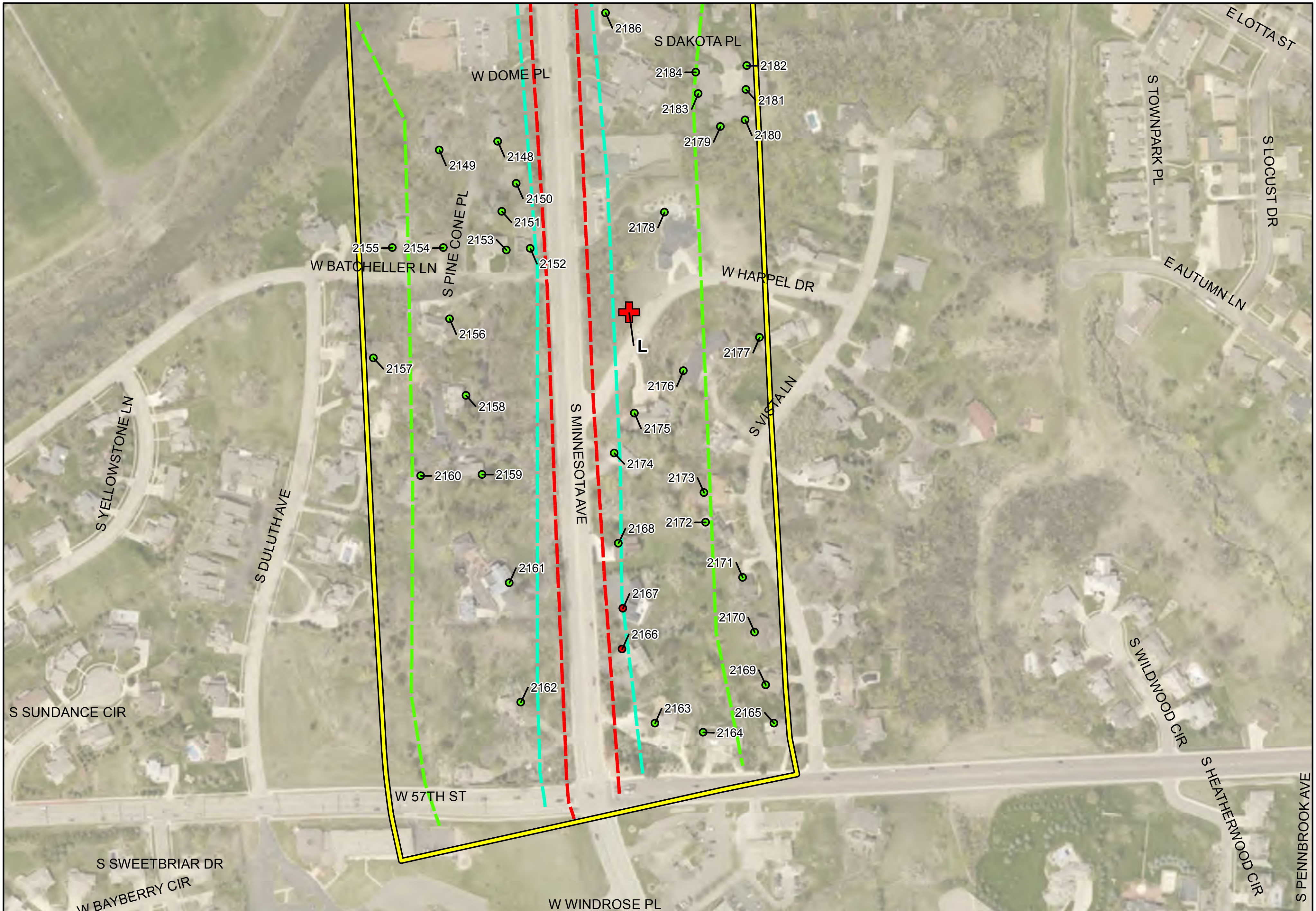

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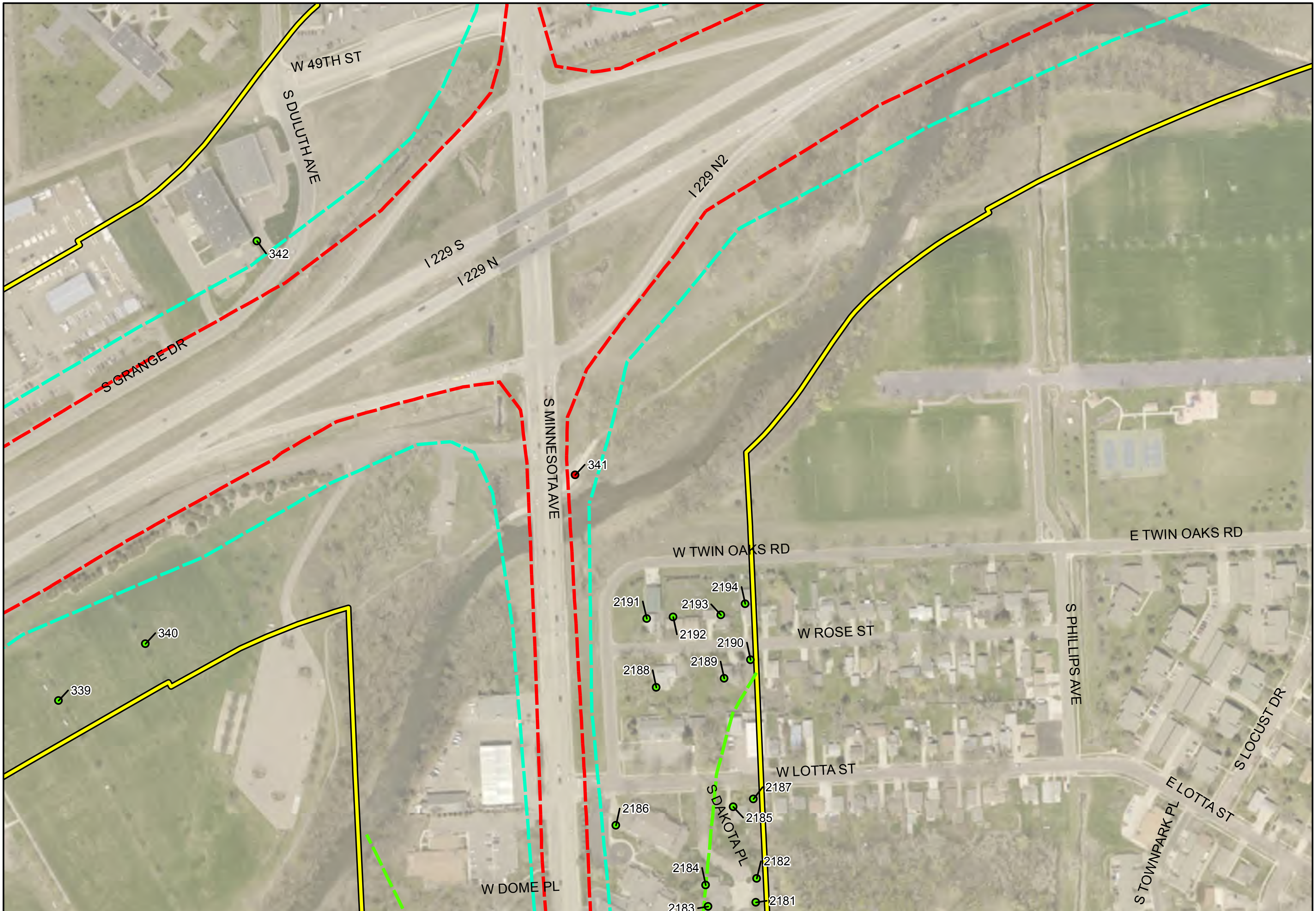
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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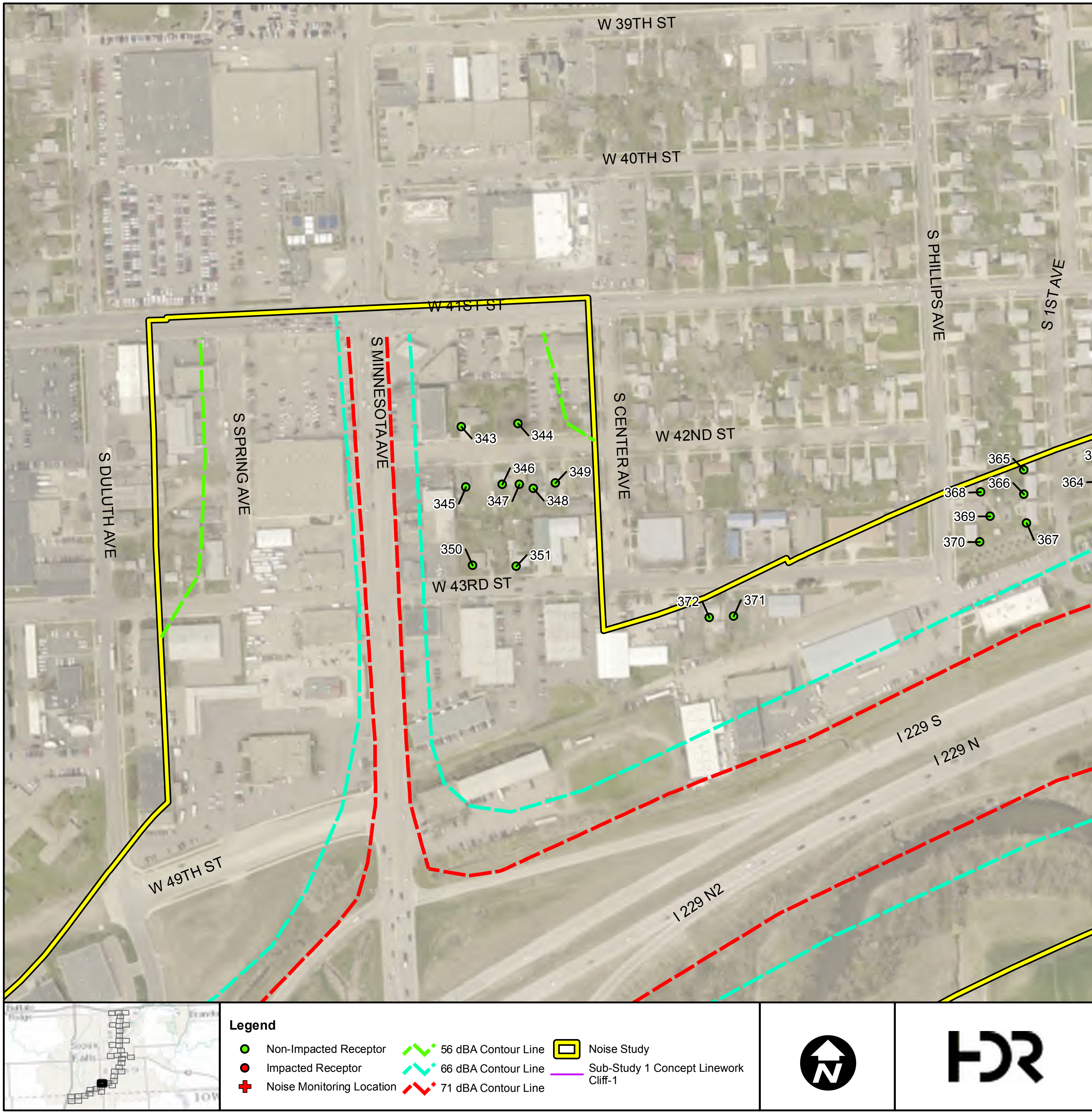
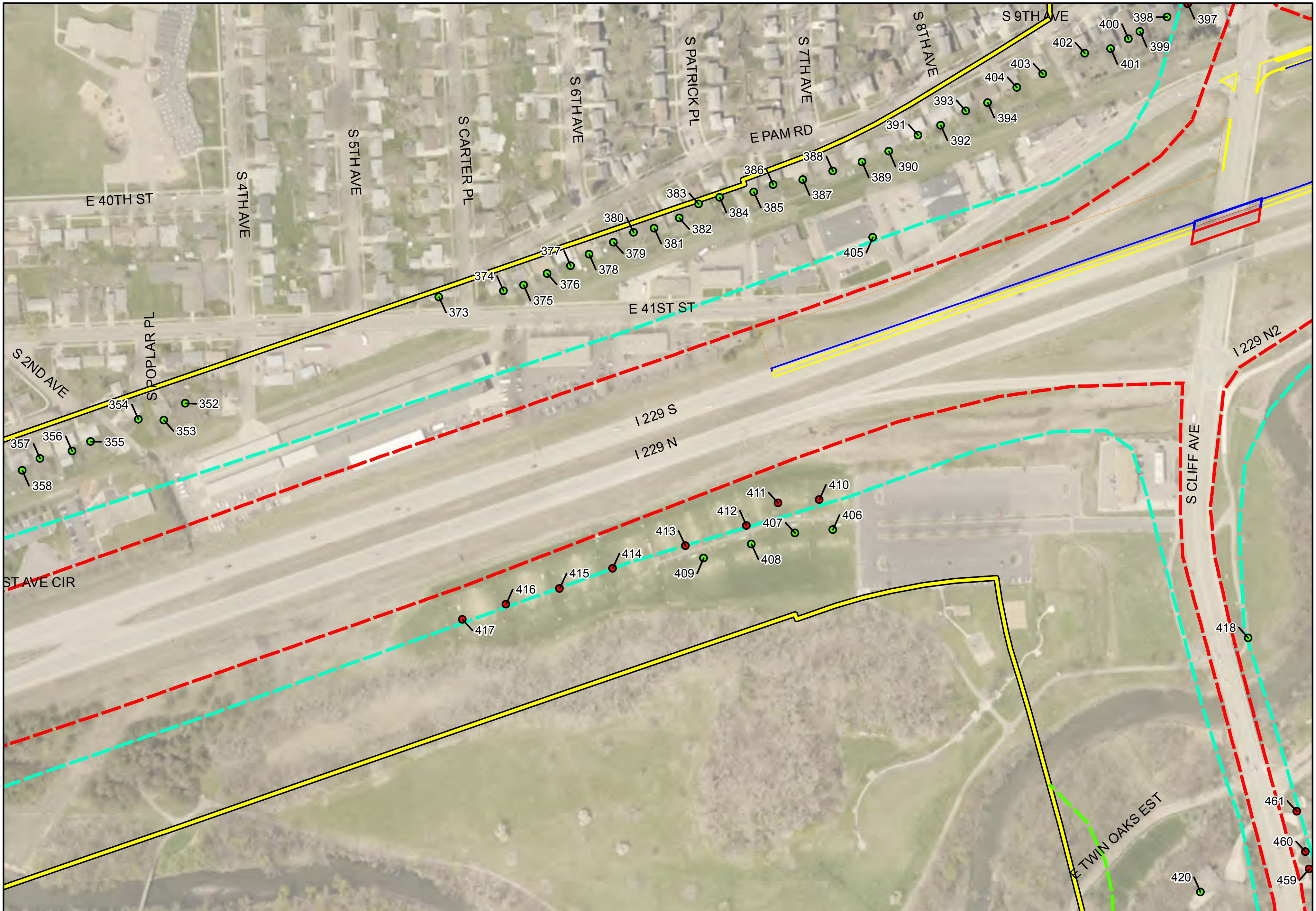
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



Legend

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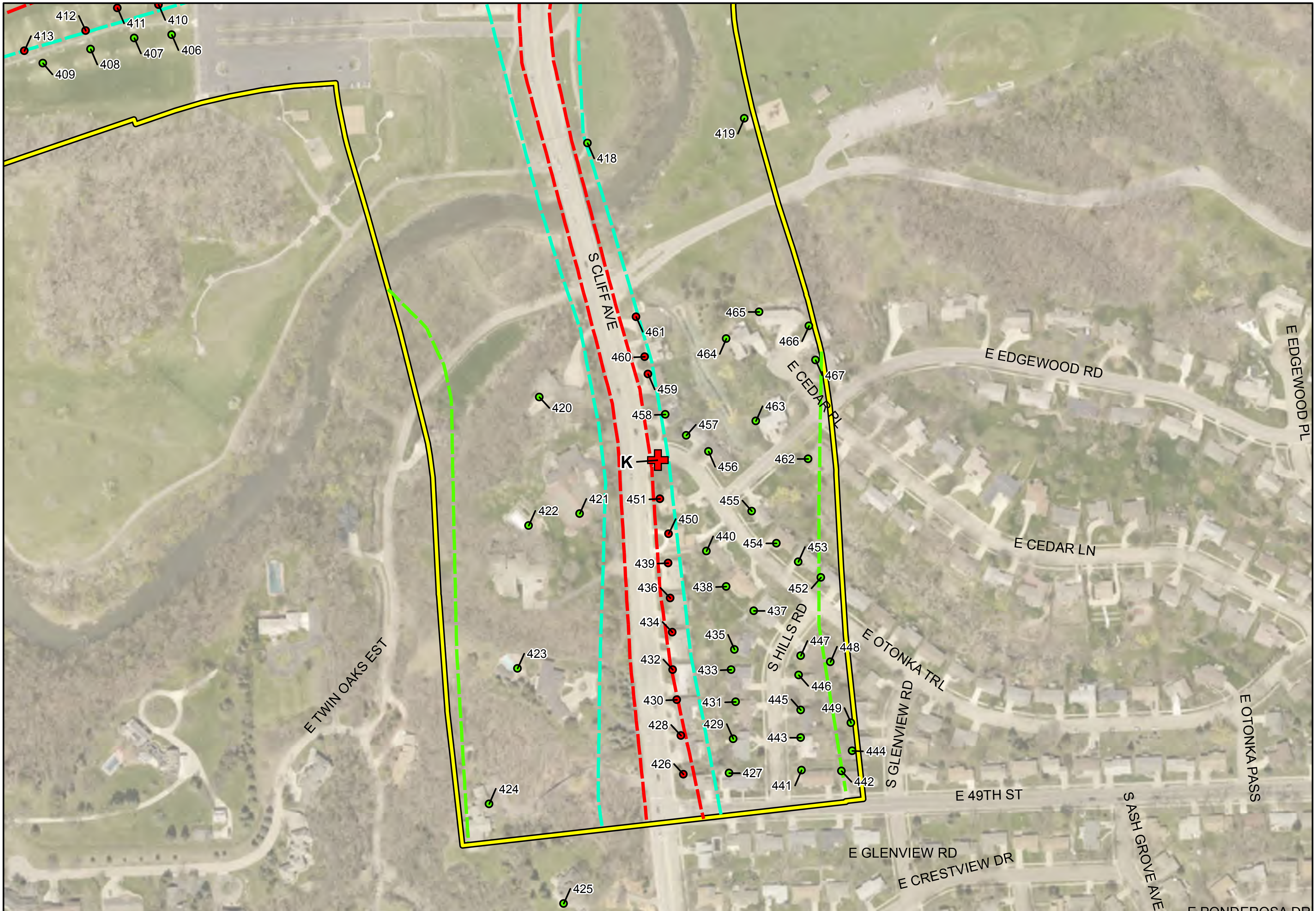
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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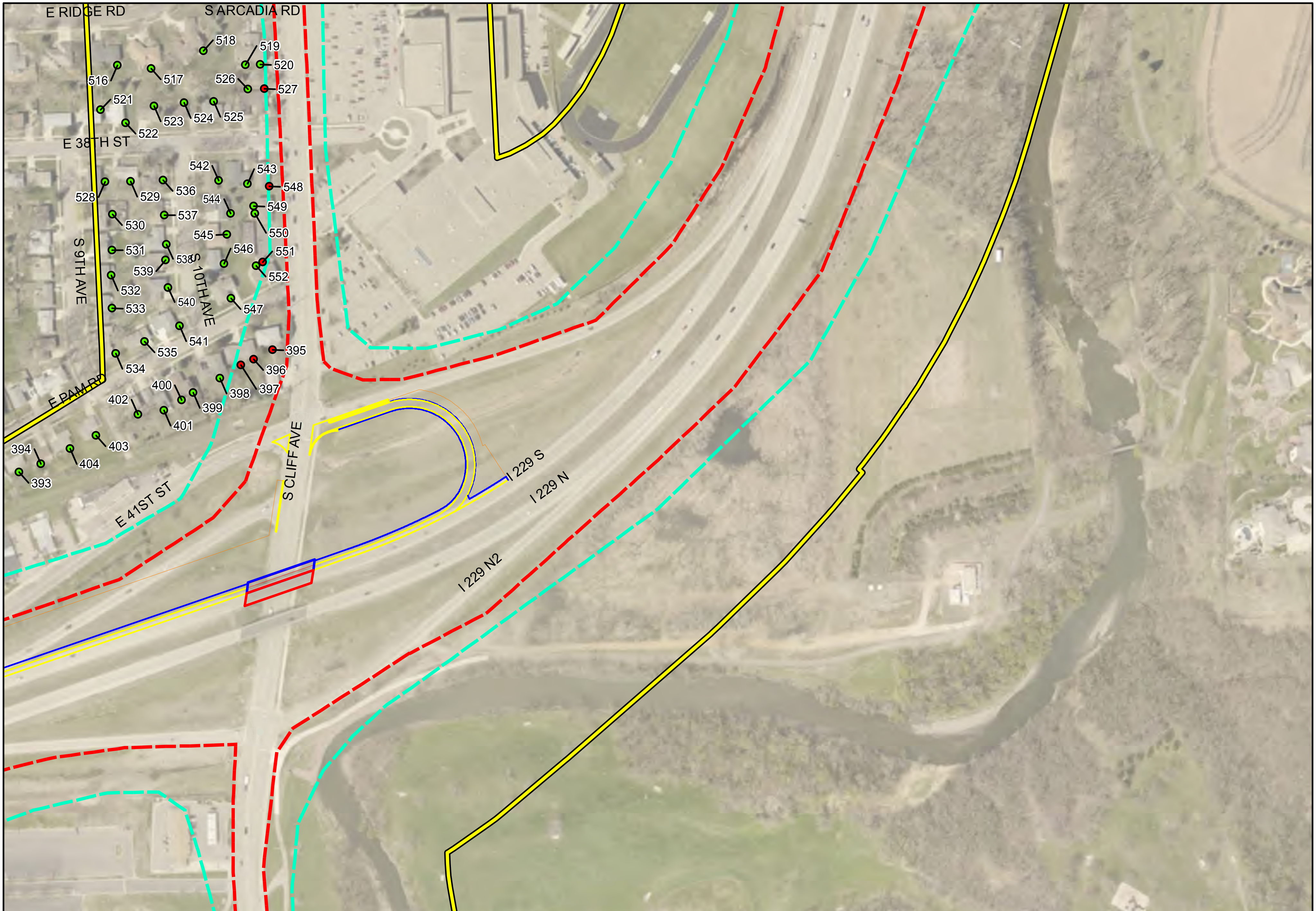
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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Sub-Study #1
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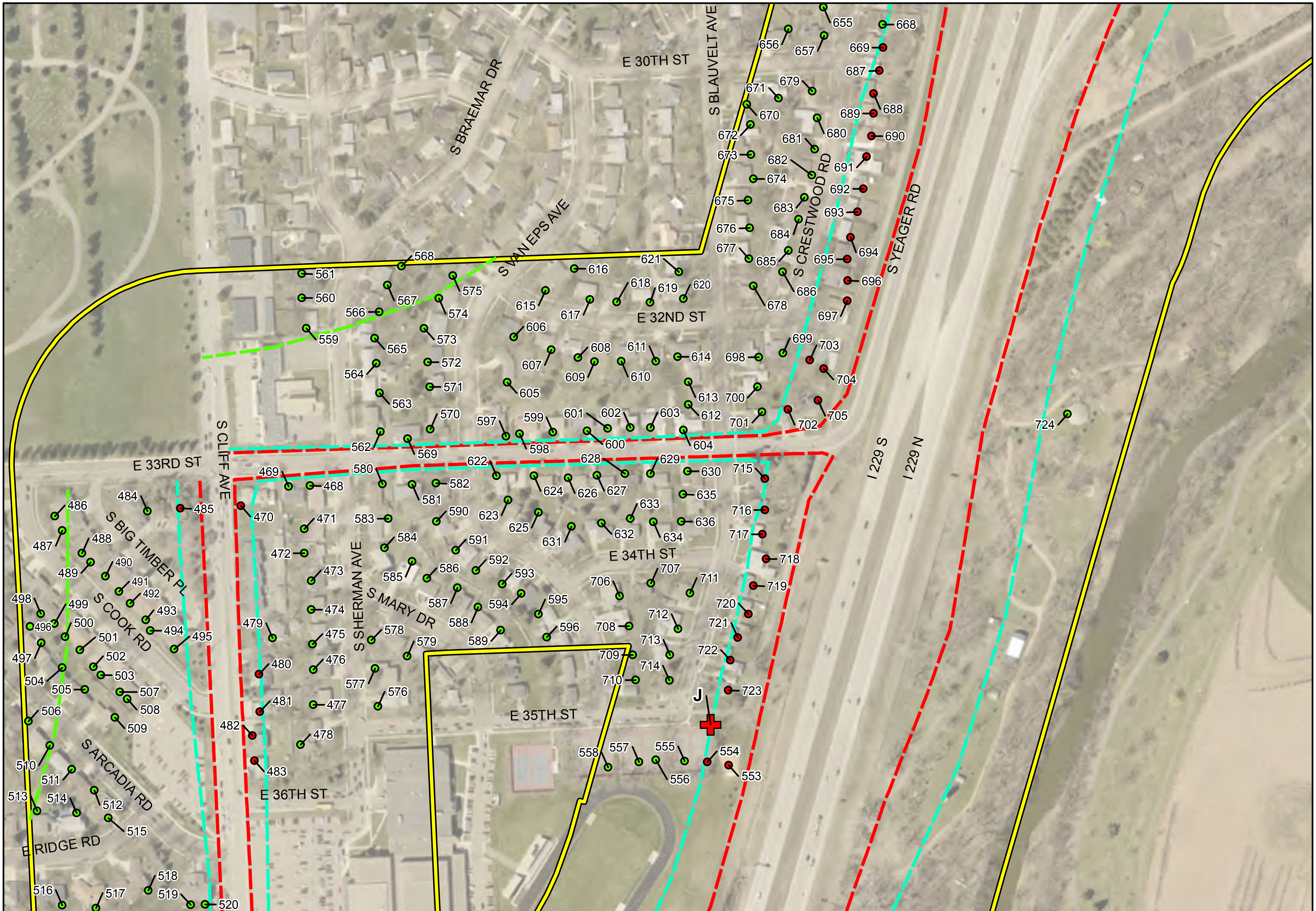

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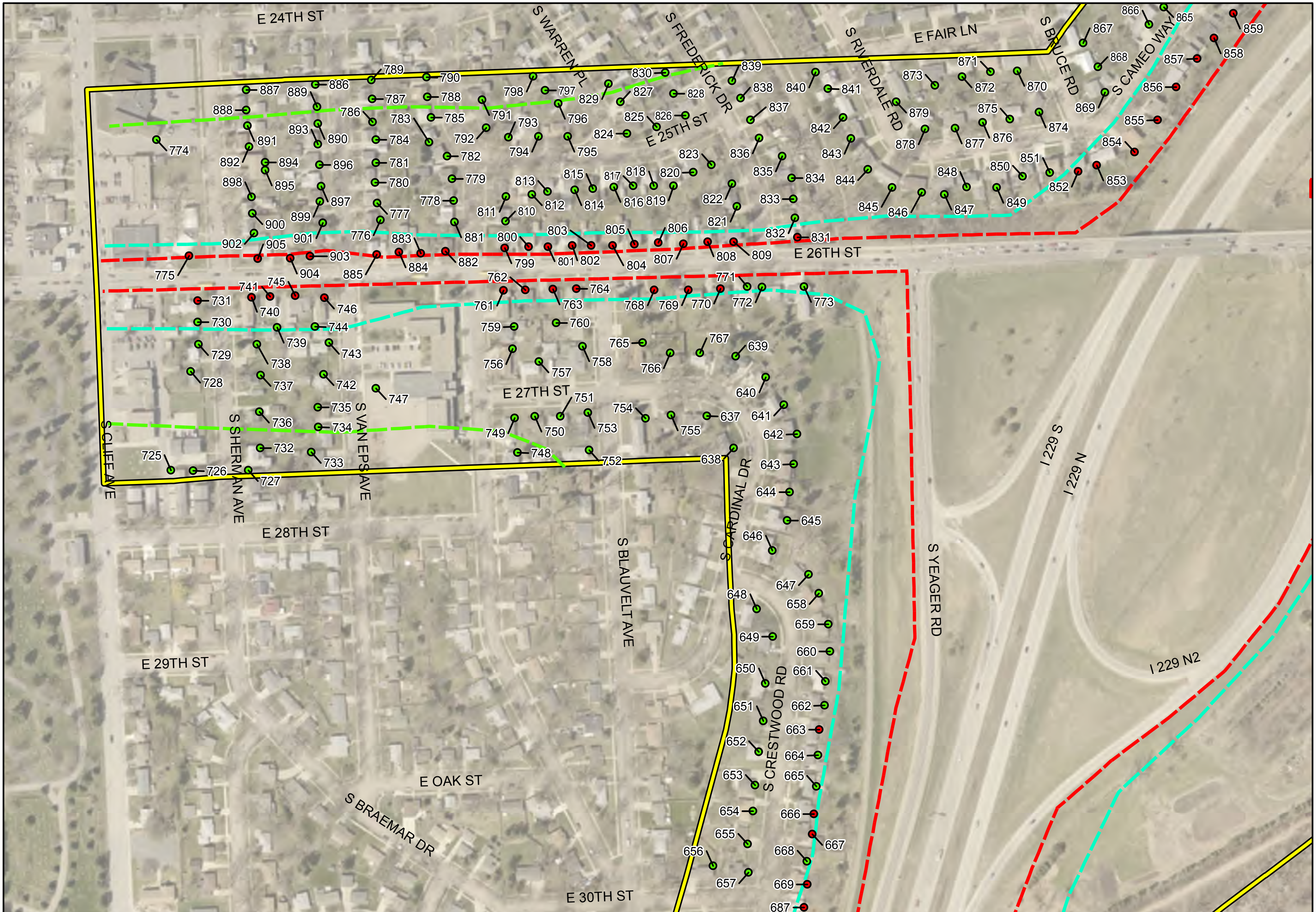

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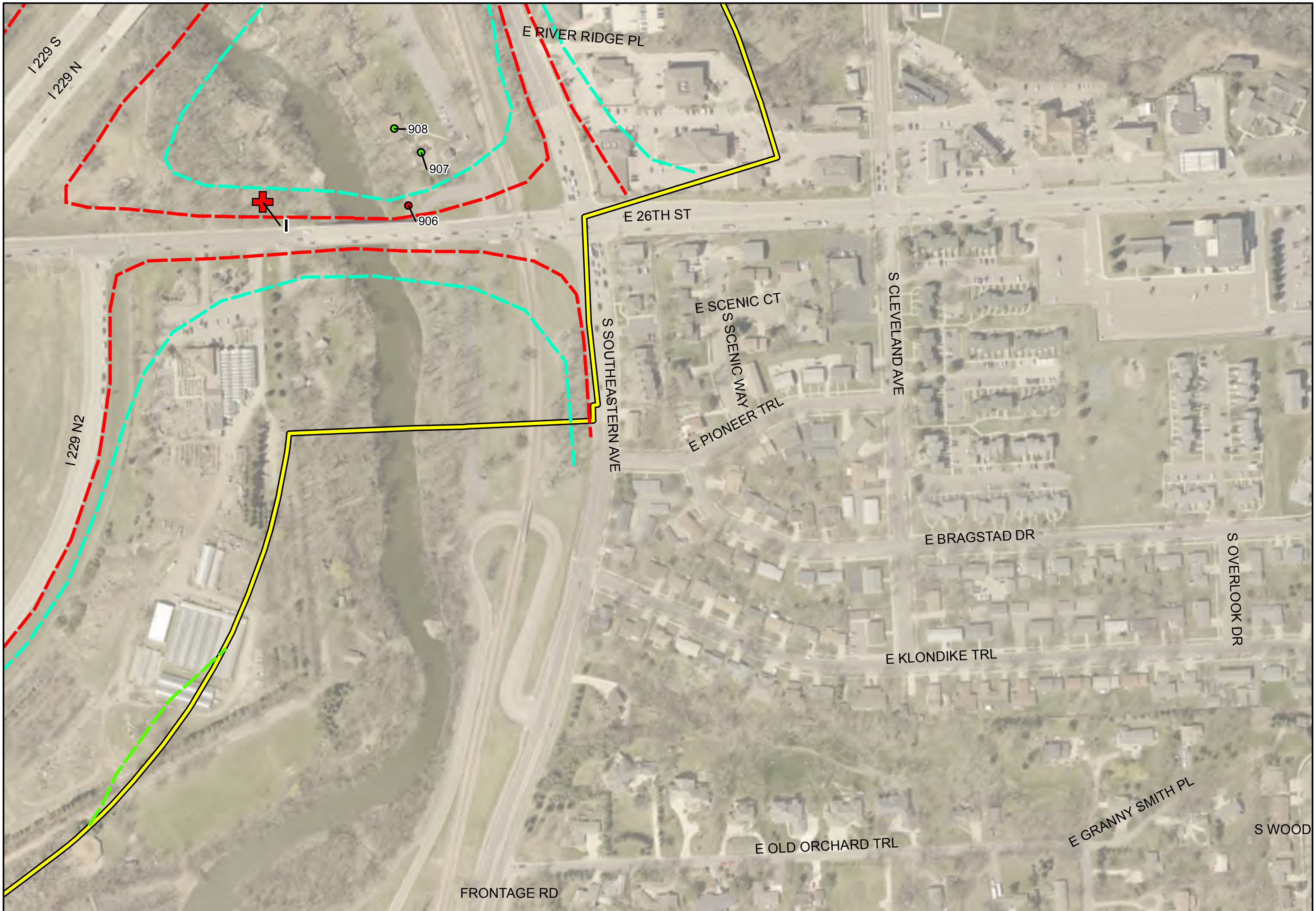

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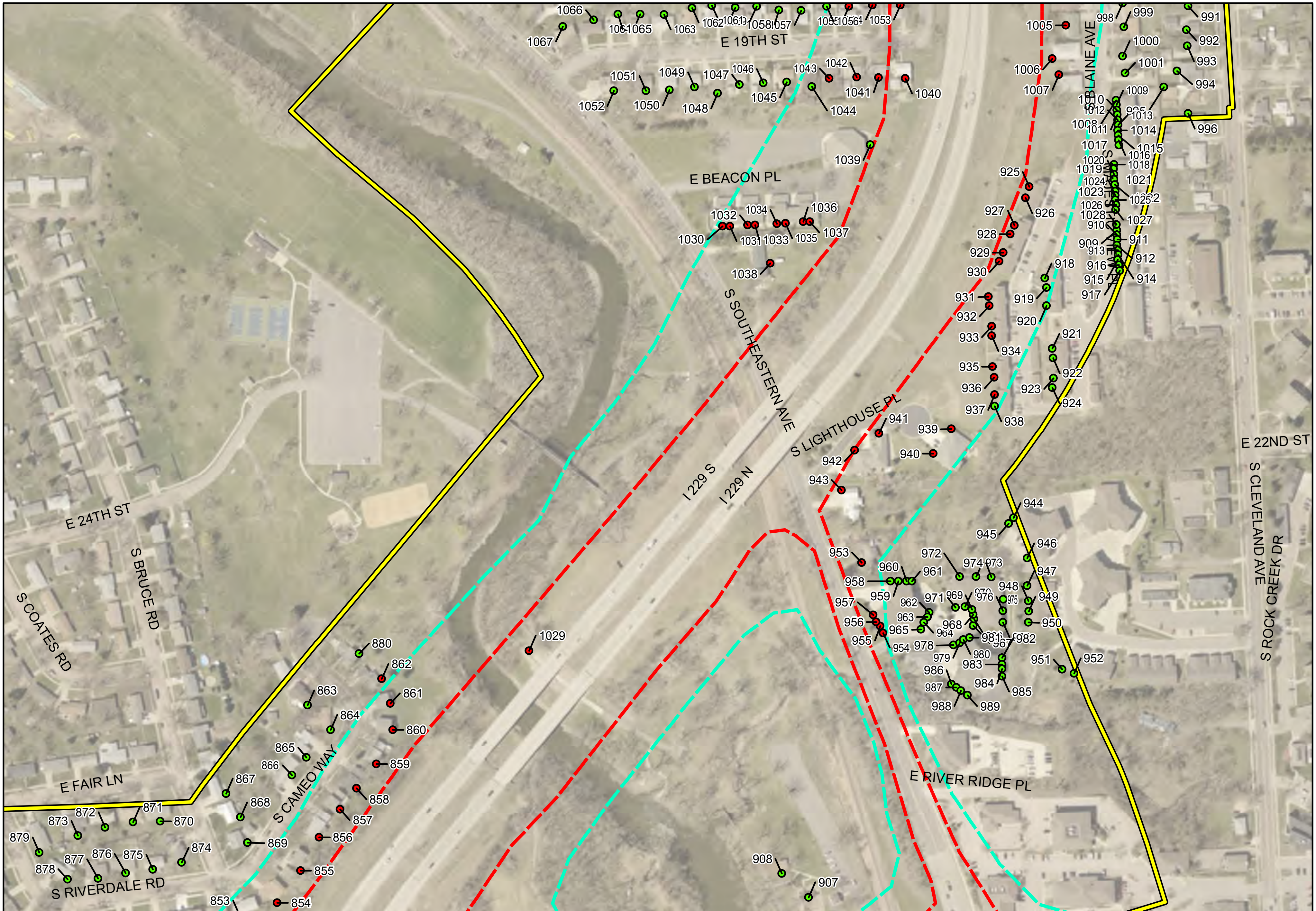

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Sub-Study #1
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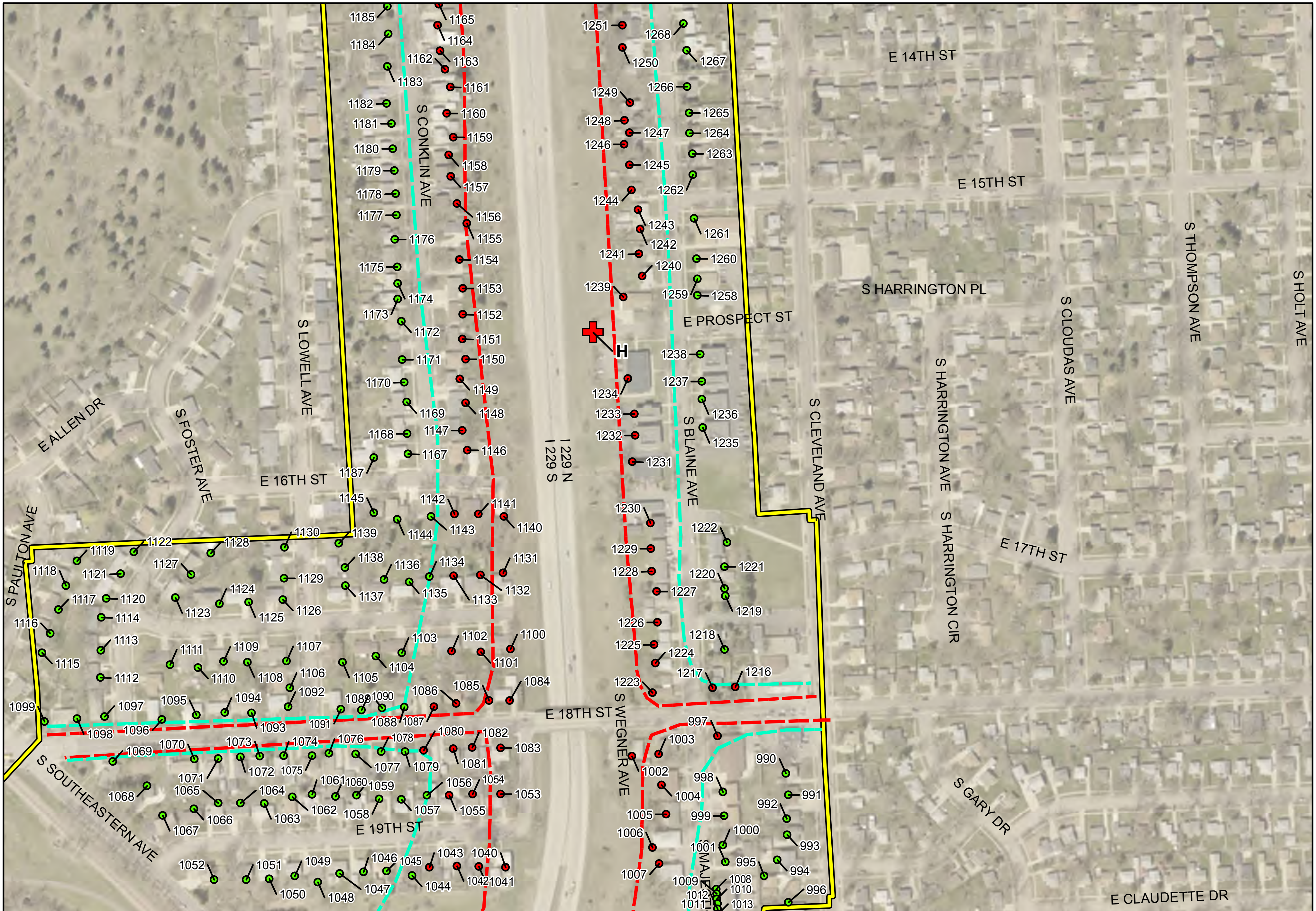

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Sub-Study #1
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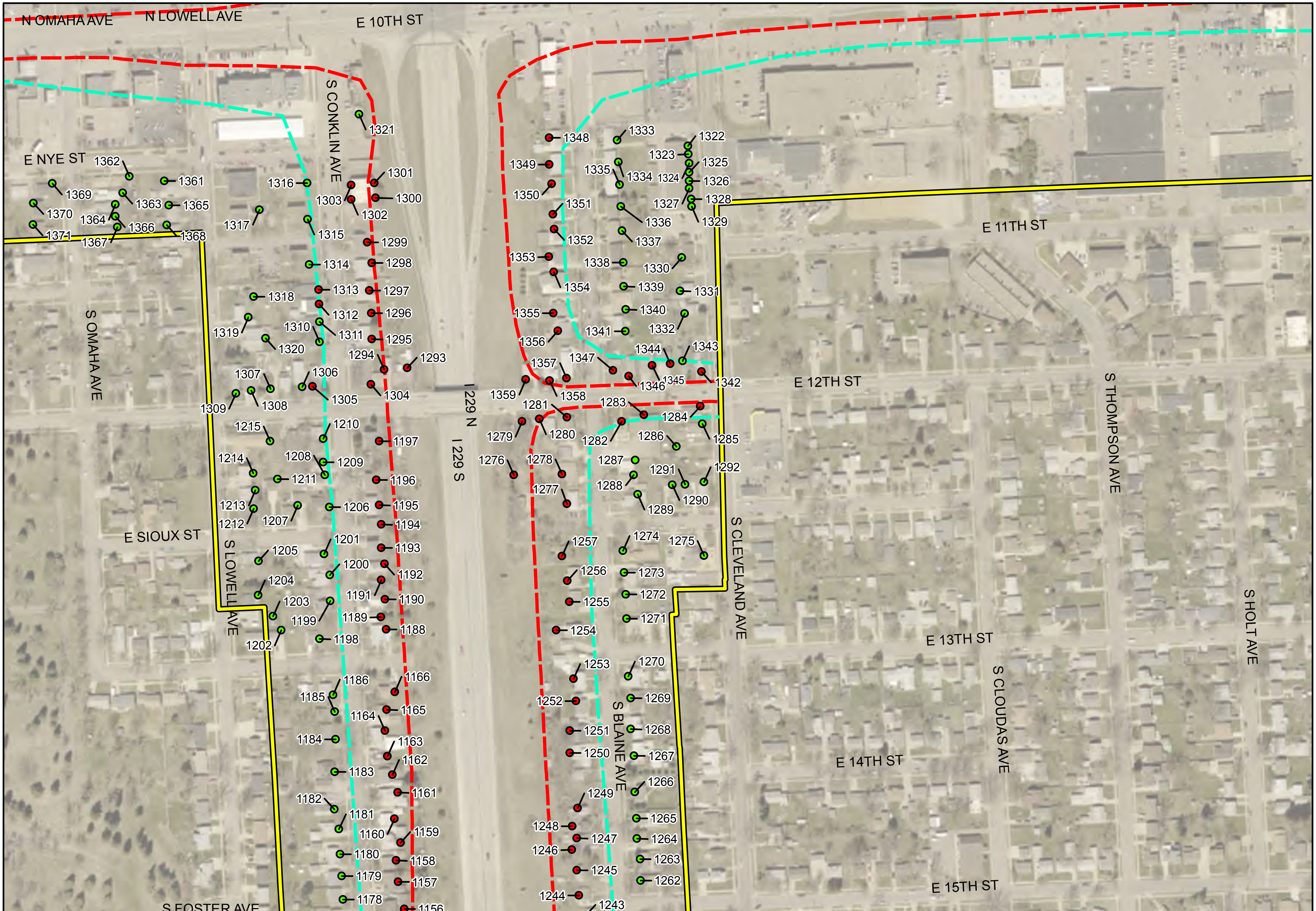

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Sub-Study #1
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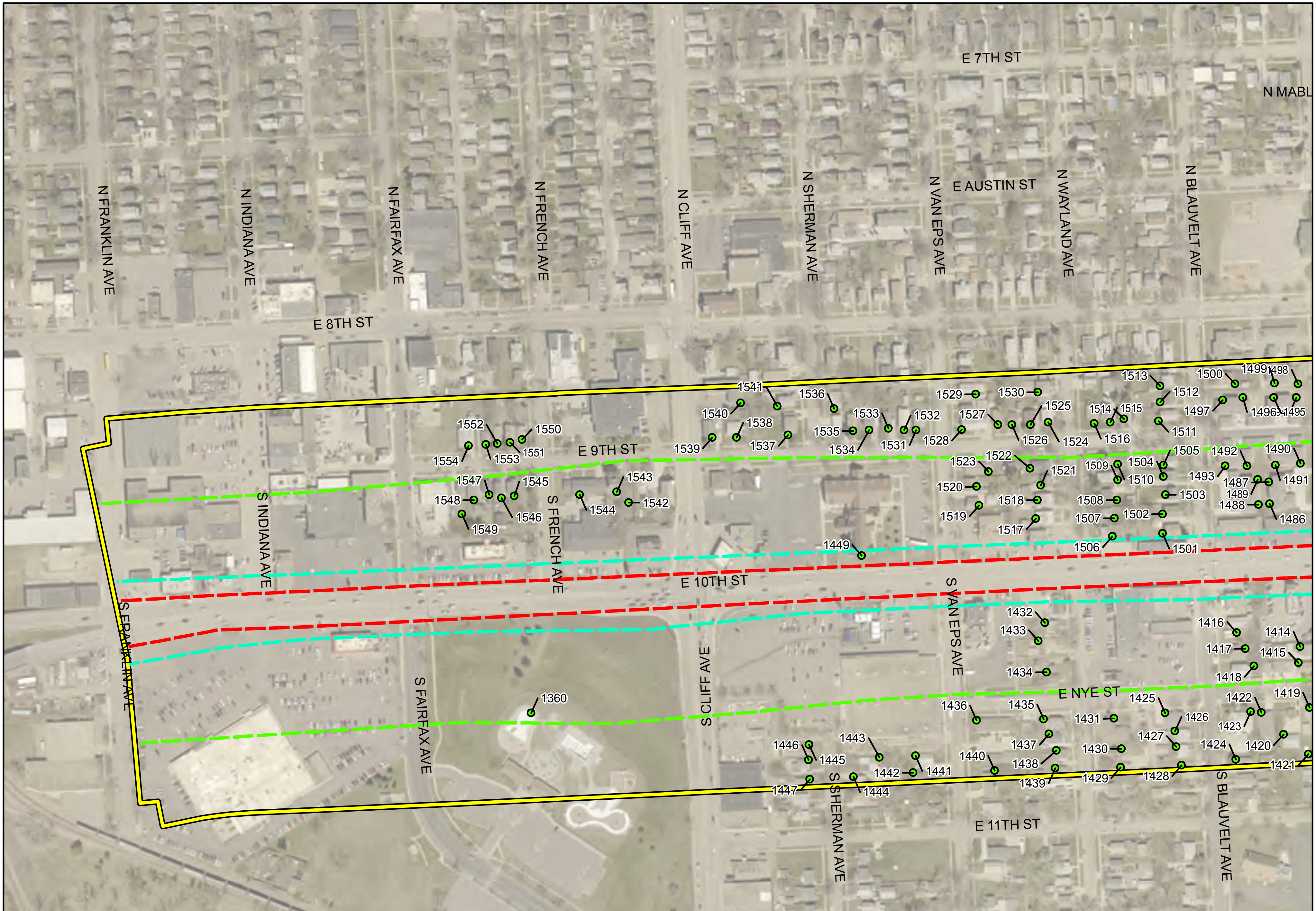

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I-229 Major Investment Corridor Study
Sub-Study #1
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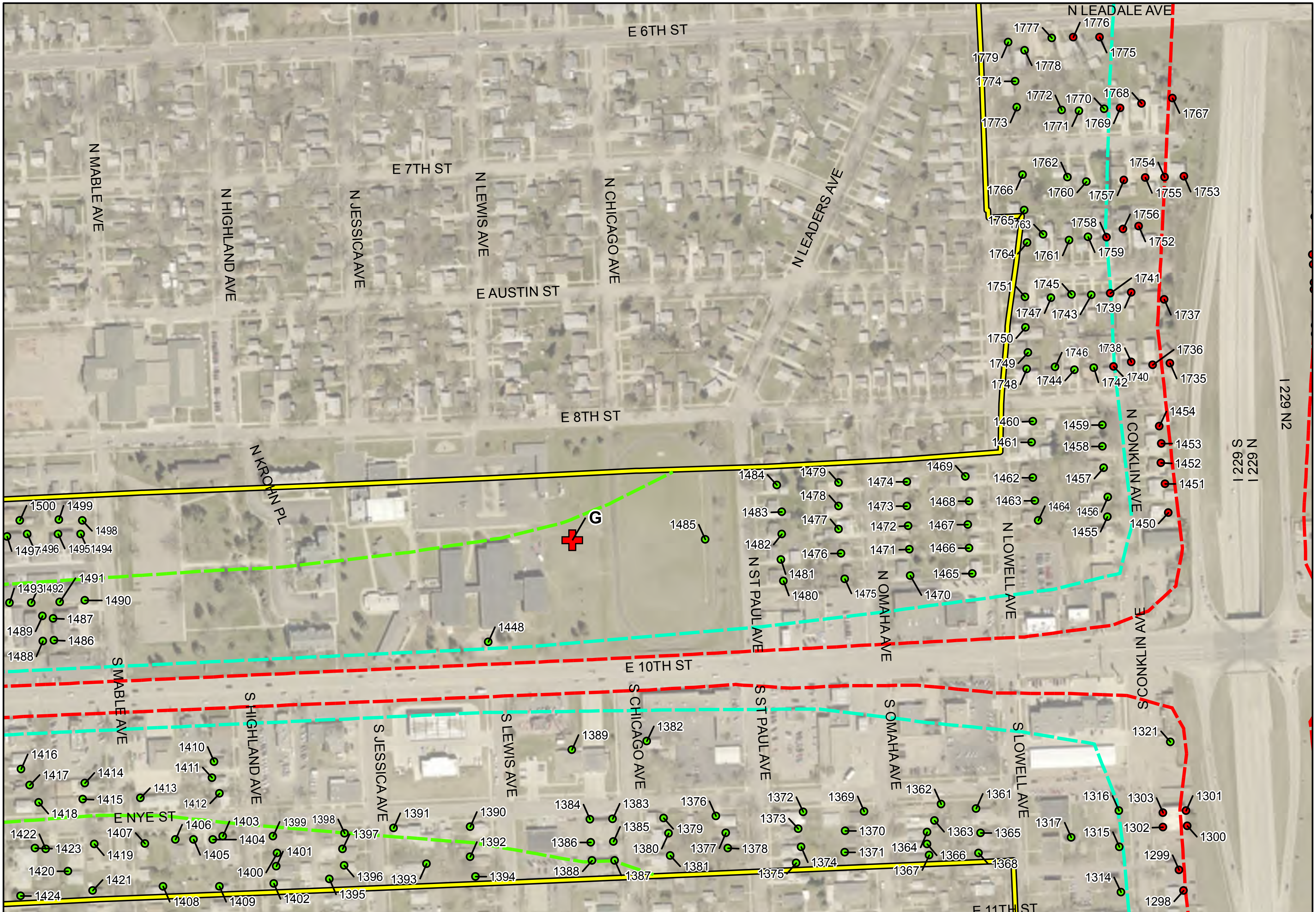

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I-229 Major Investment Corridor Study
Sub-Study #1
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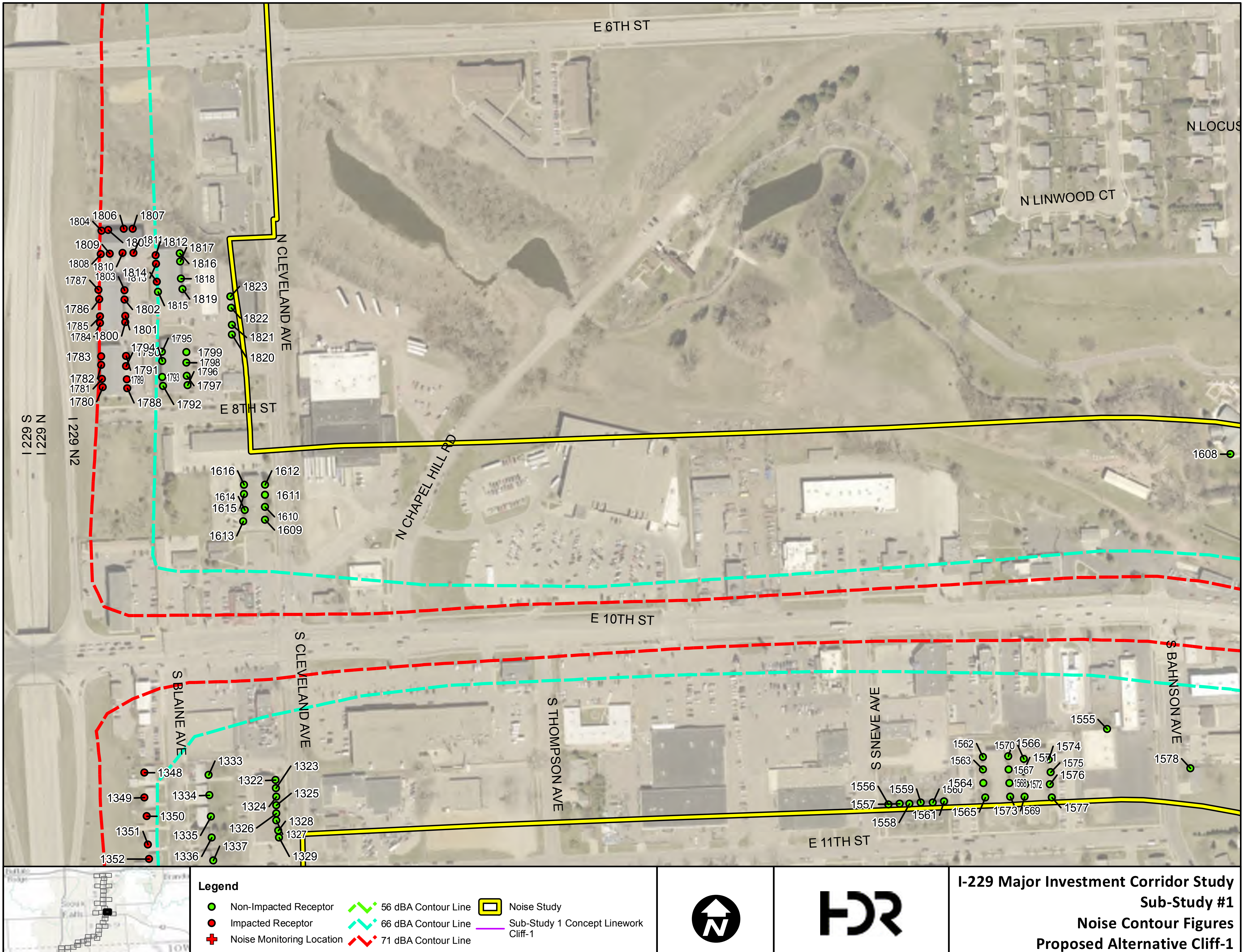
Proposed Alternative Cliff-1



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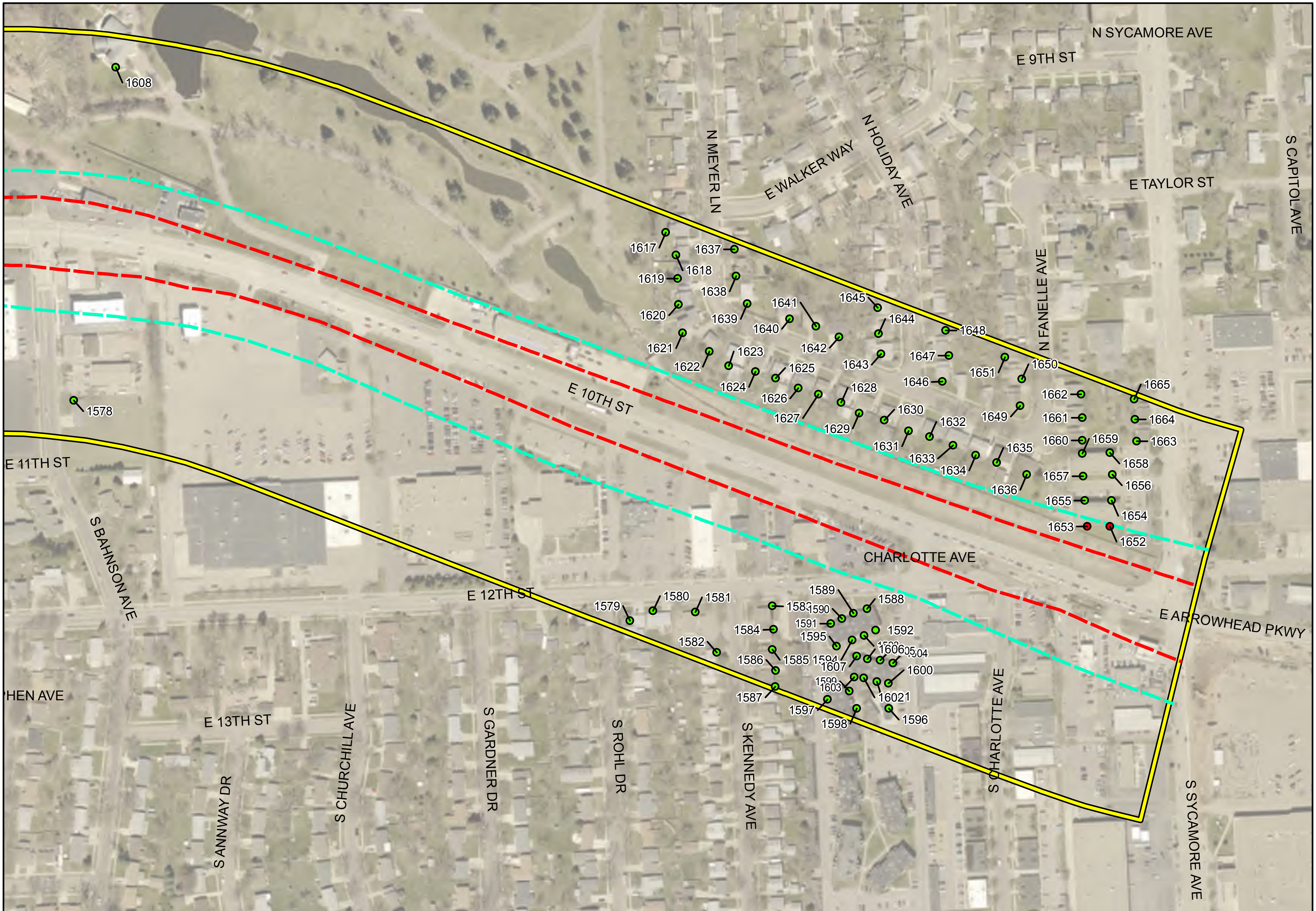
I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

Proposed Alternative Cliff-1



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I-229 Major Investment Corridor Study
Sub-Study #1
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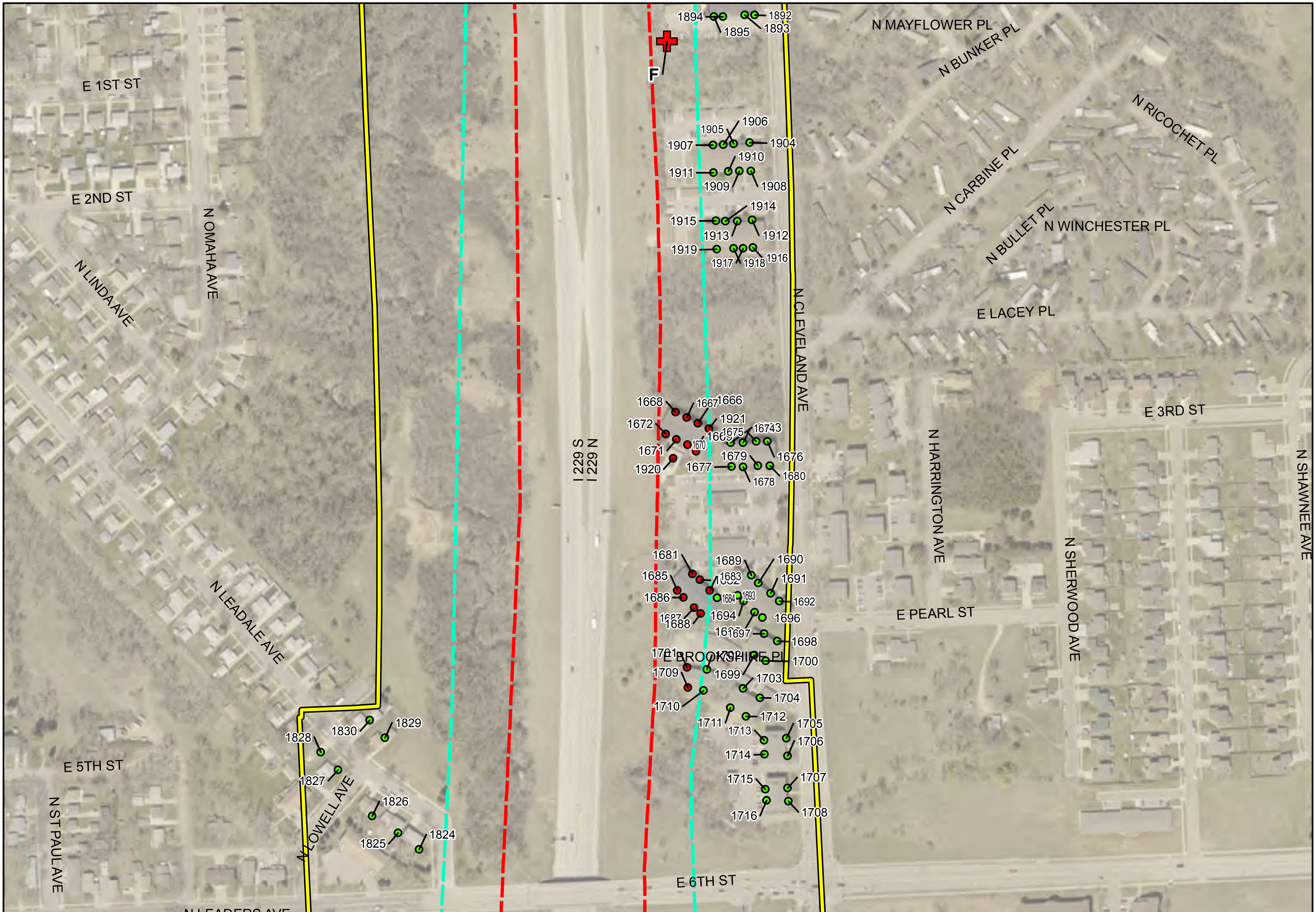

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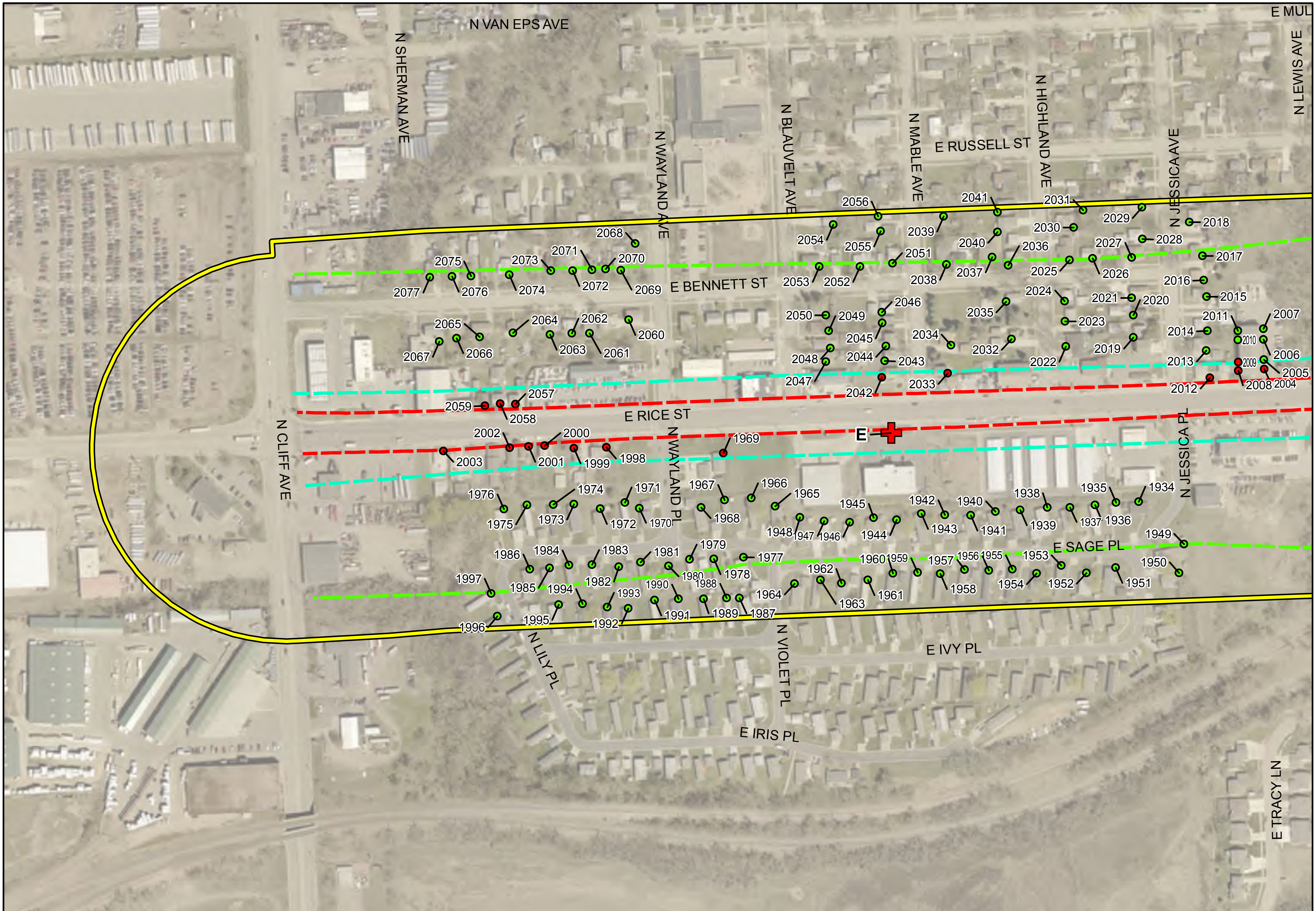

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I-229 Major Investment Corridor Study
Sub-Study #1
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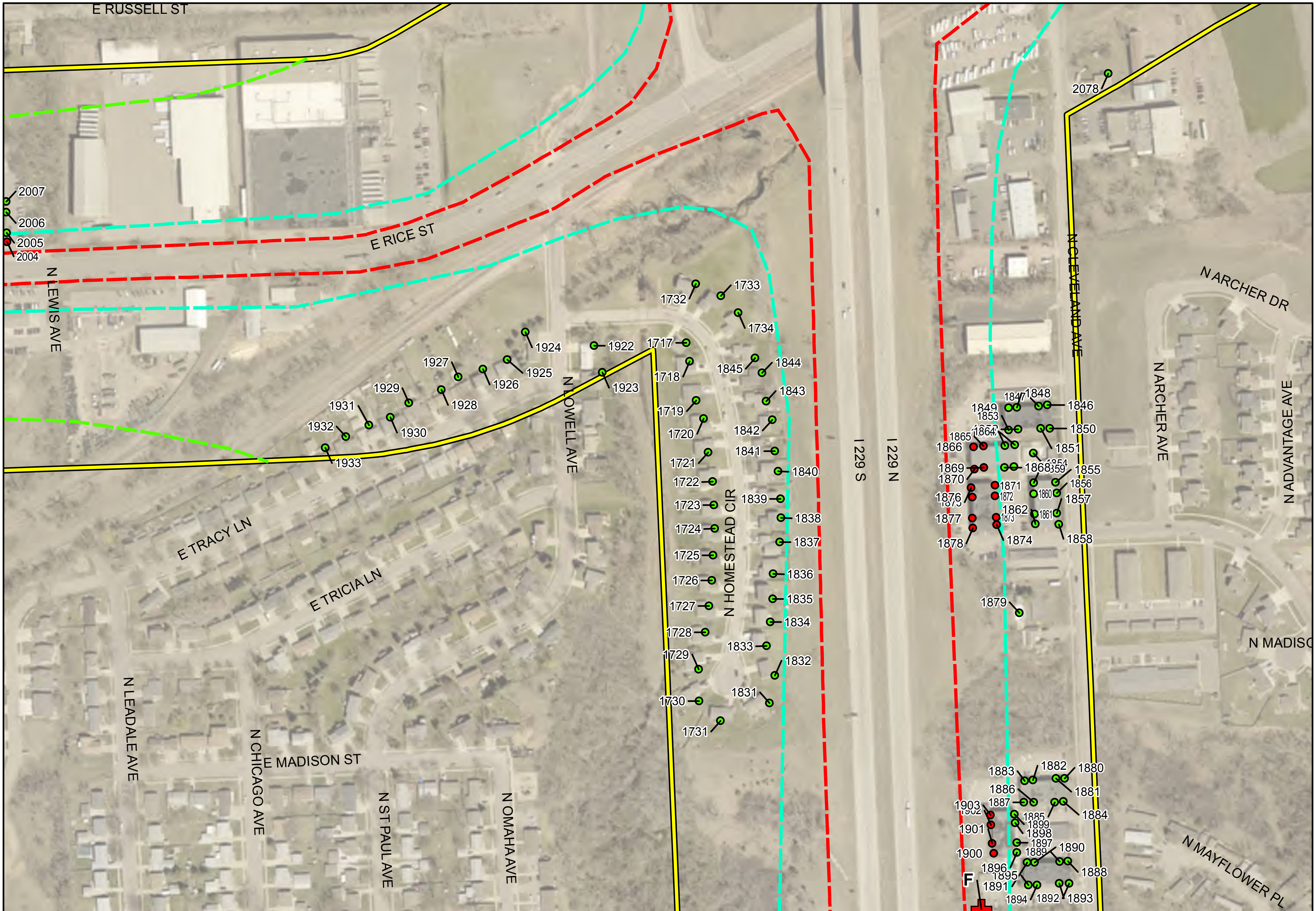

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Sub-Study #1
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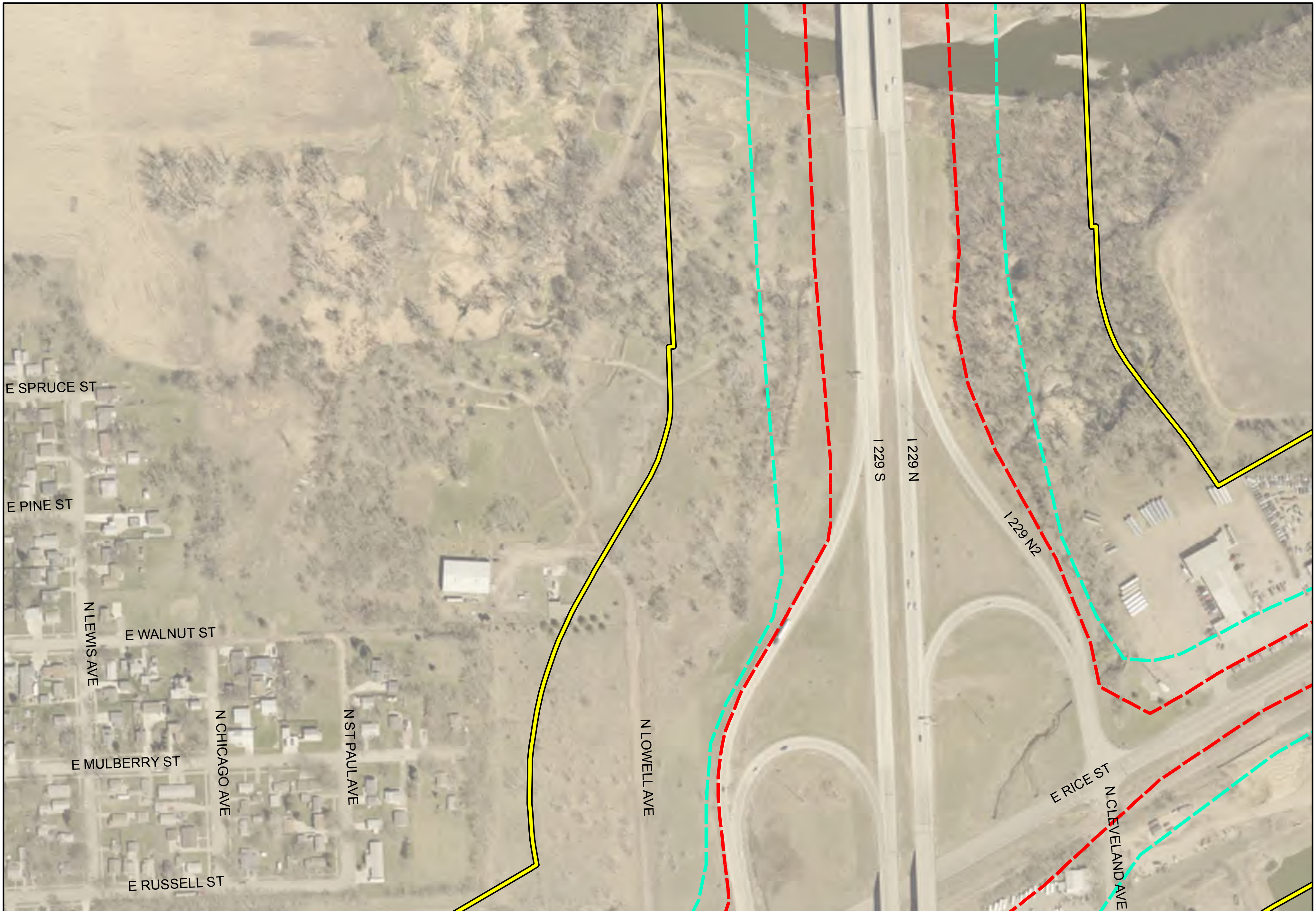

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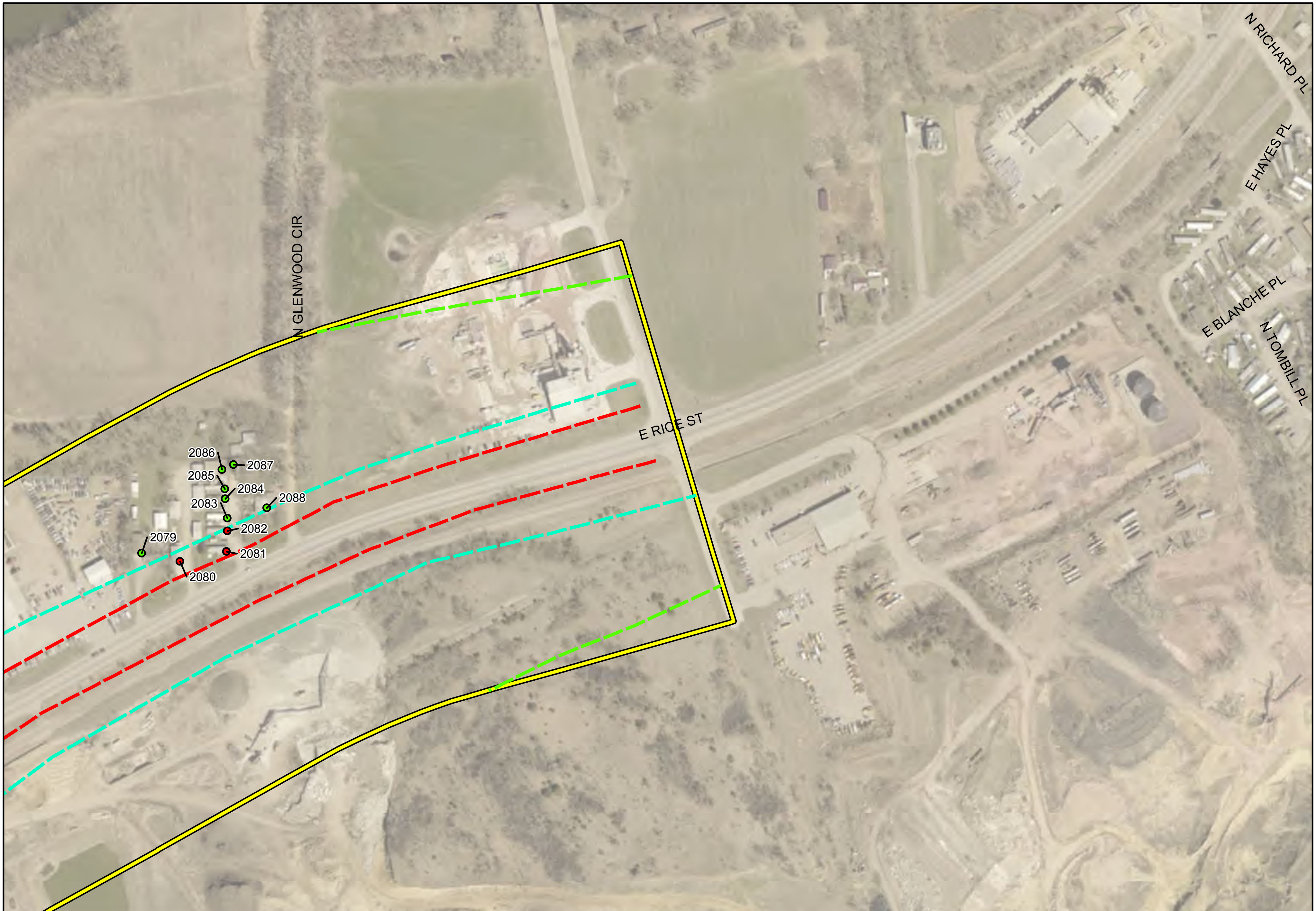

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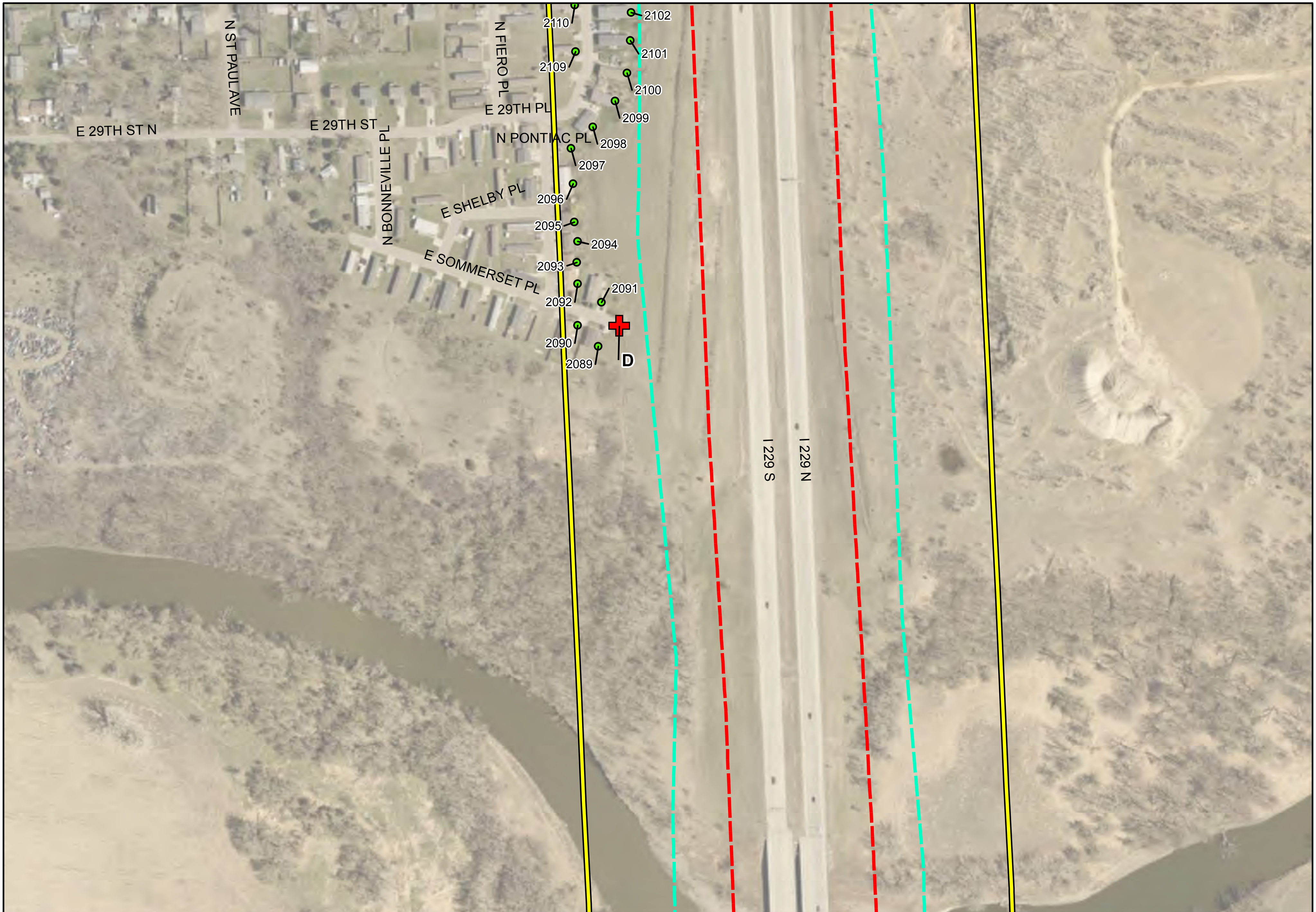

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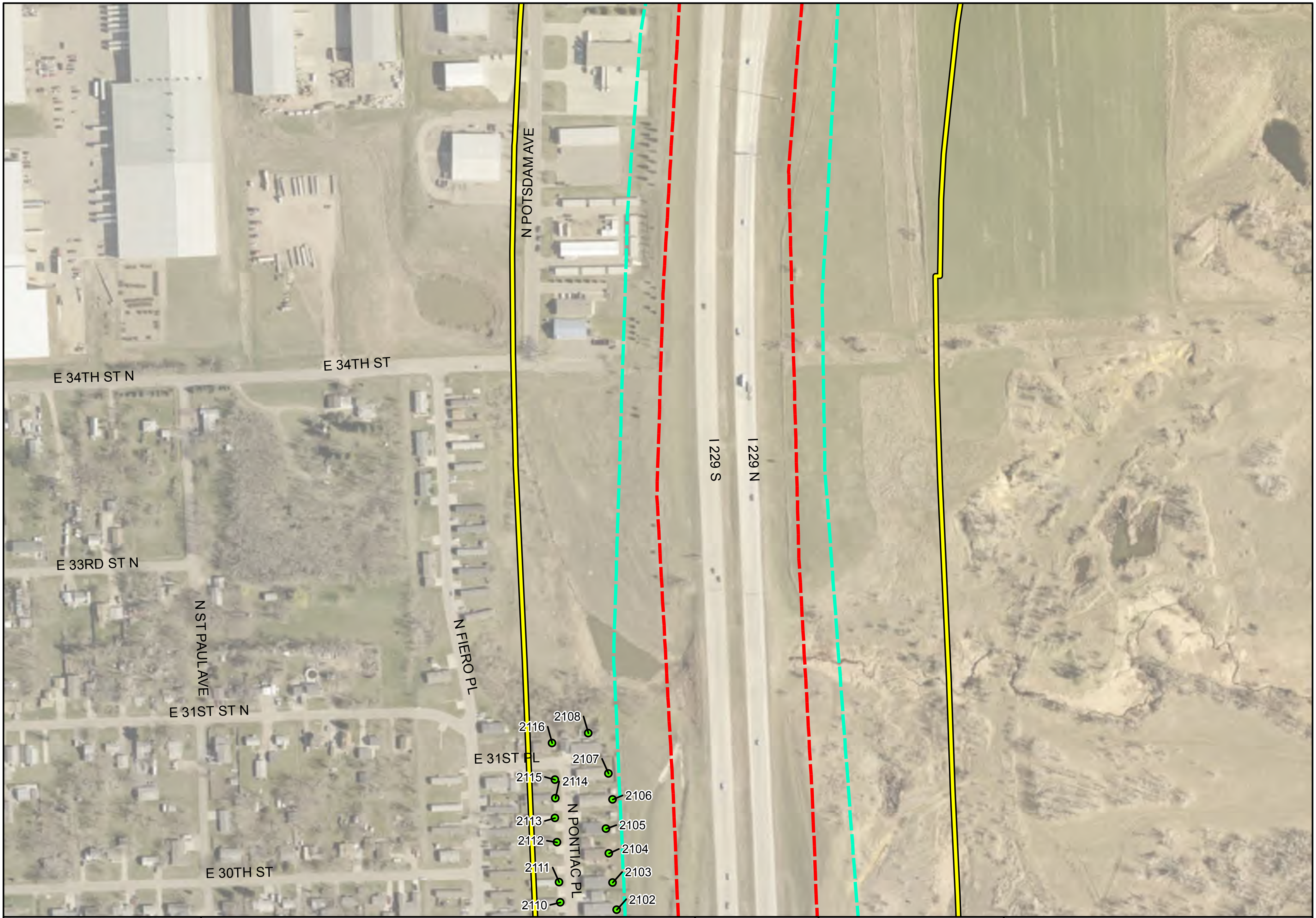

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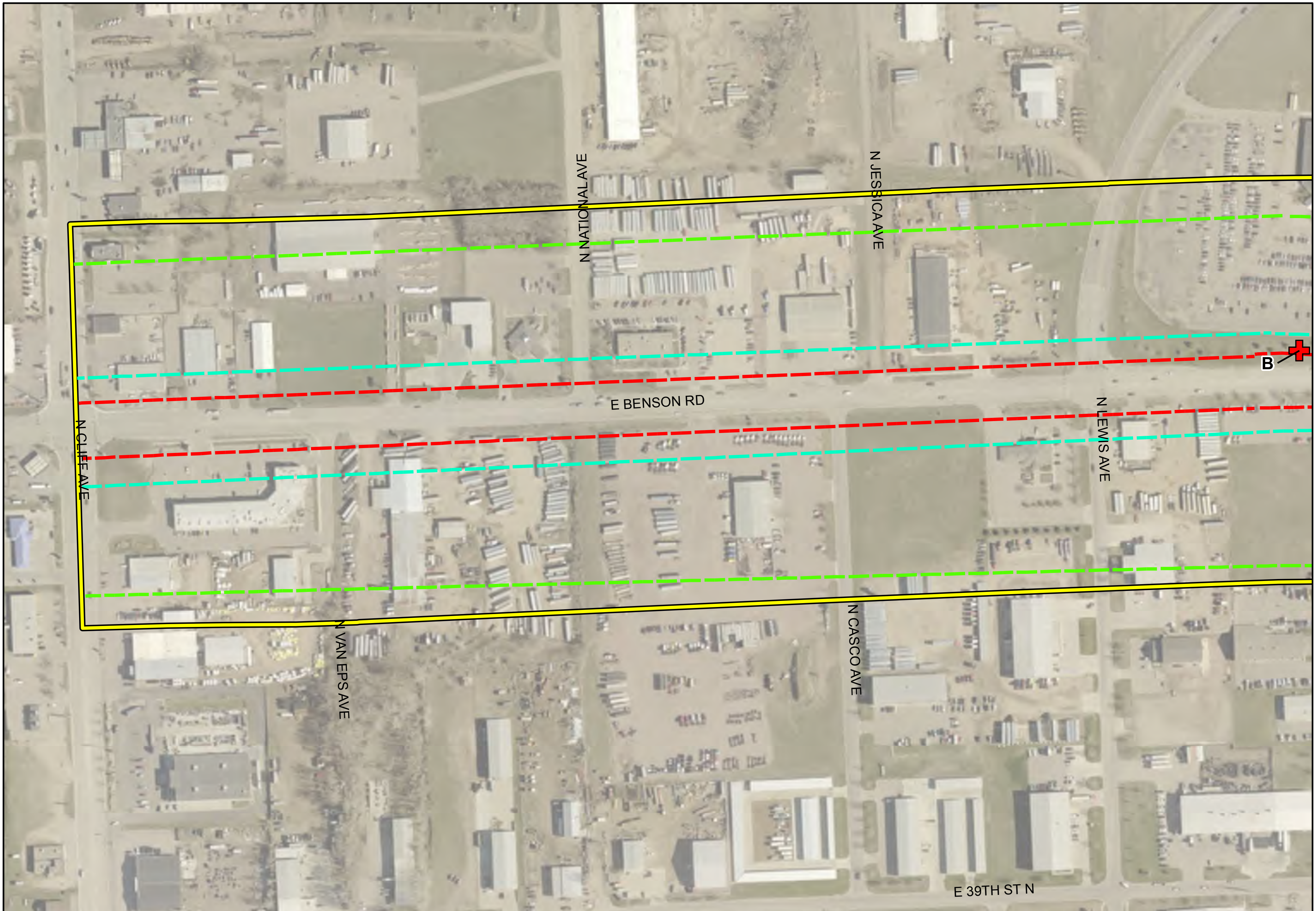

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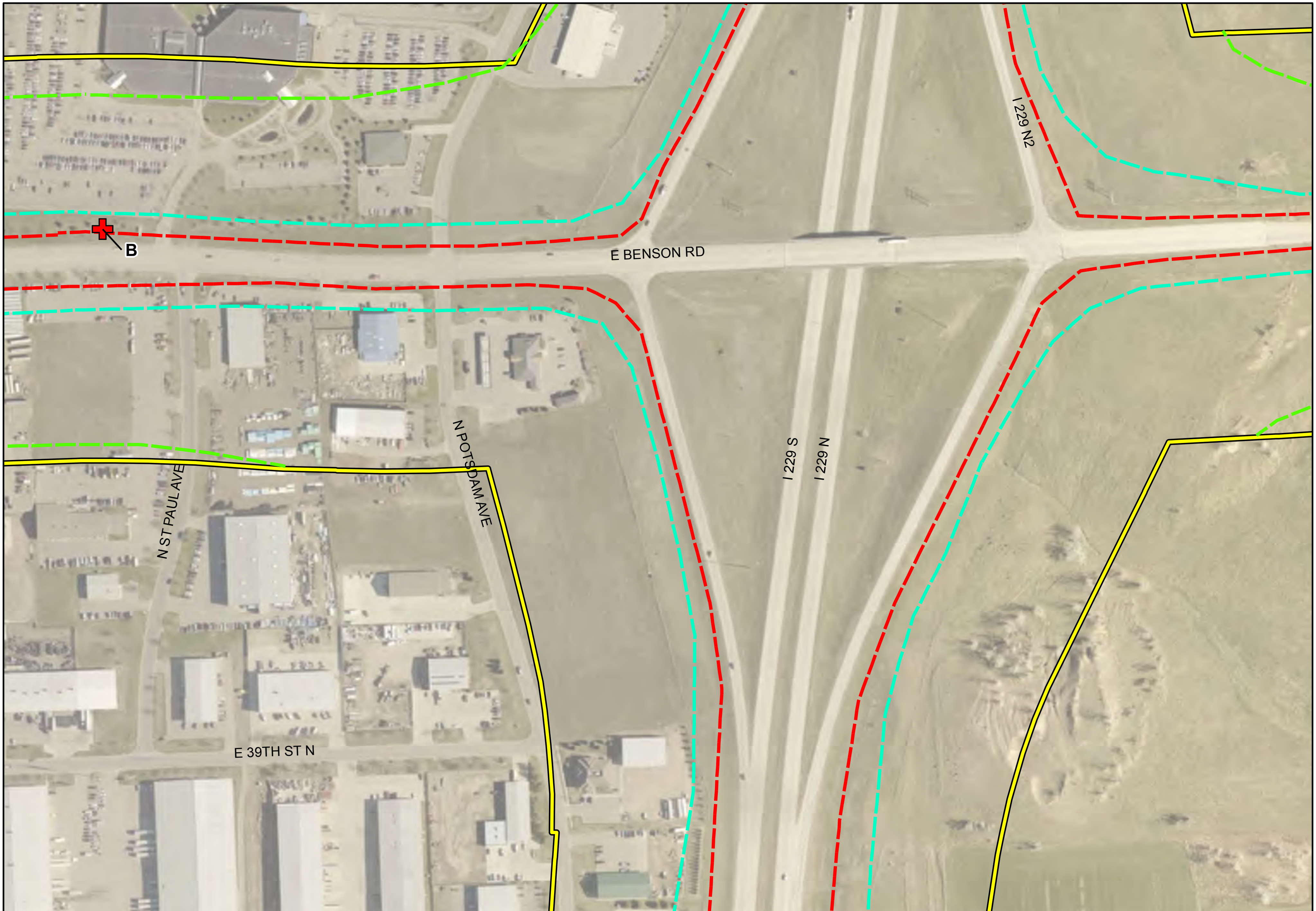

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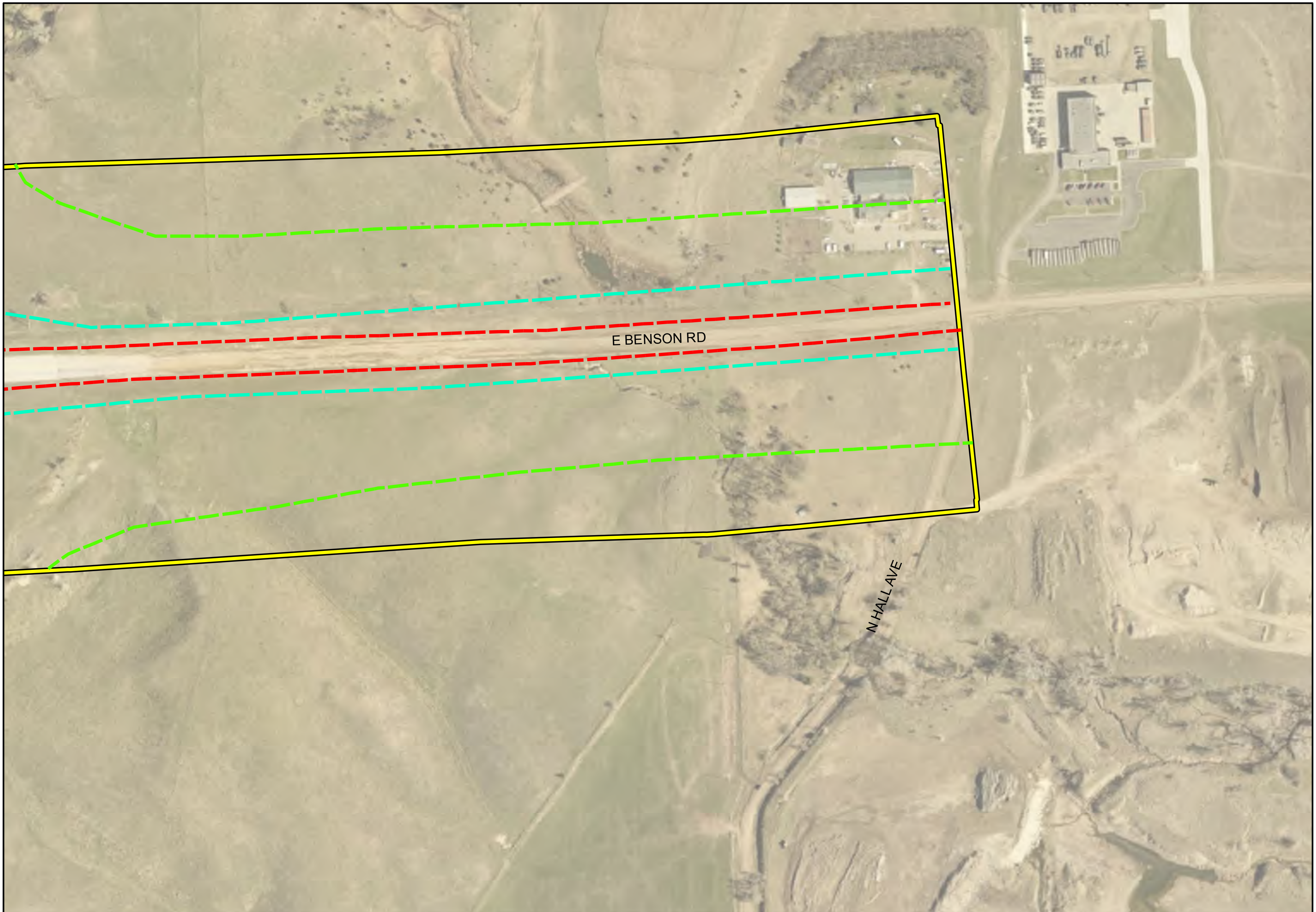

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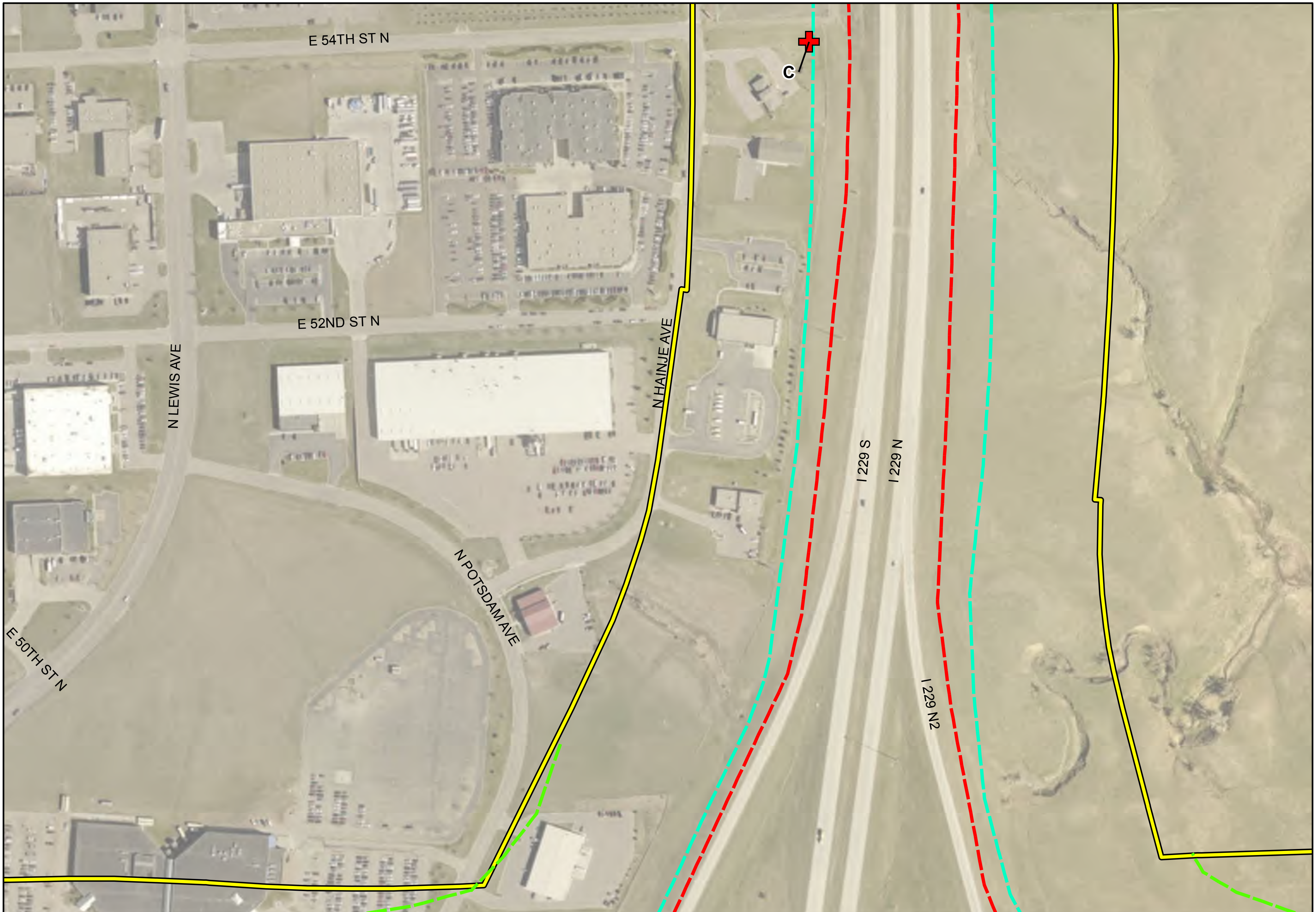

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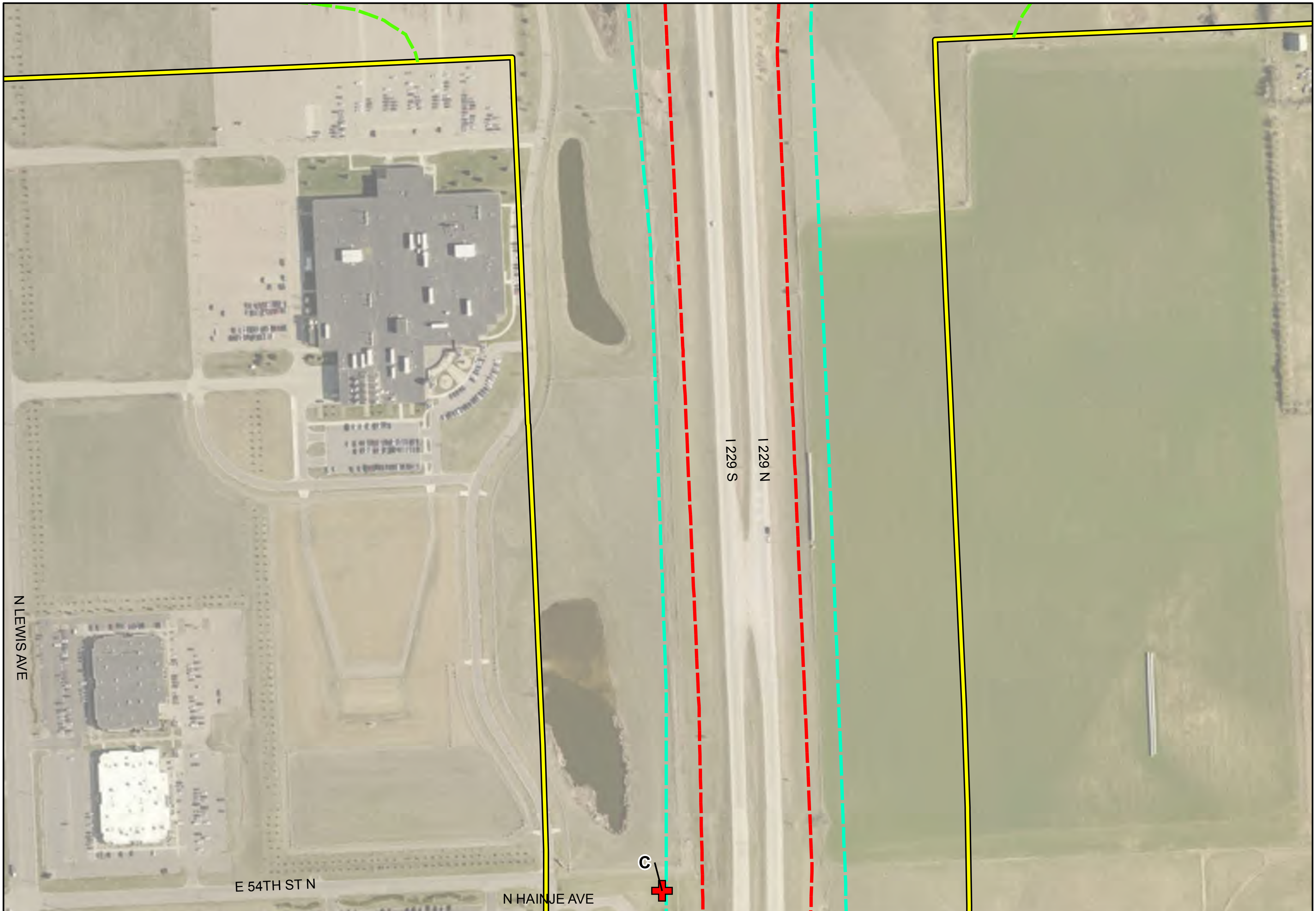

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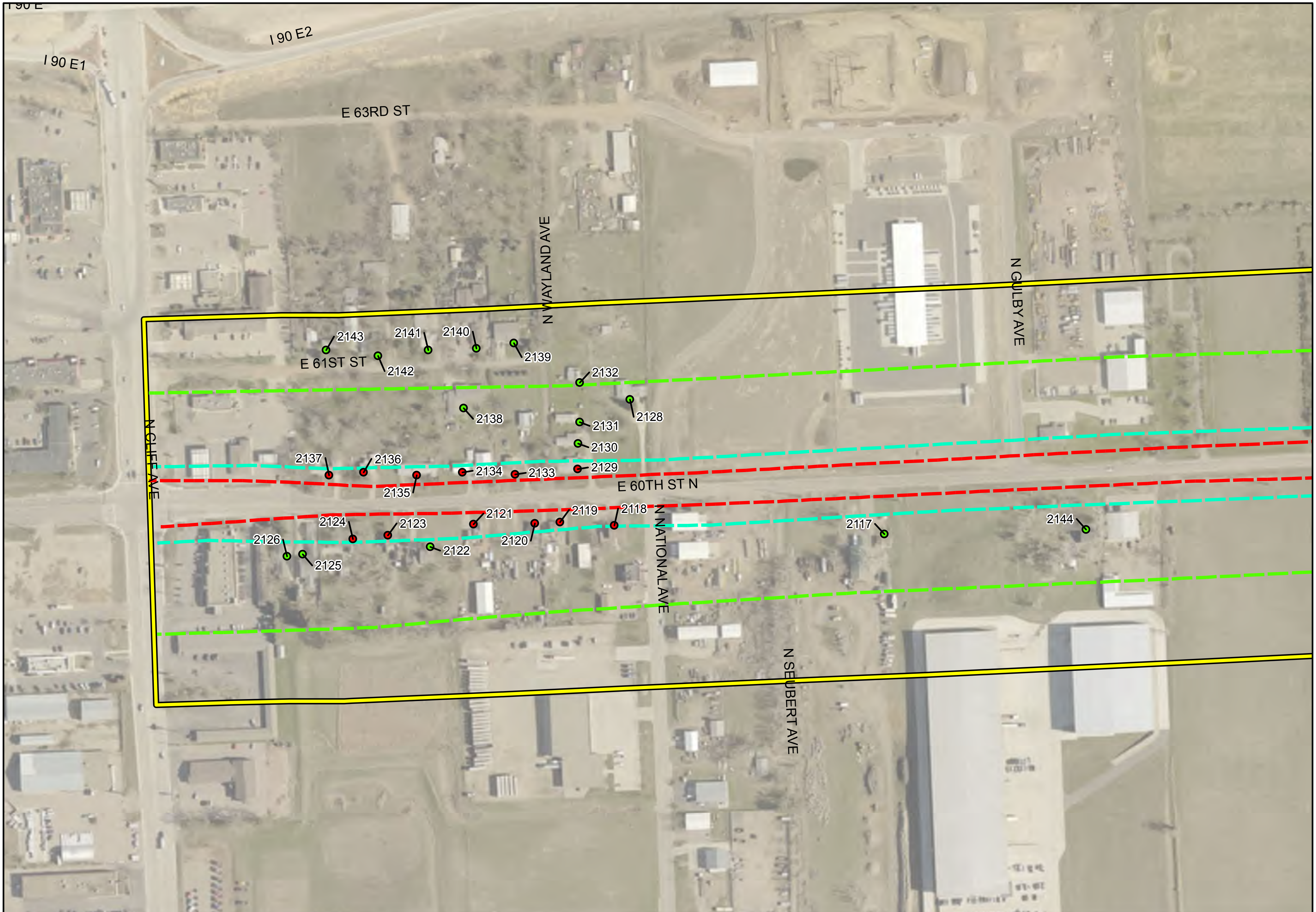

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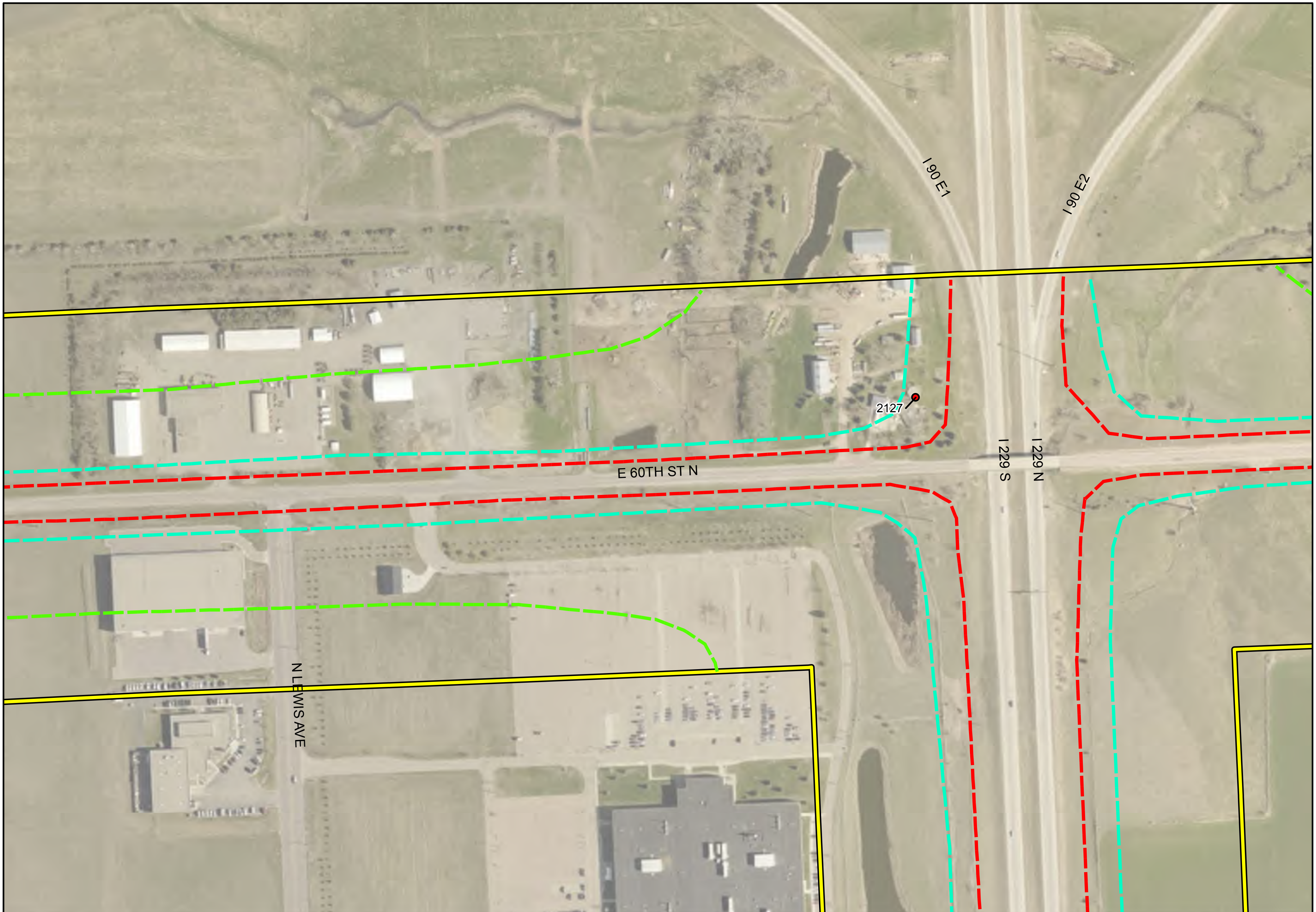
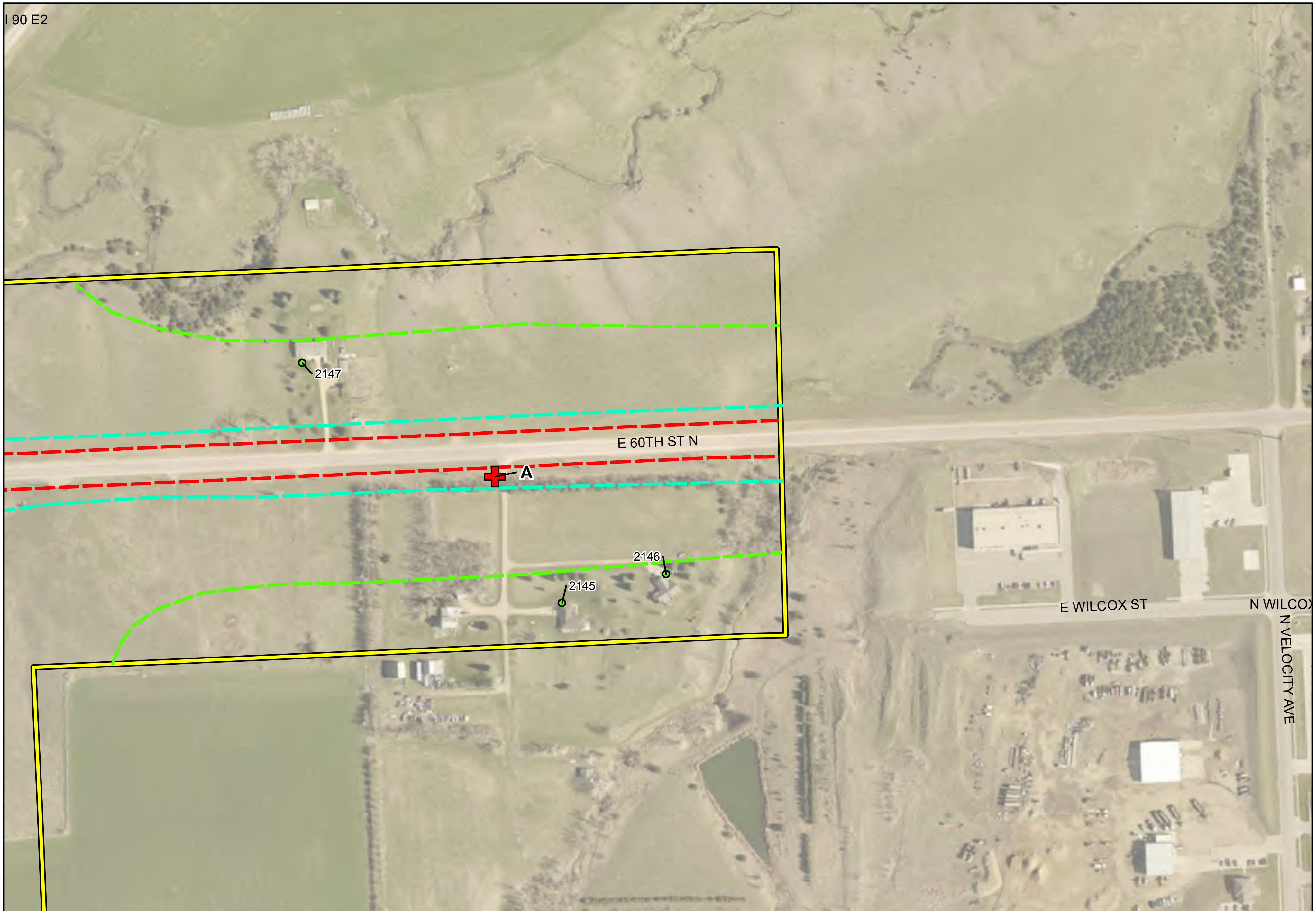
Noise Contour Figures
Proposed Alternative Cliff-1



Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 1 Concept Linework Cliff-1

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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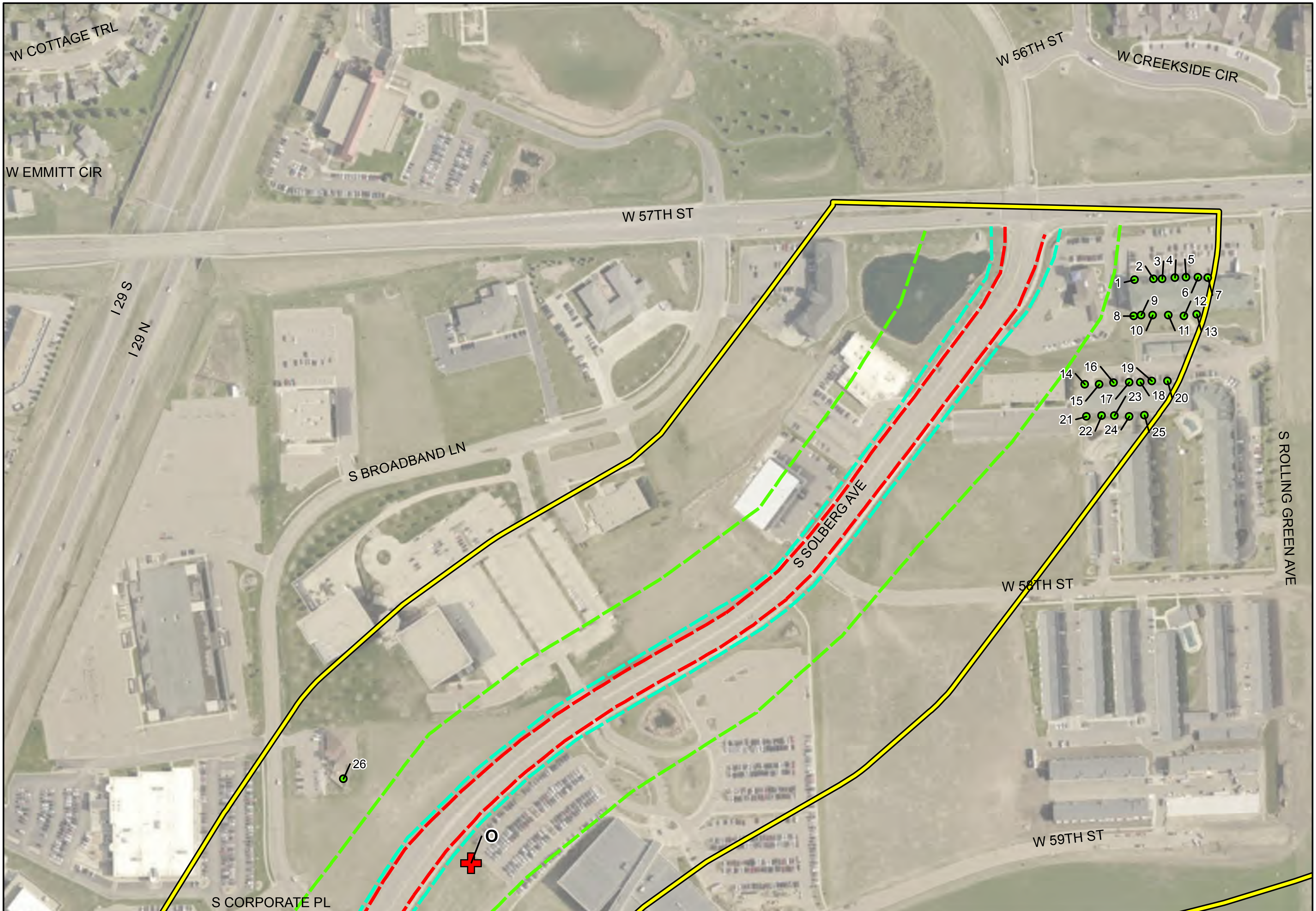
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-1



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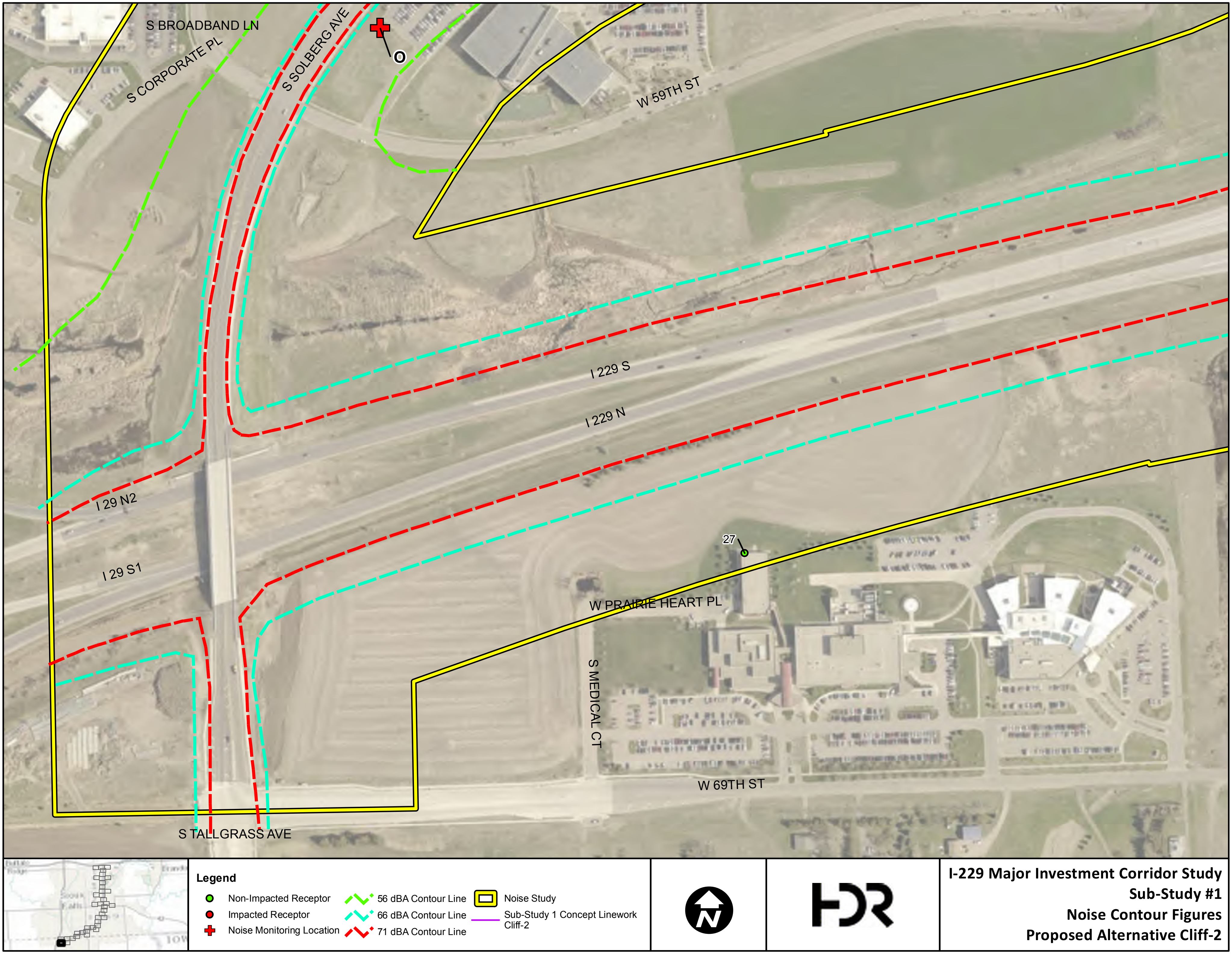
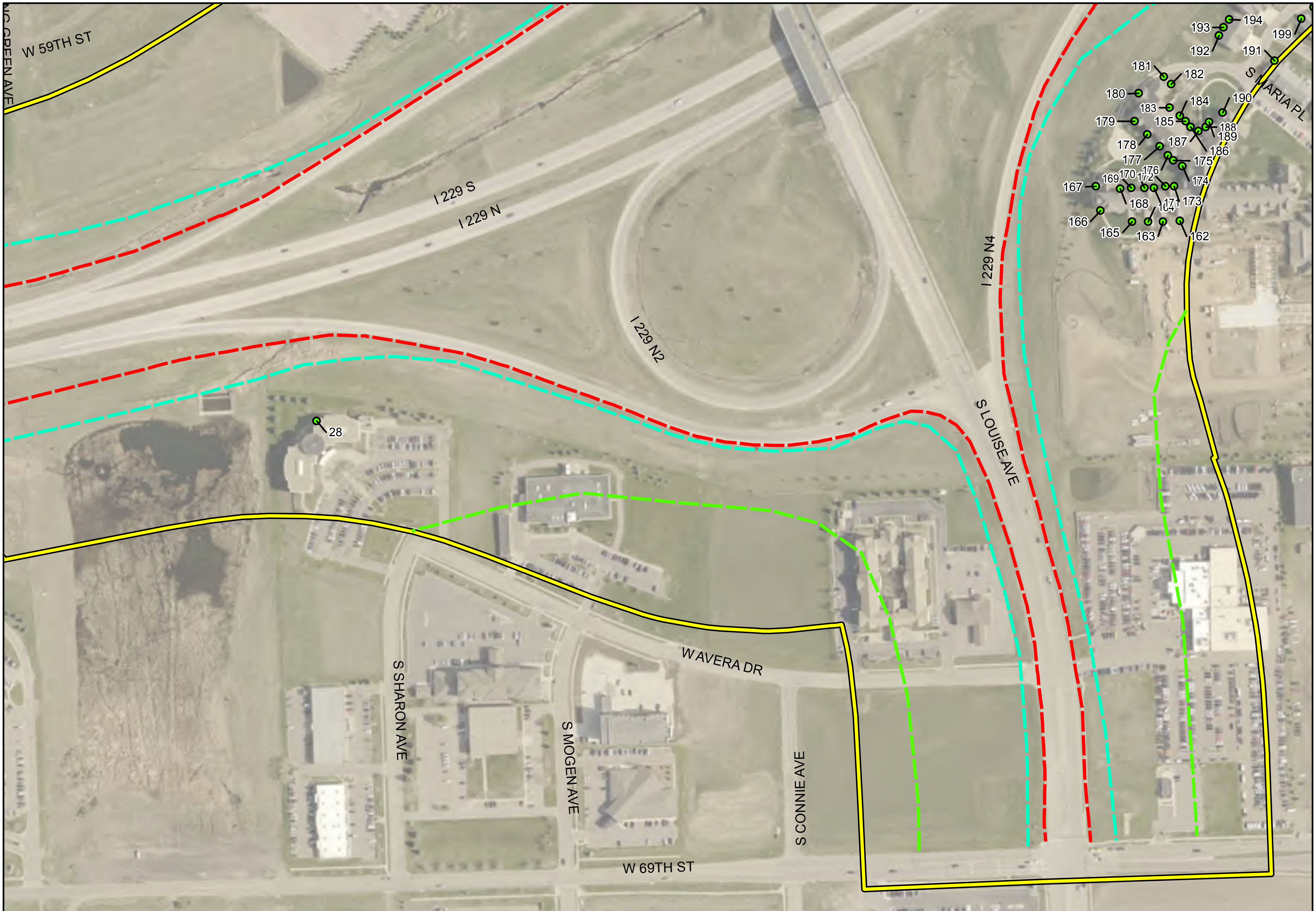
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-2



I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-2



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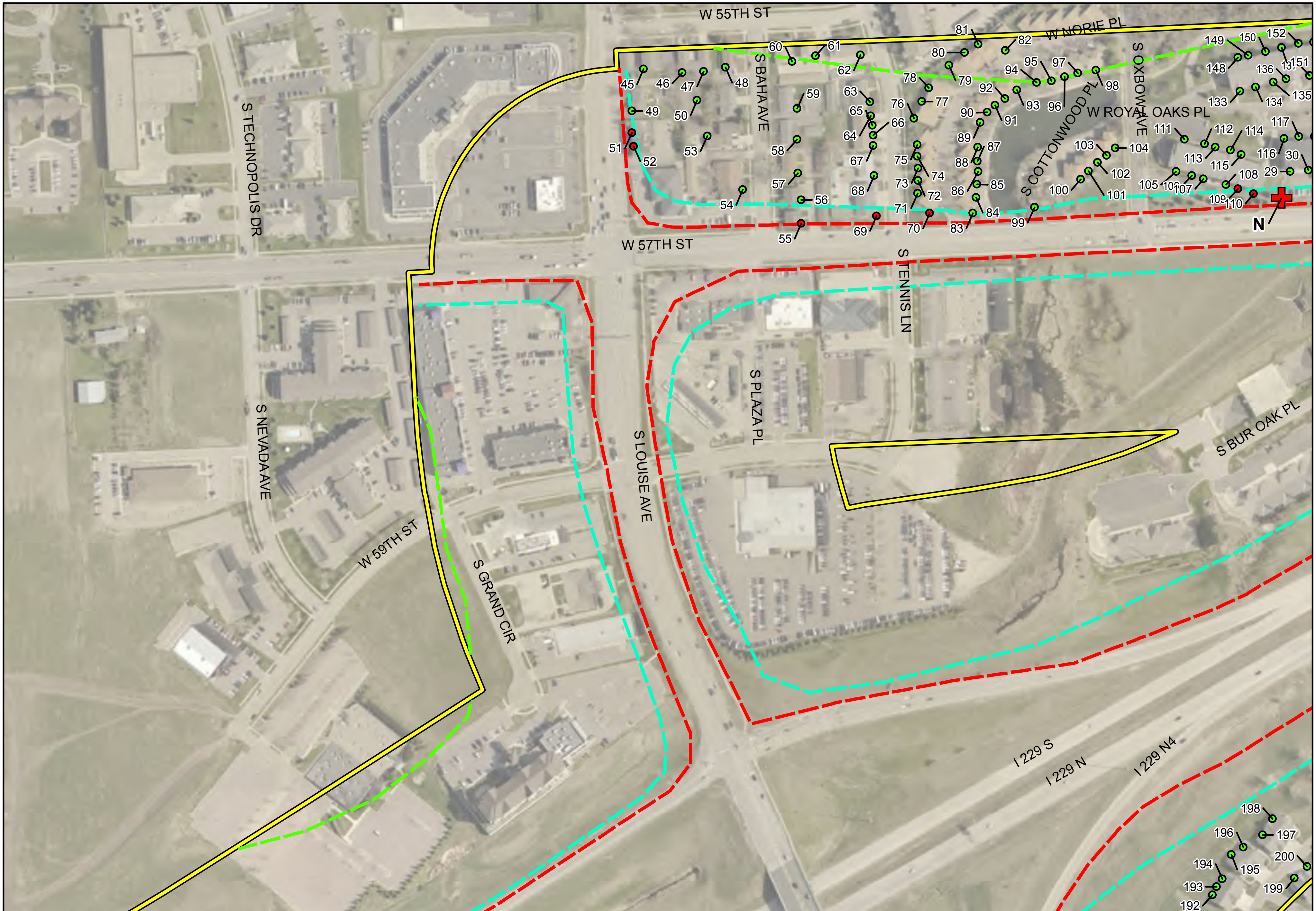
I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

Proposed Alternative Cliff-2



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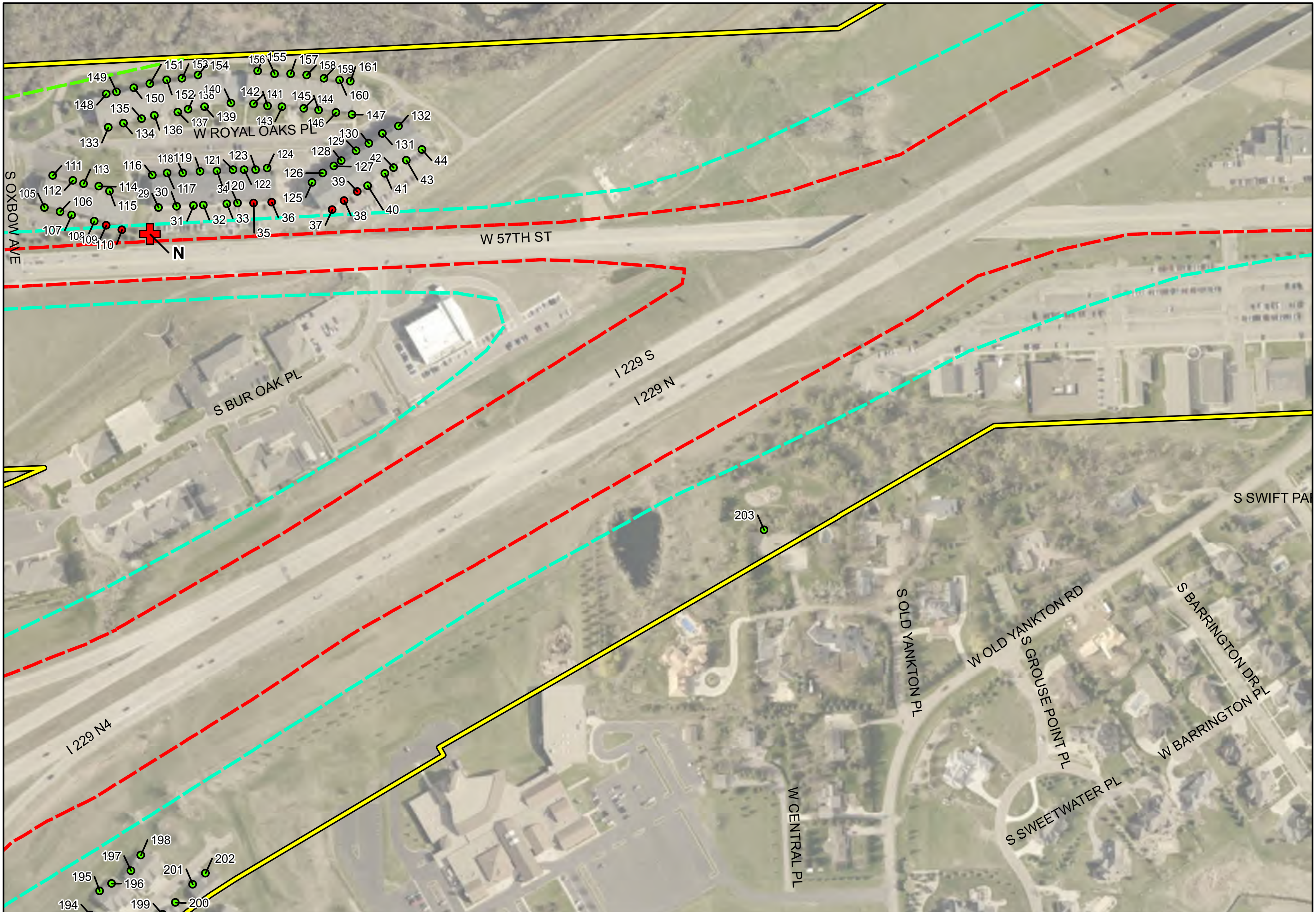
I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

Proposed Alternative Cliff-2



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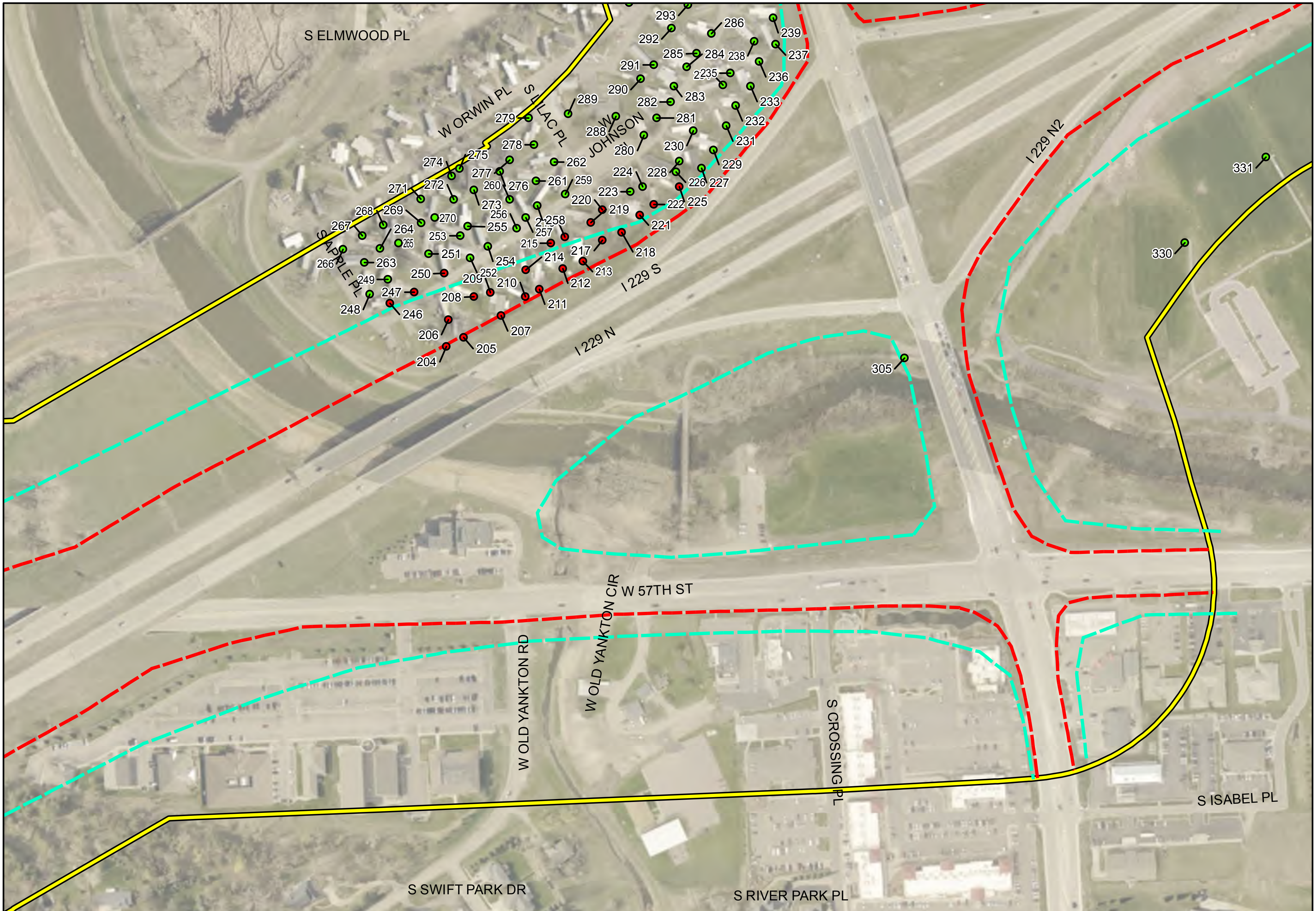
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-2



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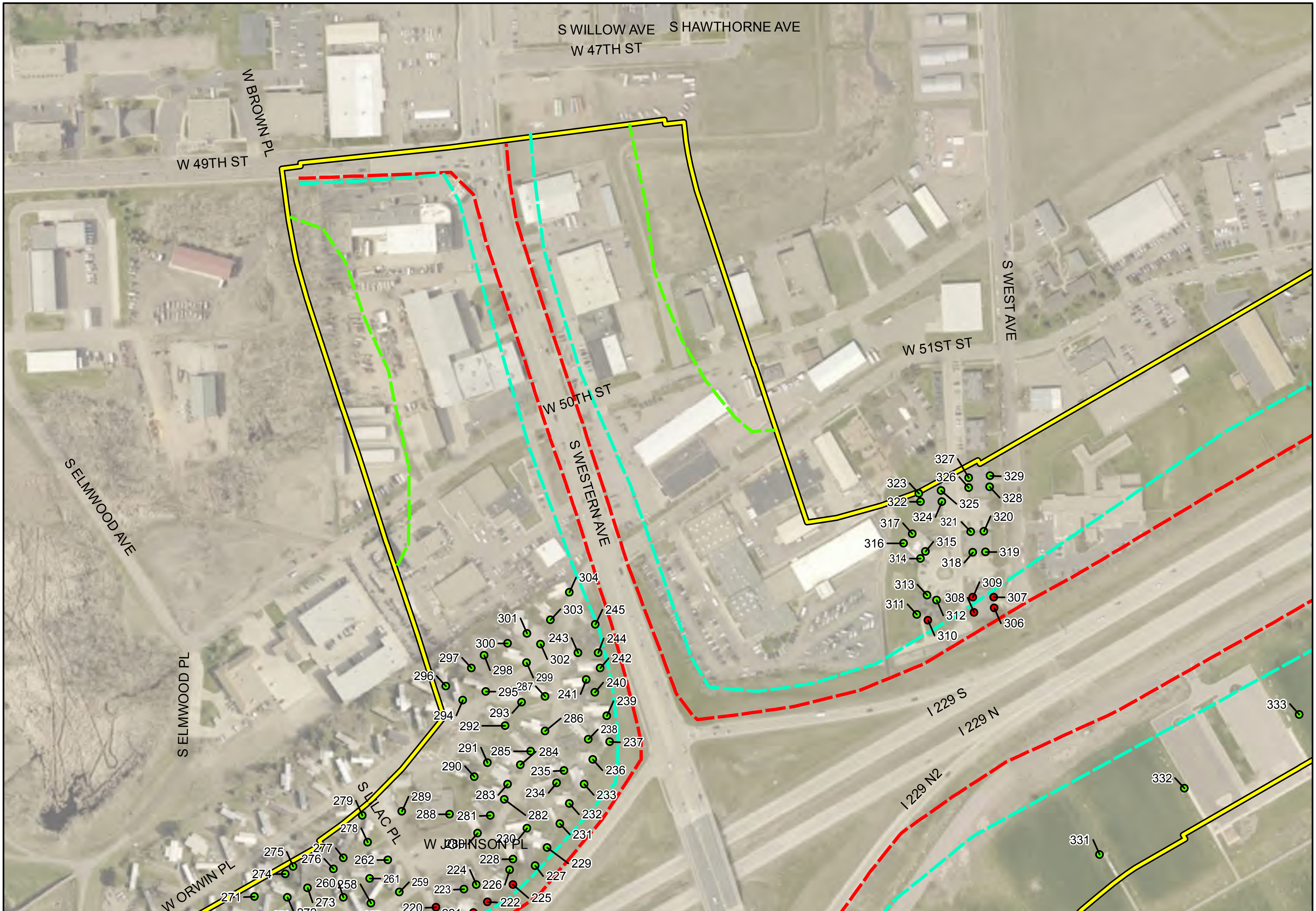
HDR

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-2



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I-229 Major Investment Corridor Study
Sub-Study #1
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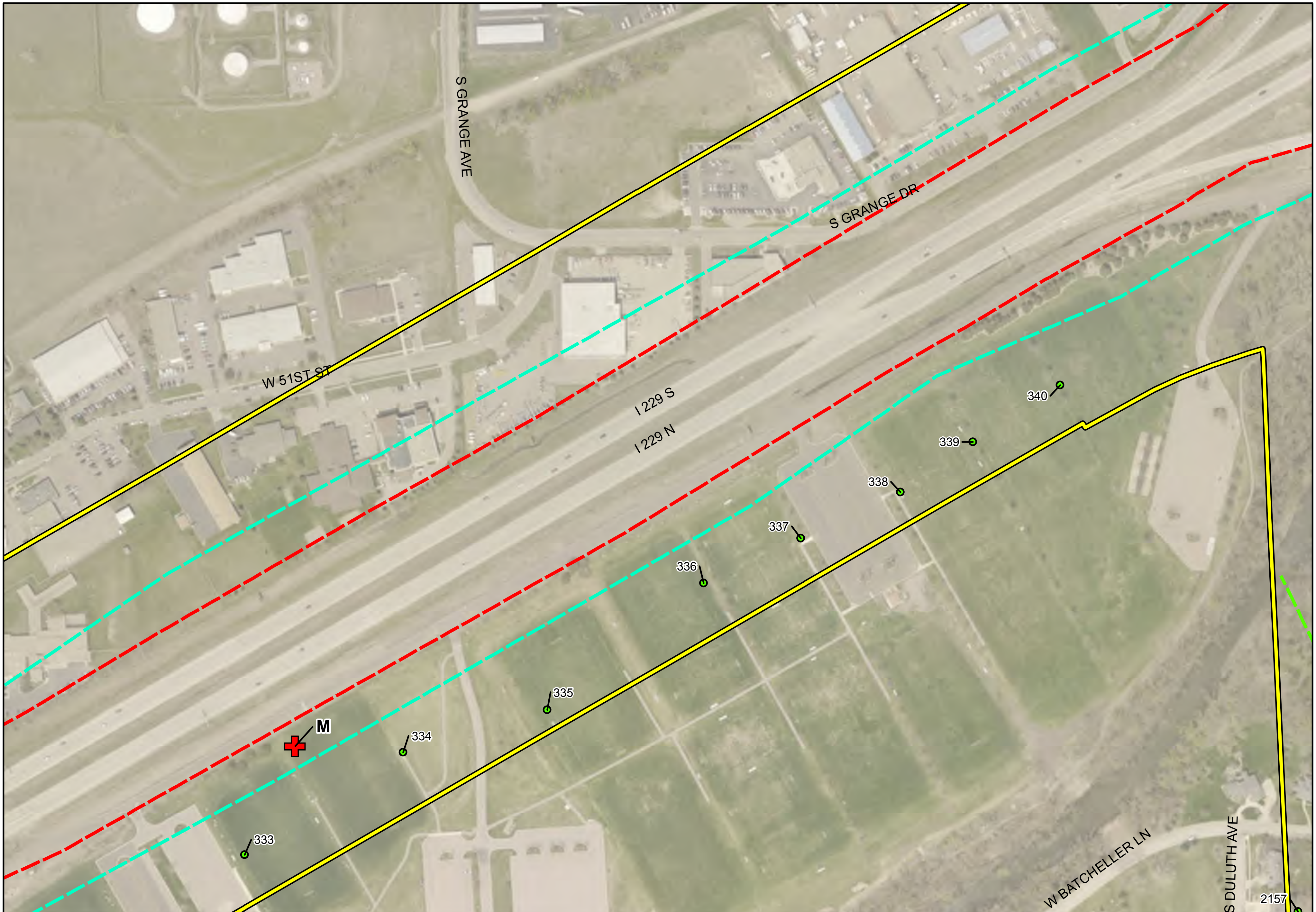

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Sub-Study #1
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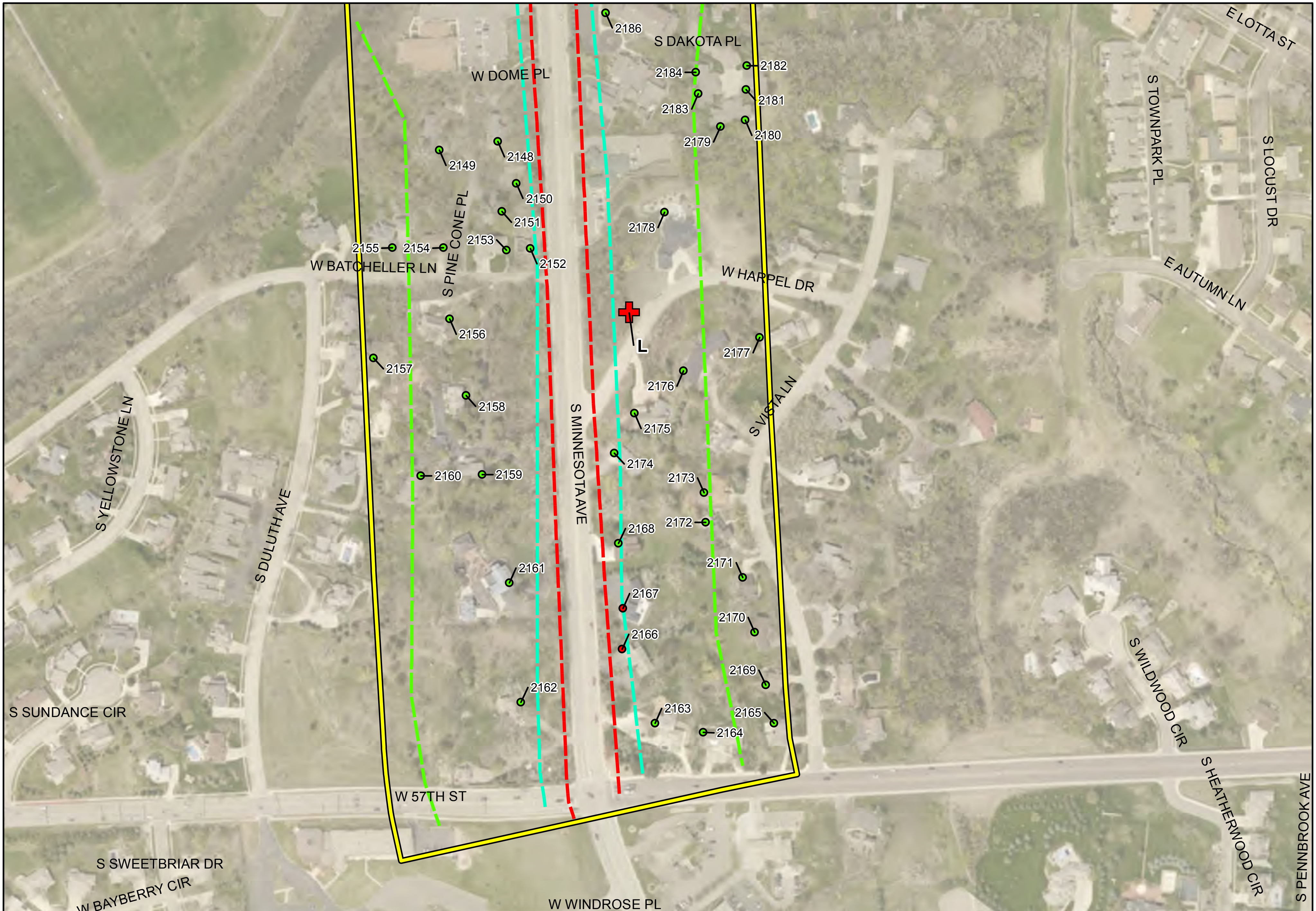

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Sub-Study #1
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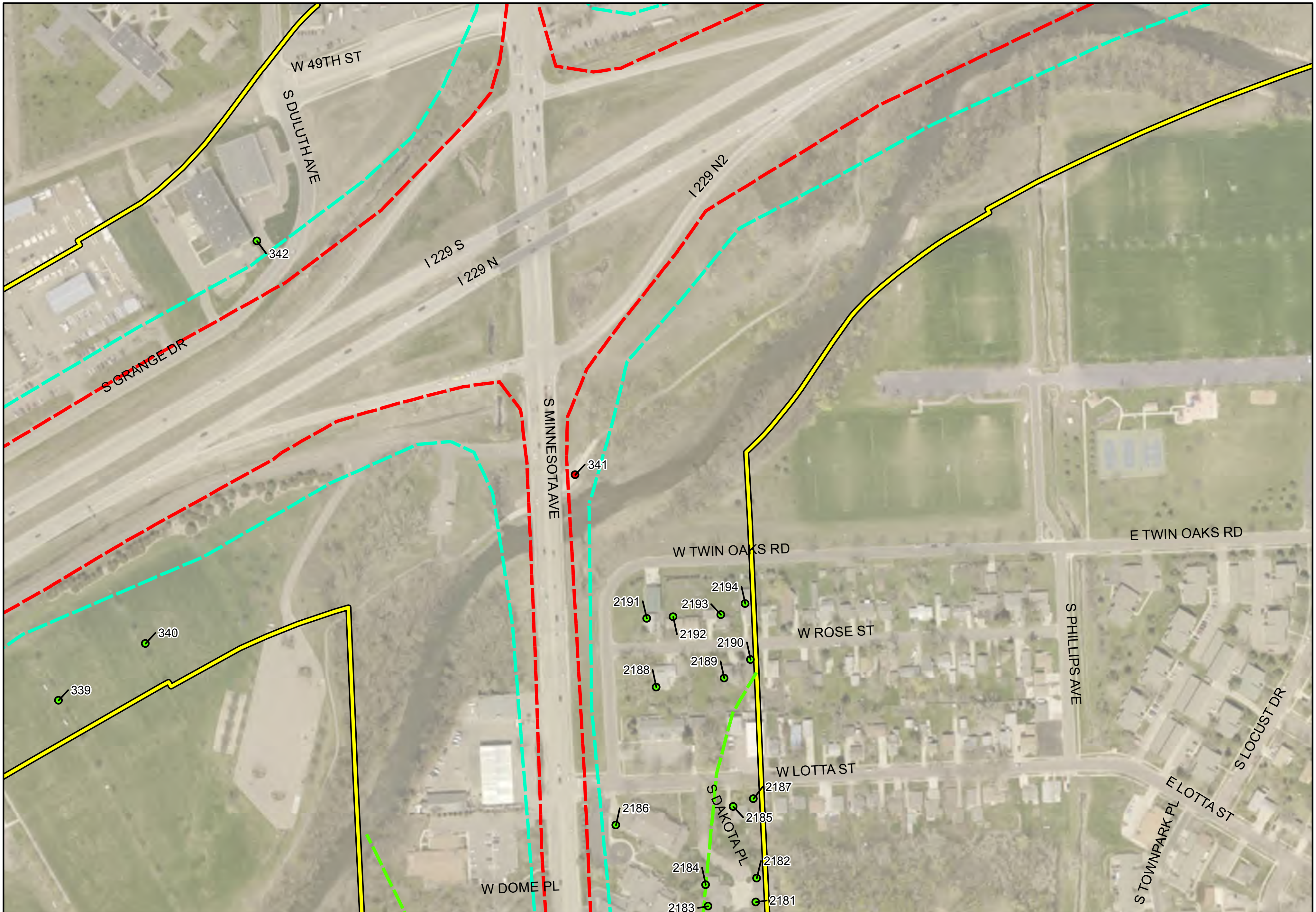

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Sub-Study #1
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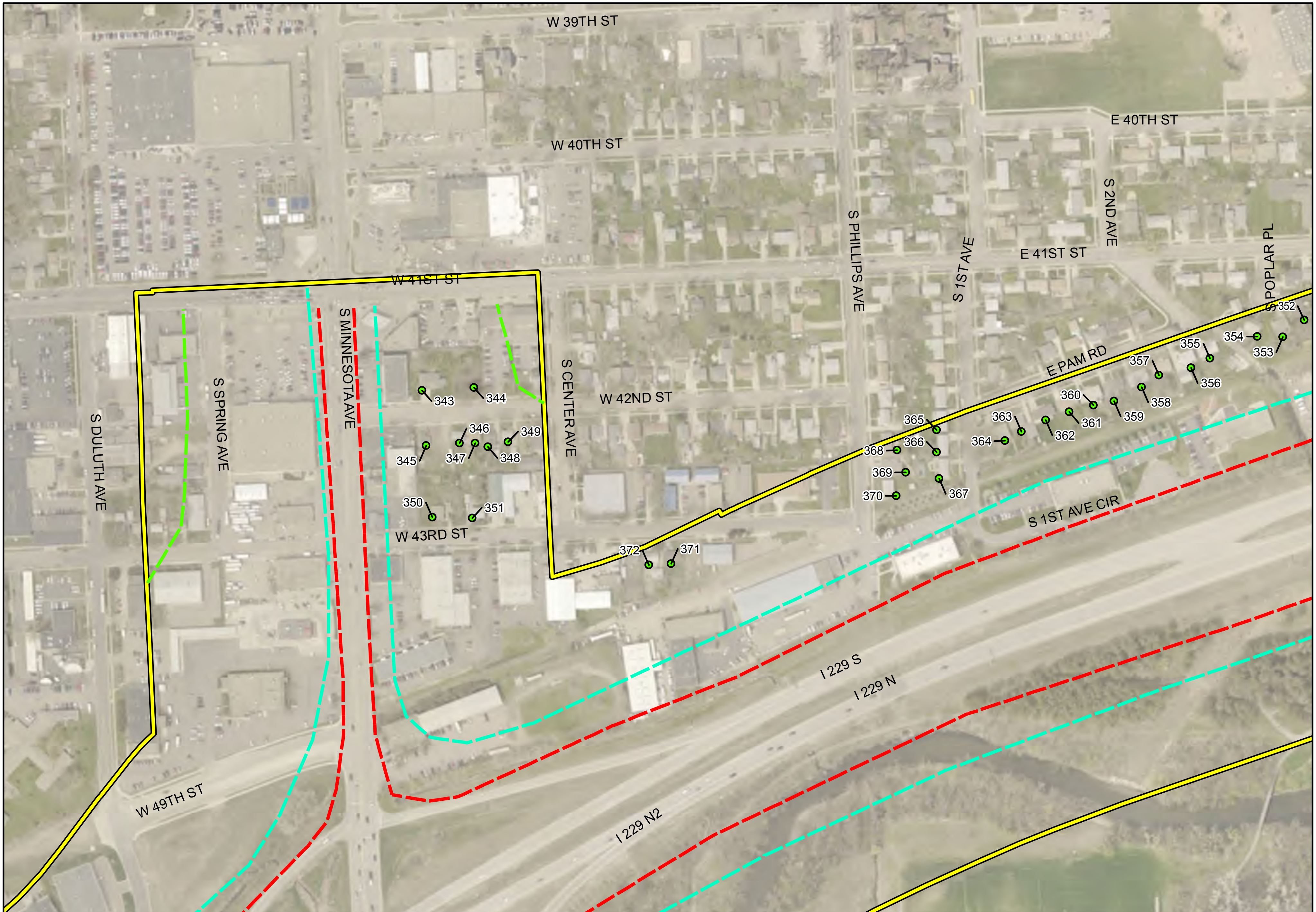

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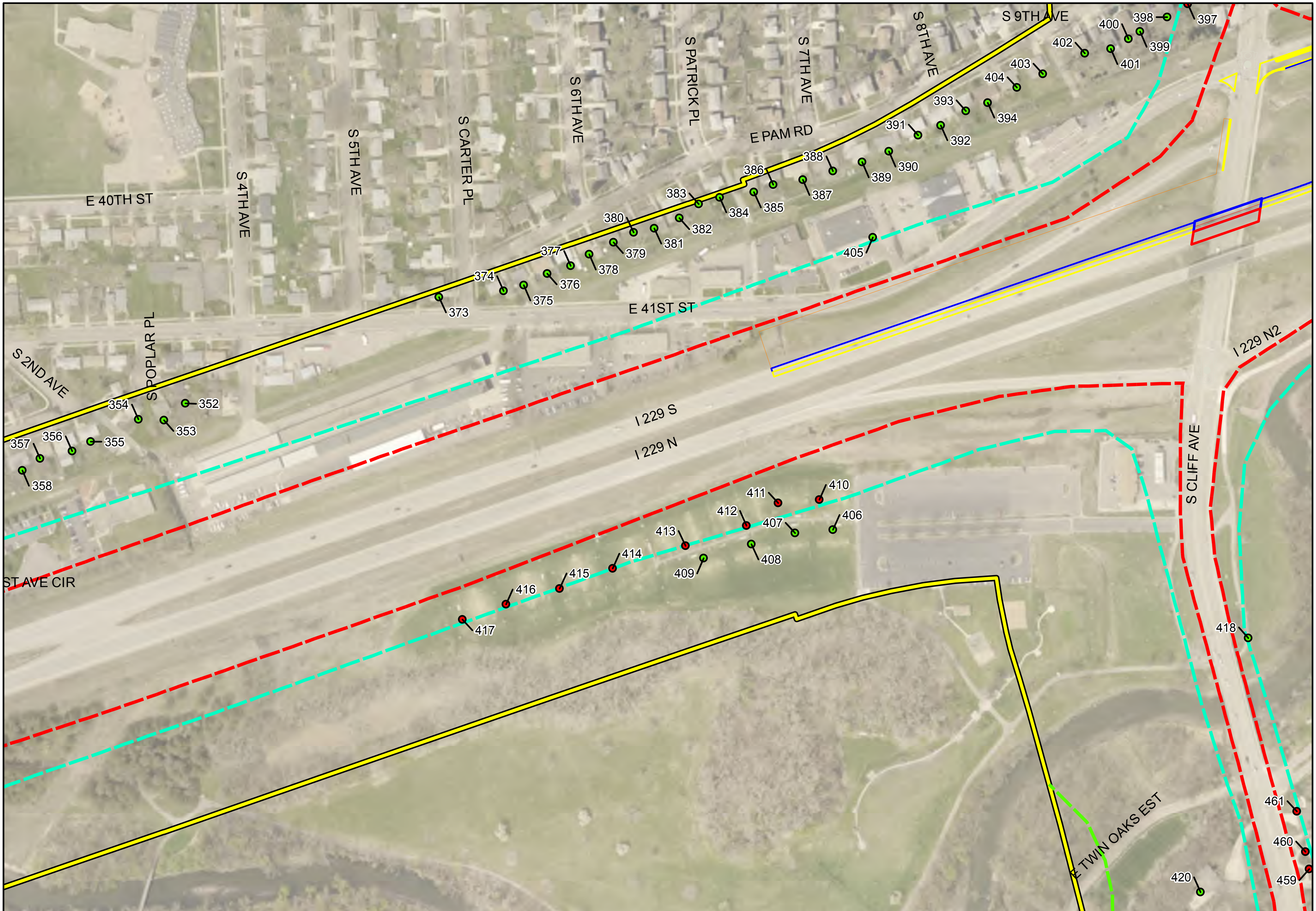
I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

Proposed Alternative Cliff-2



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I-229 Major Investment Corridor Study
Sub-Study #1
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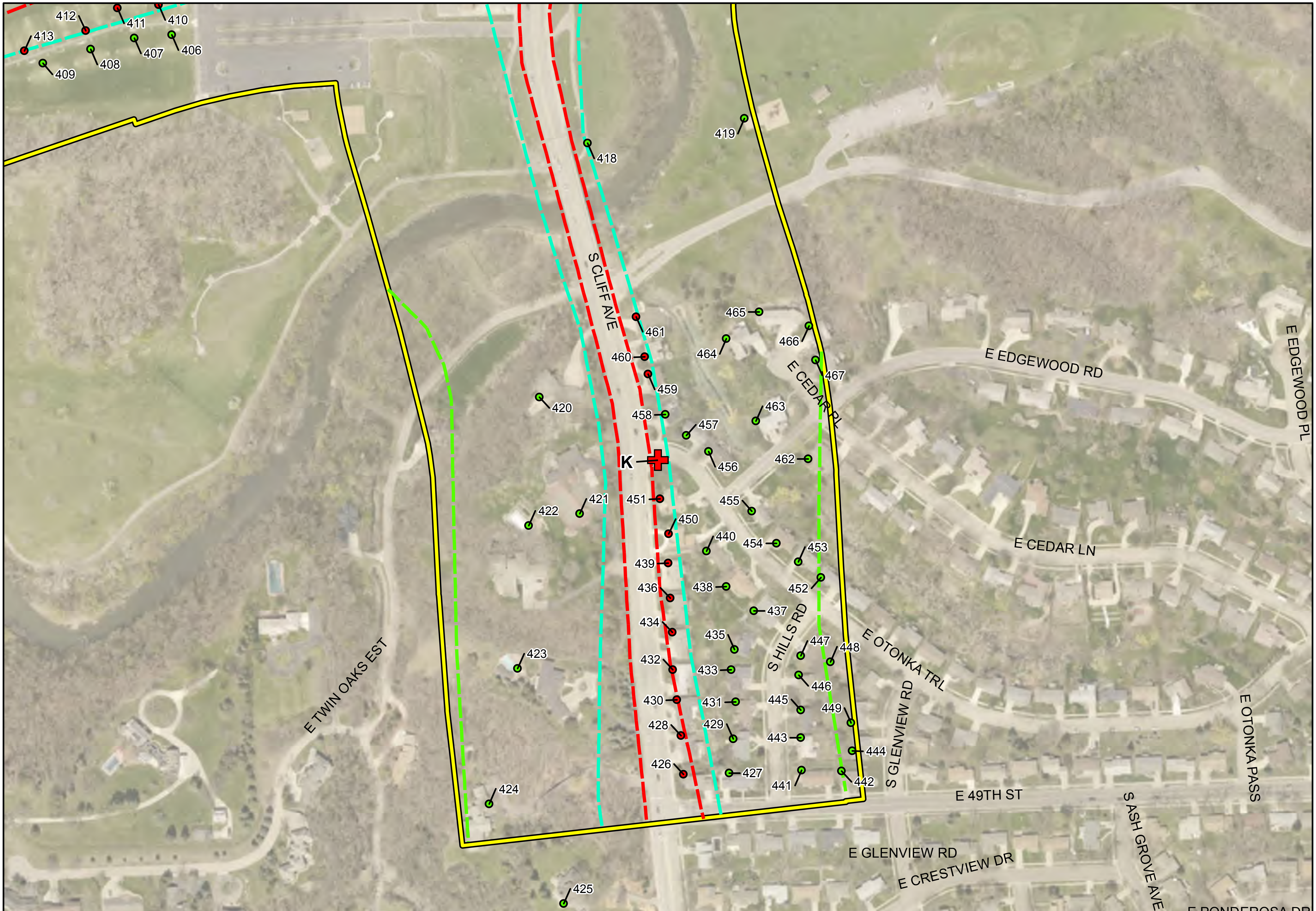

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Sub-Study #1
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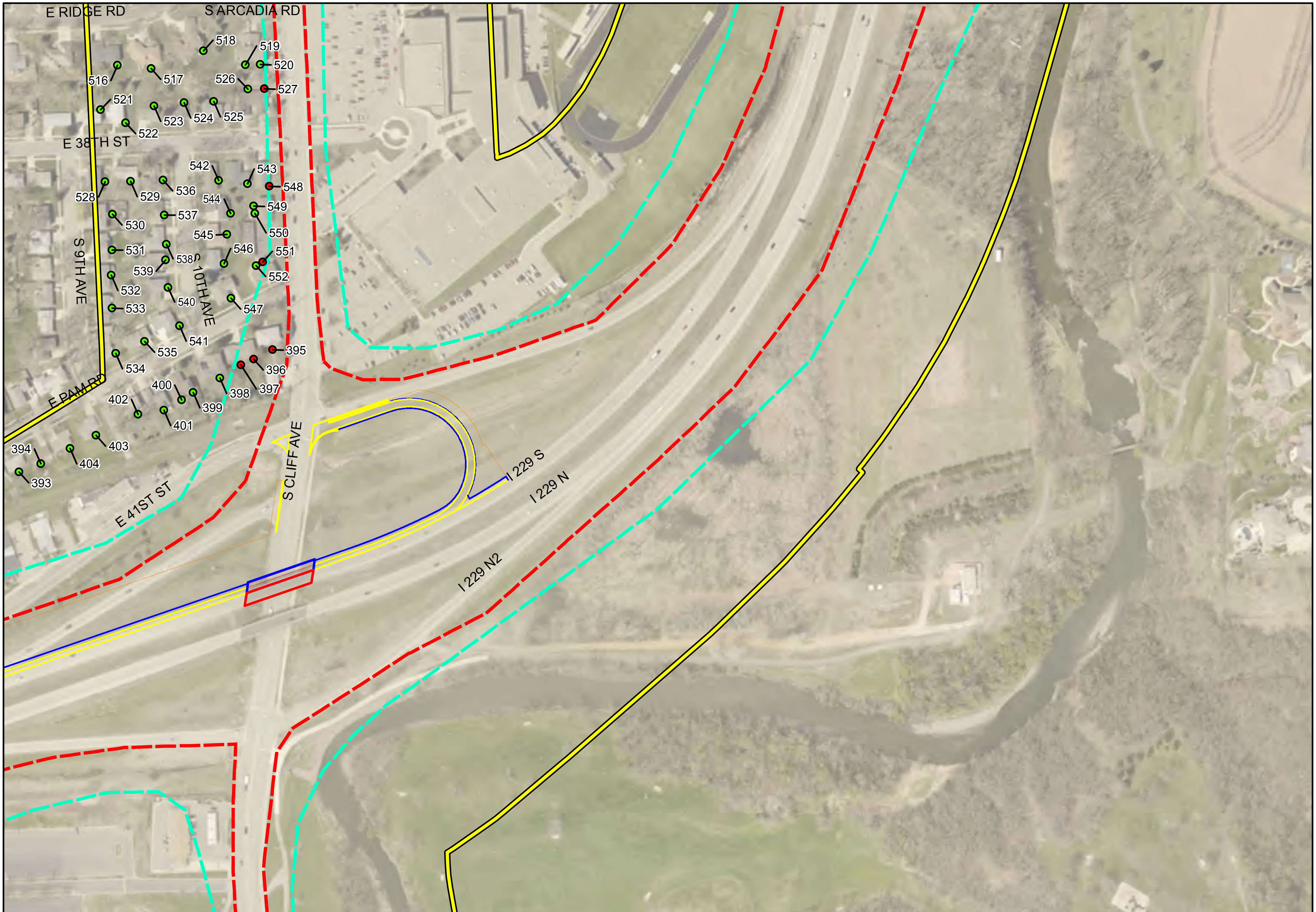

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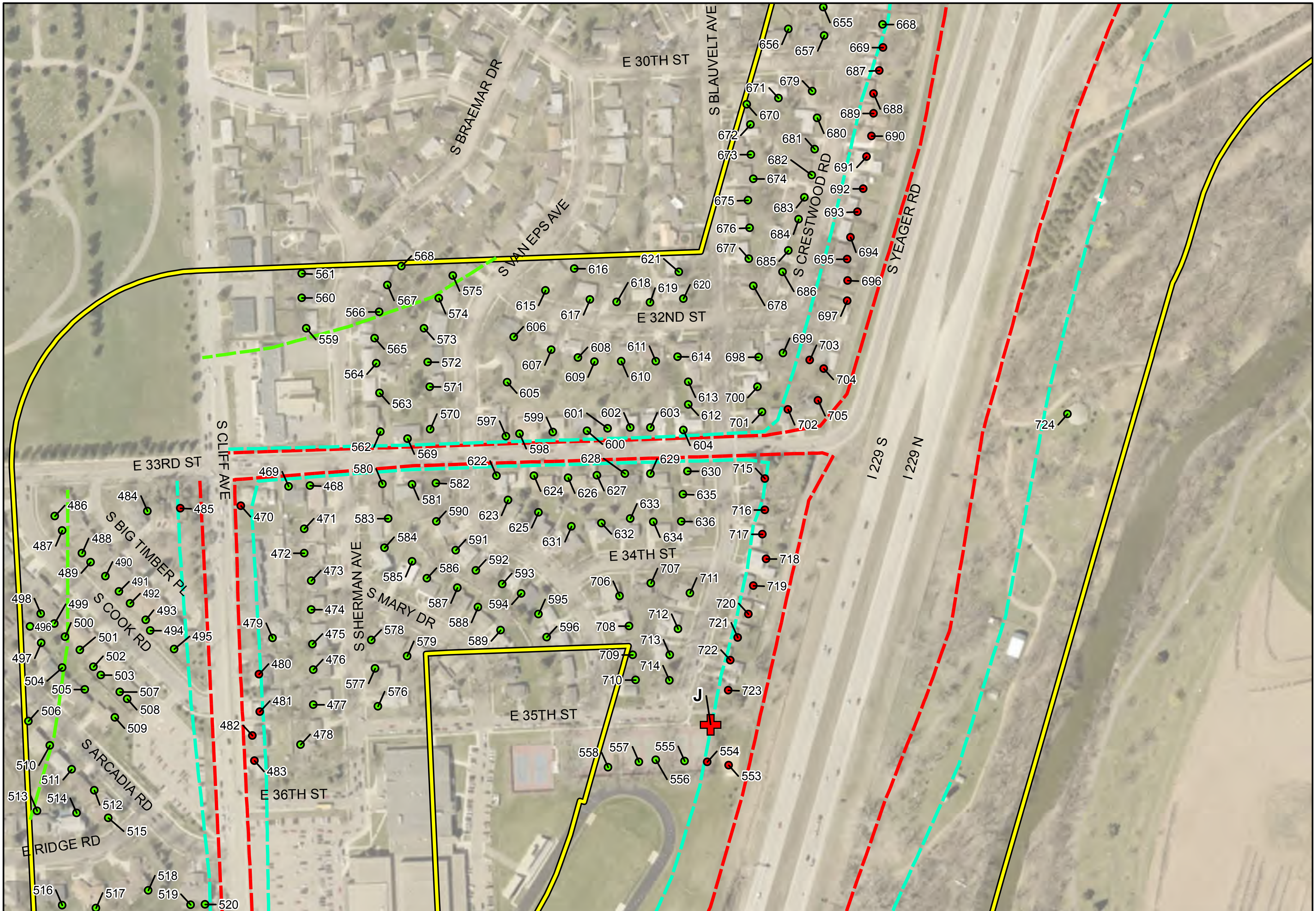

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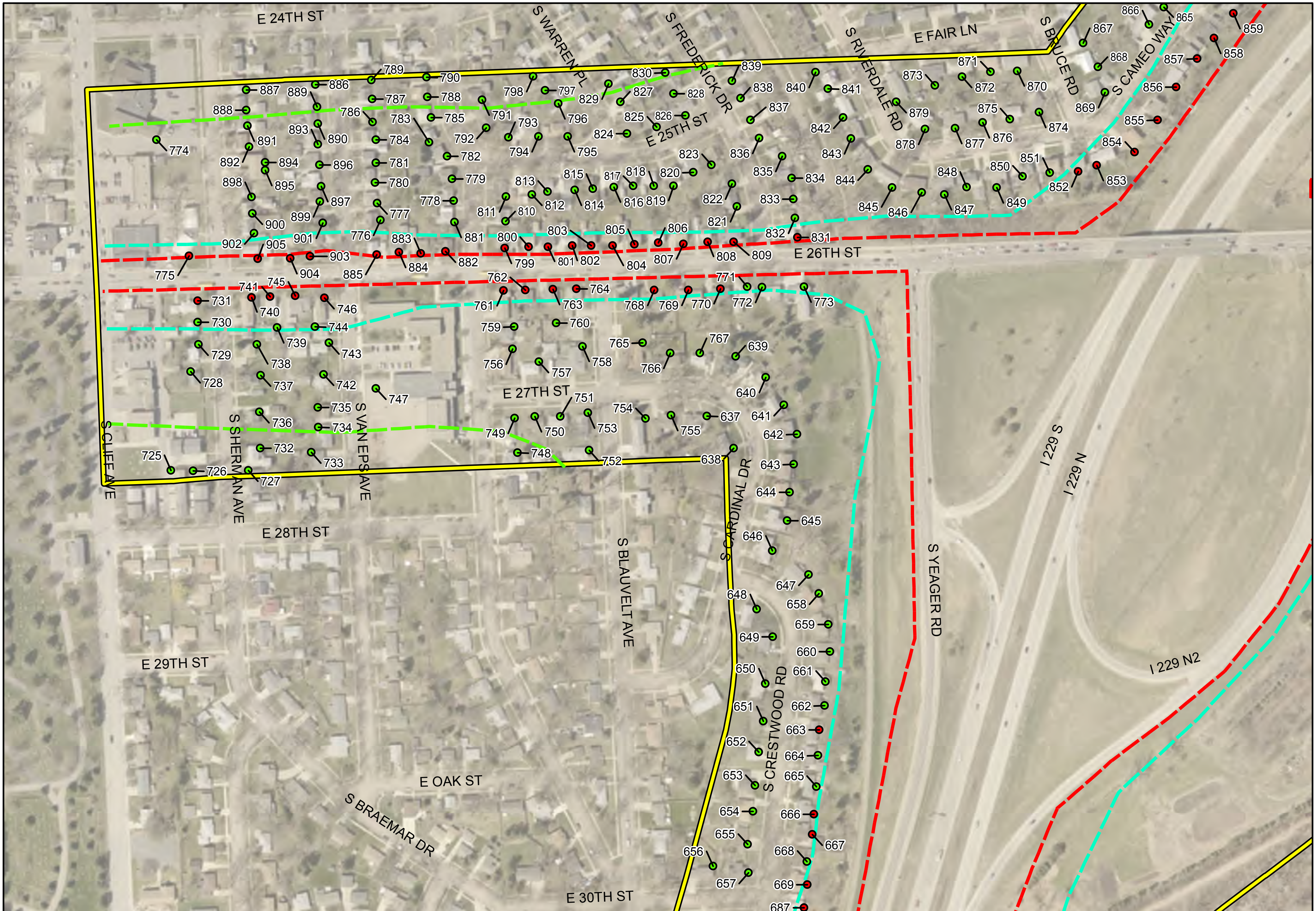

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I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

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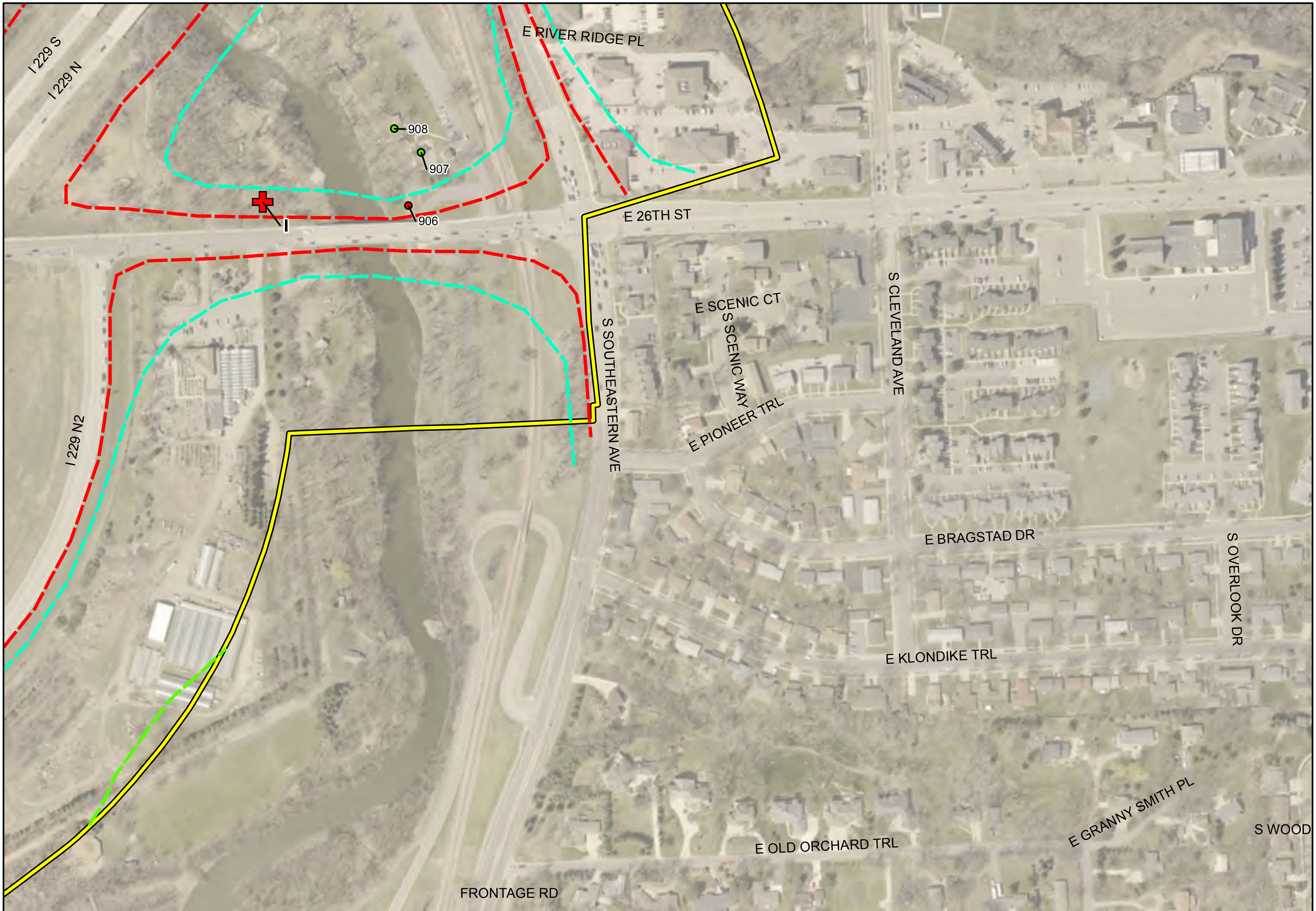

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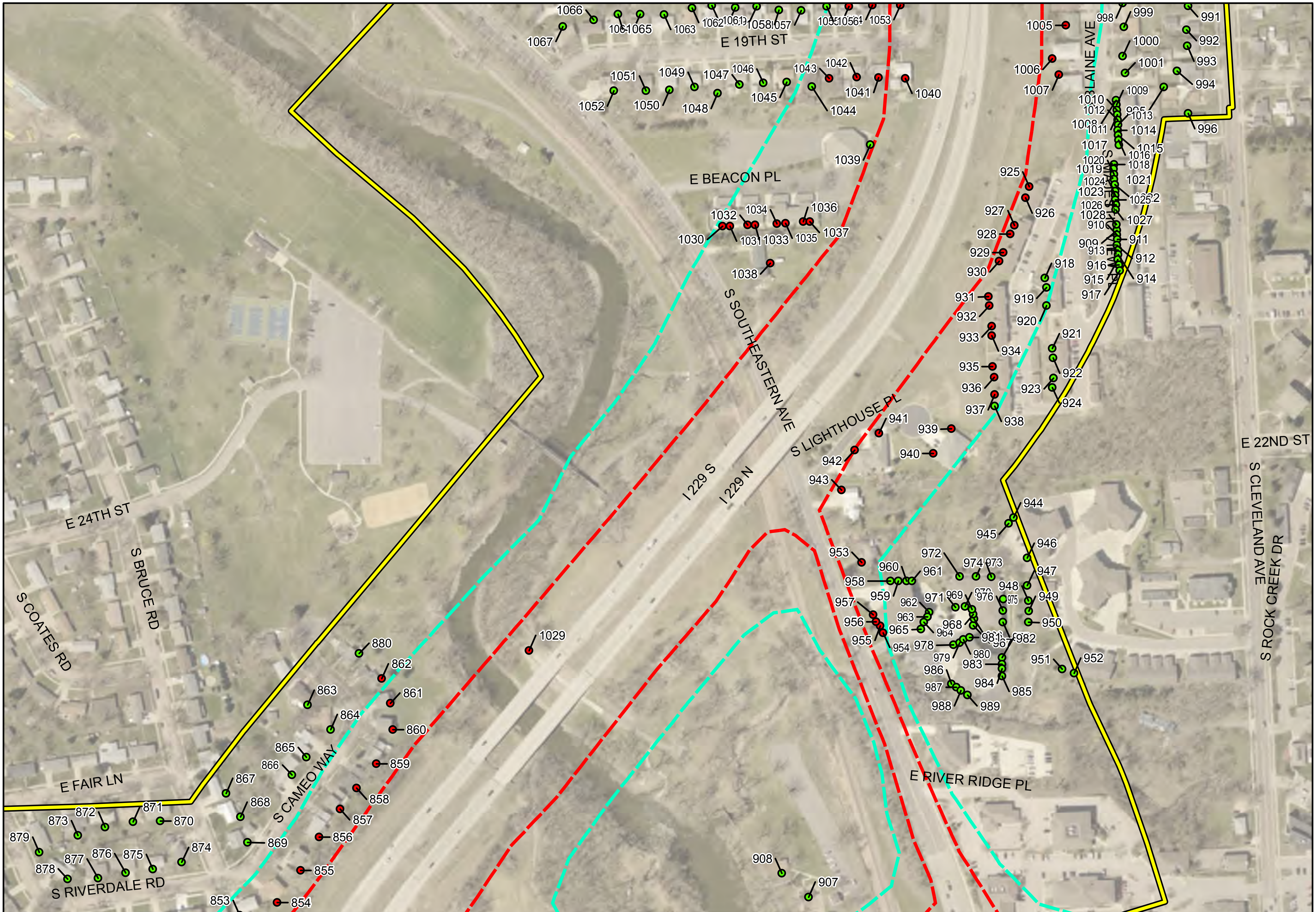

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I-229 Major Investment Corridor Study
Sub-Study #1
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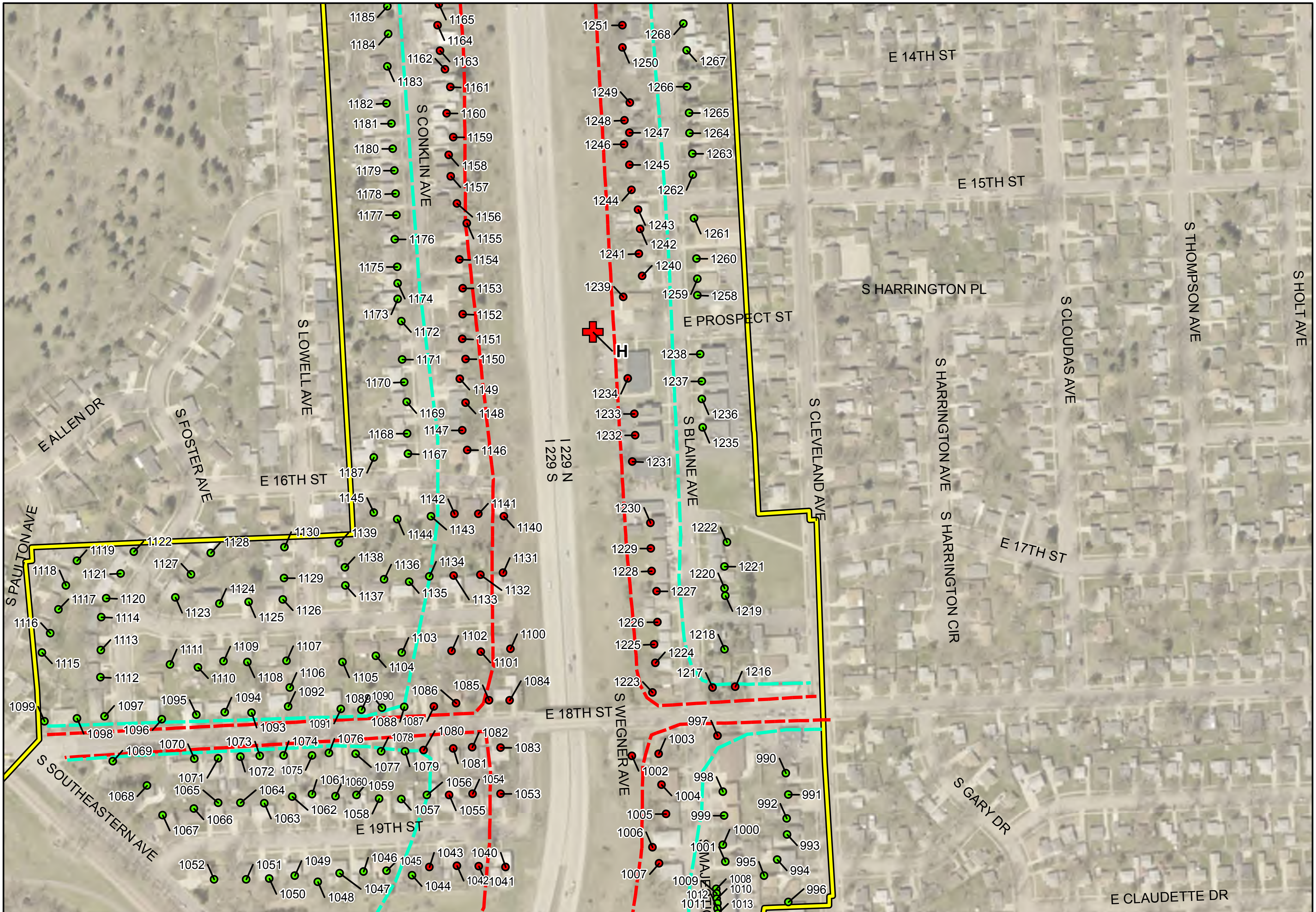

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Sub-Study #1
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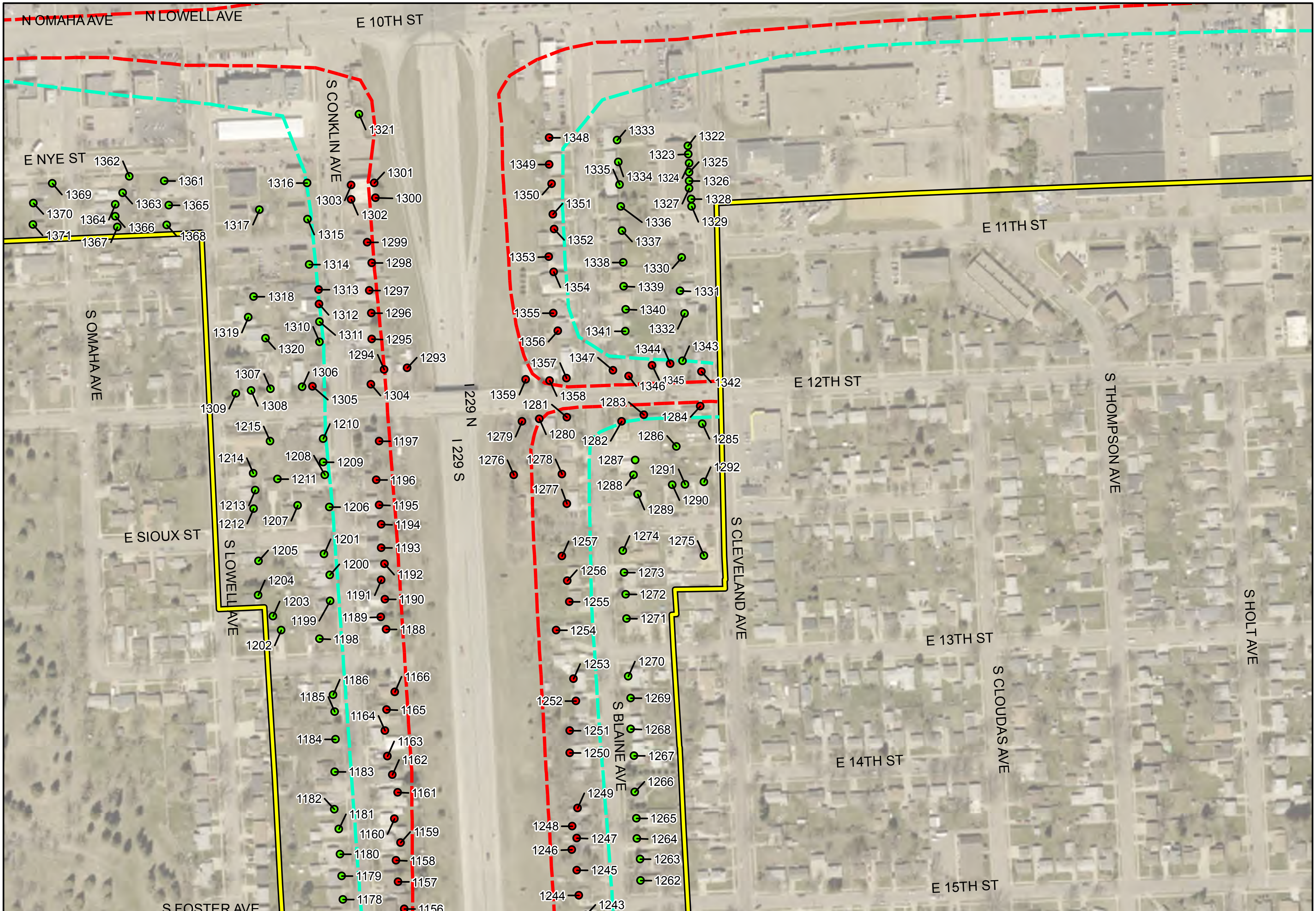

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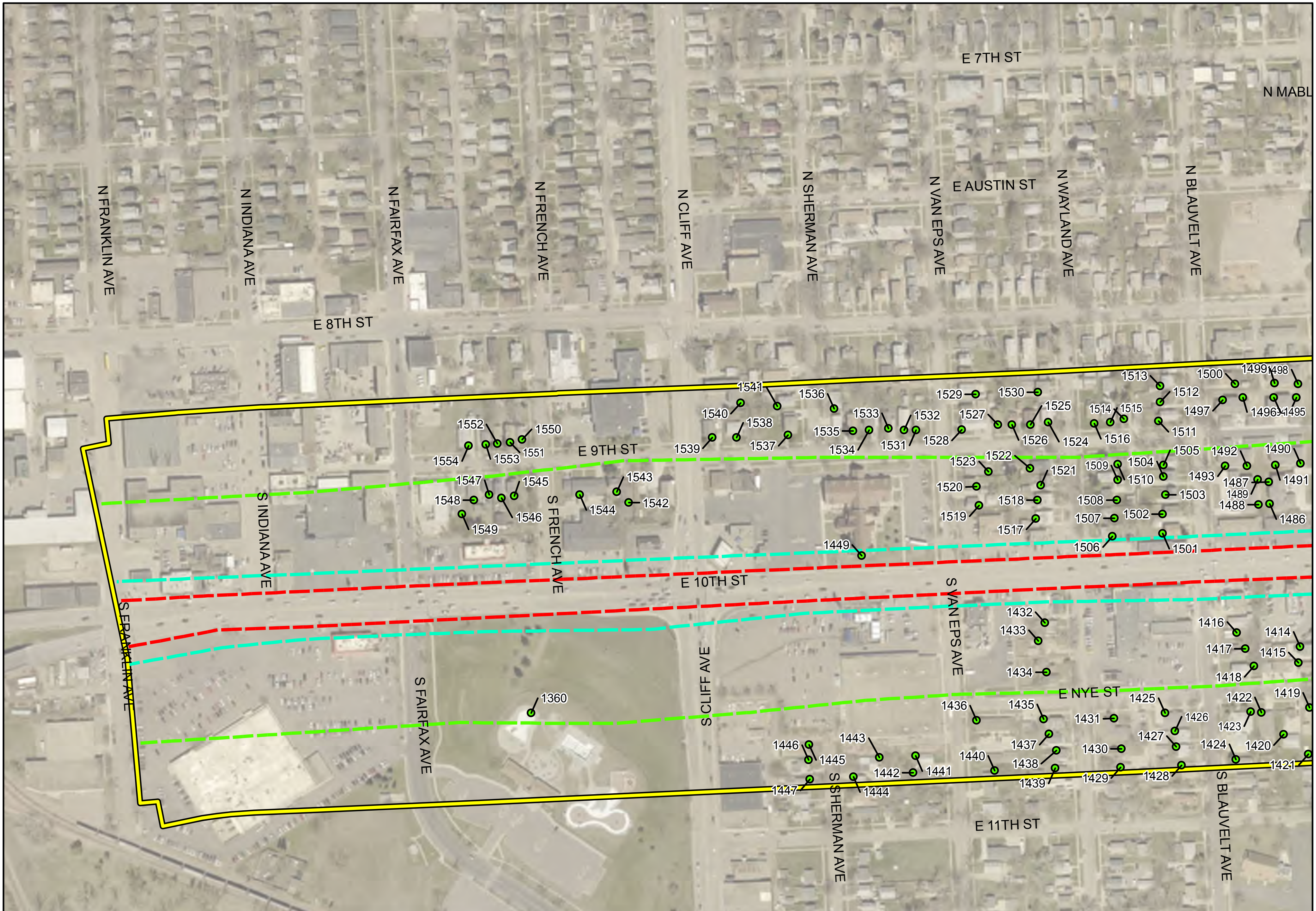

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I-229 Major Investment Corridor Study
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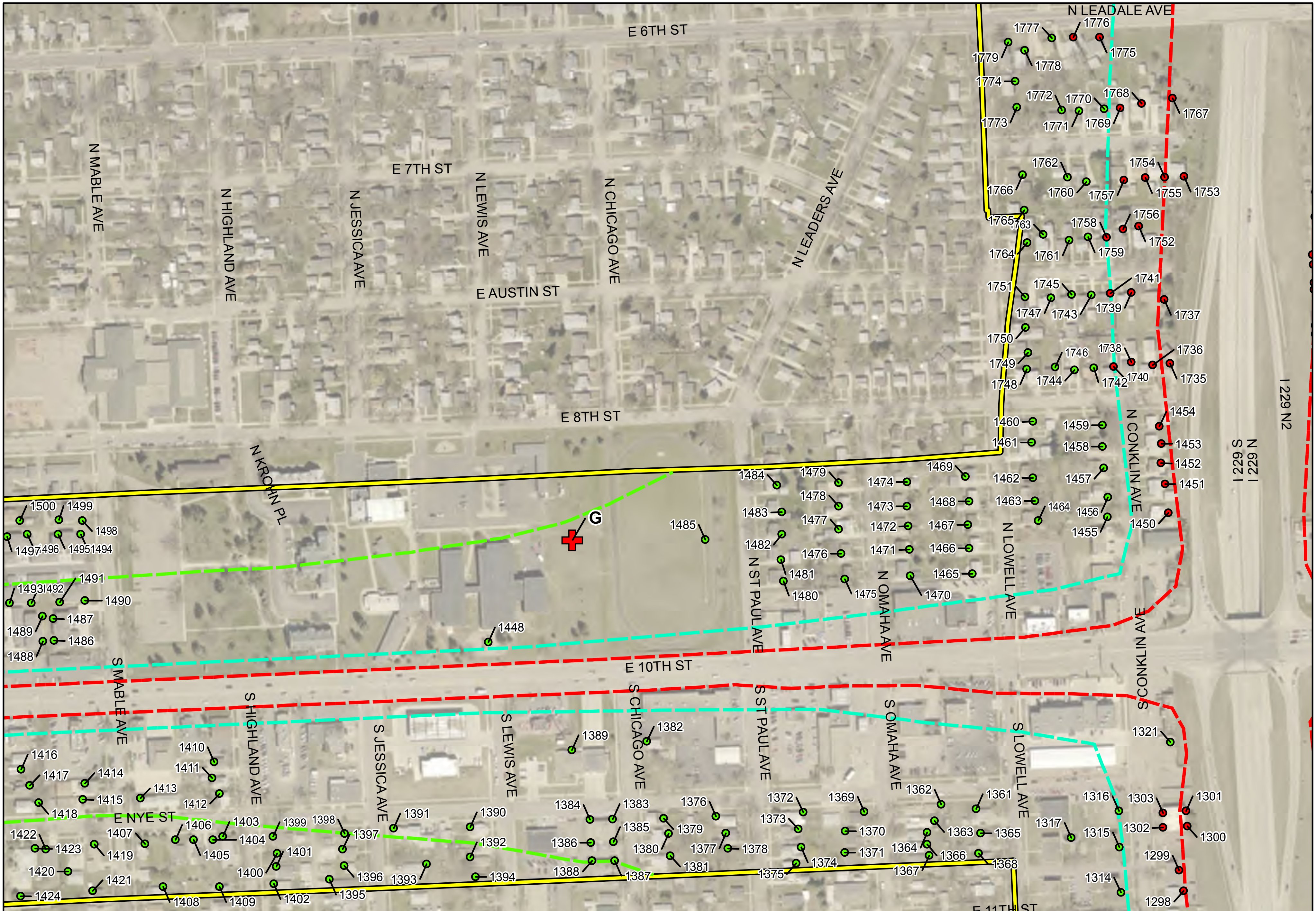

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I-229 Major Investment Corridor Study
Sub-Study #1
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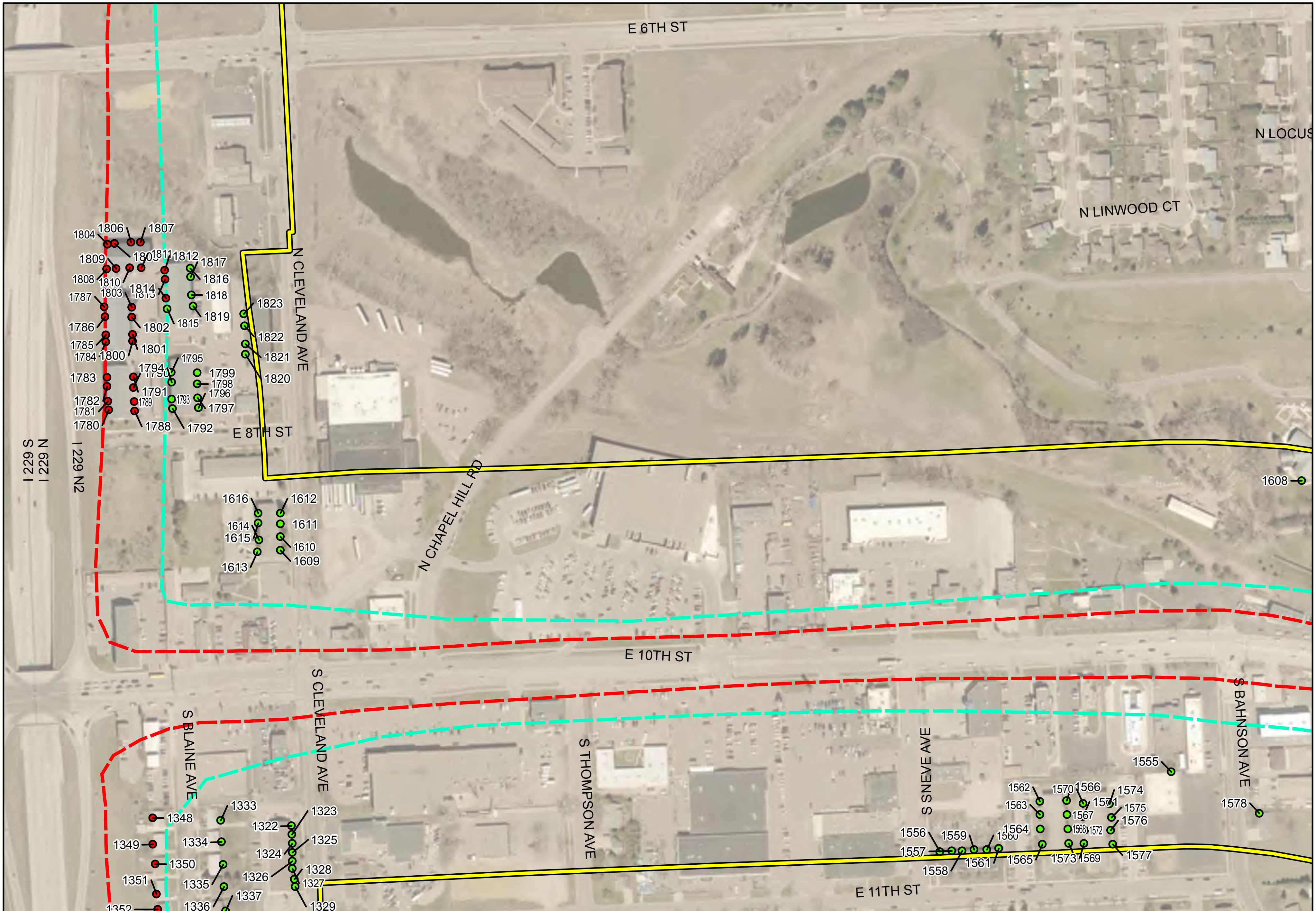

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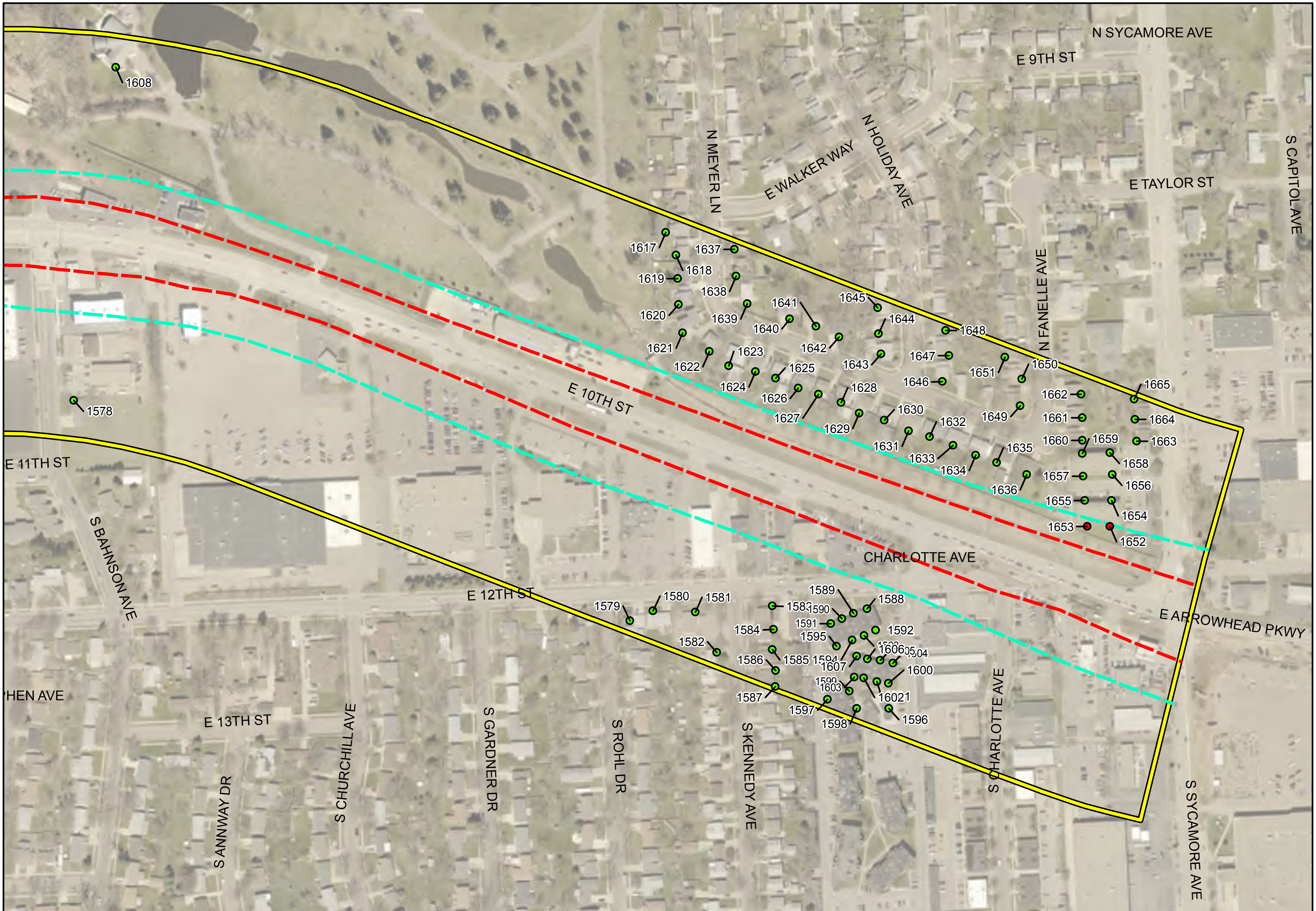
I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

Proposed Alternative Cliff-2



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I-229 Major Investment Corridor Study
Sub-Study #1
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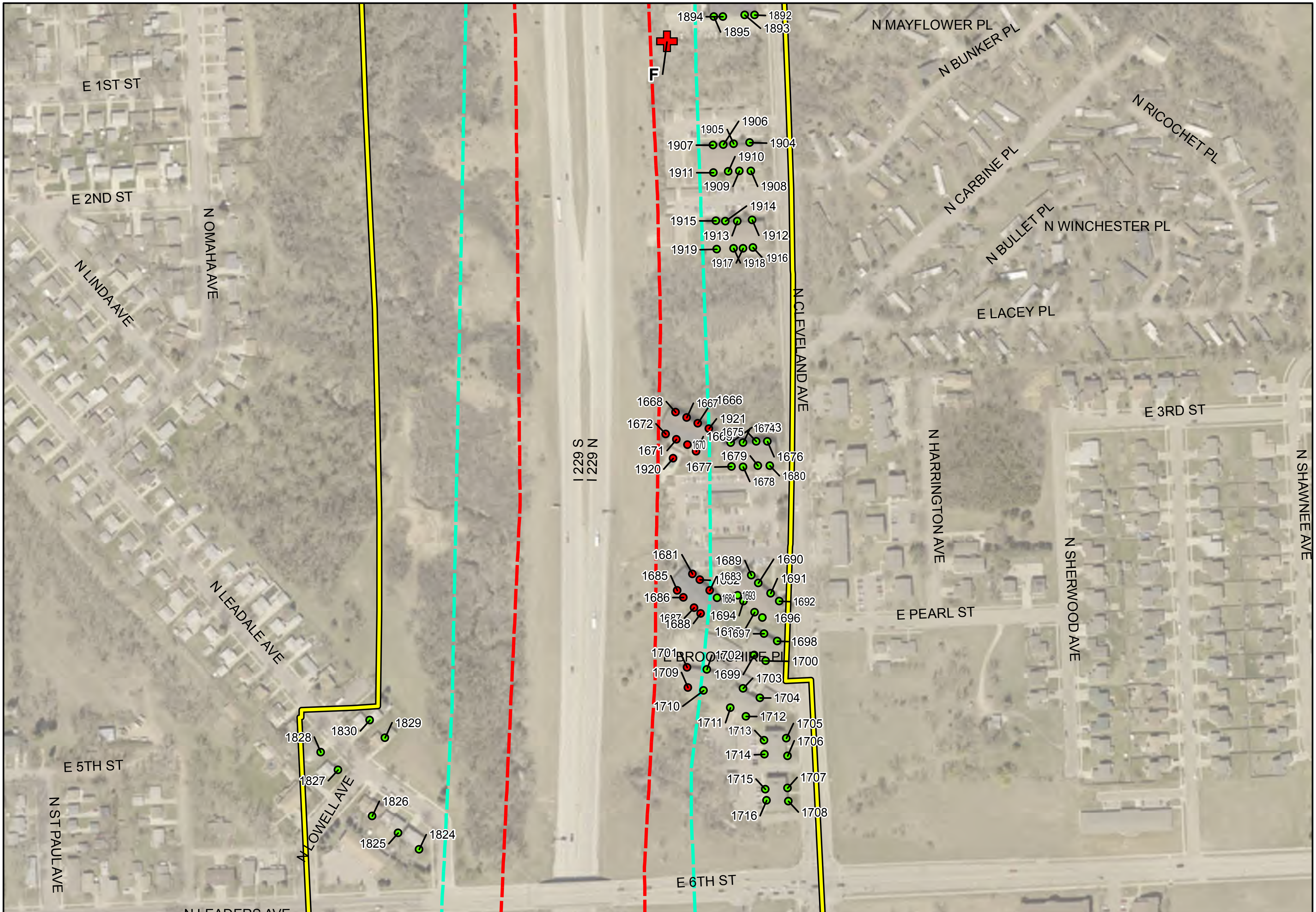

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I-229 Major Investment Corridor Study
Sub-Study #1
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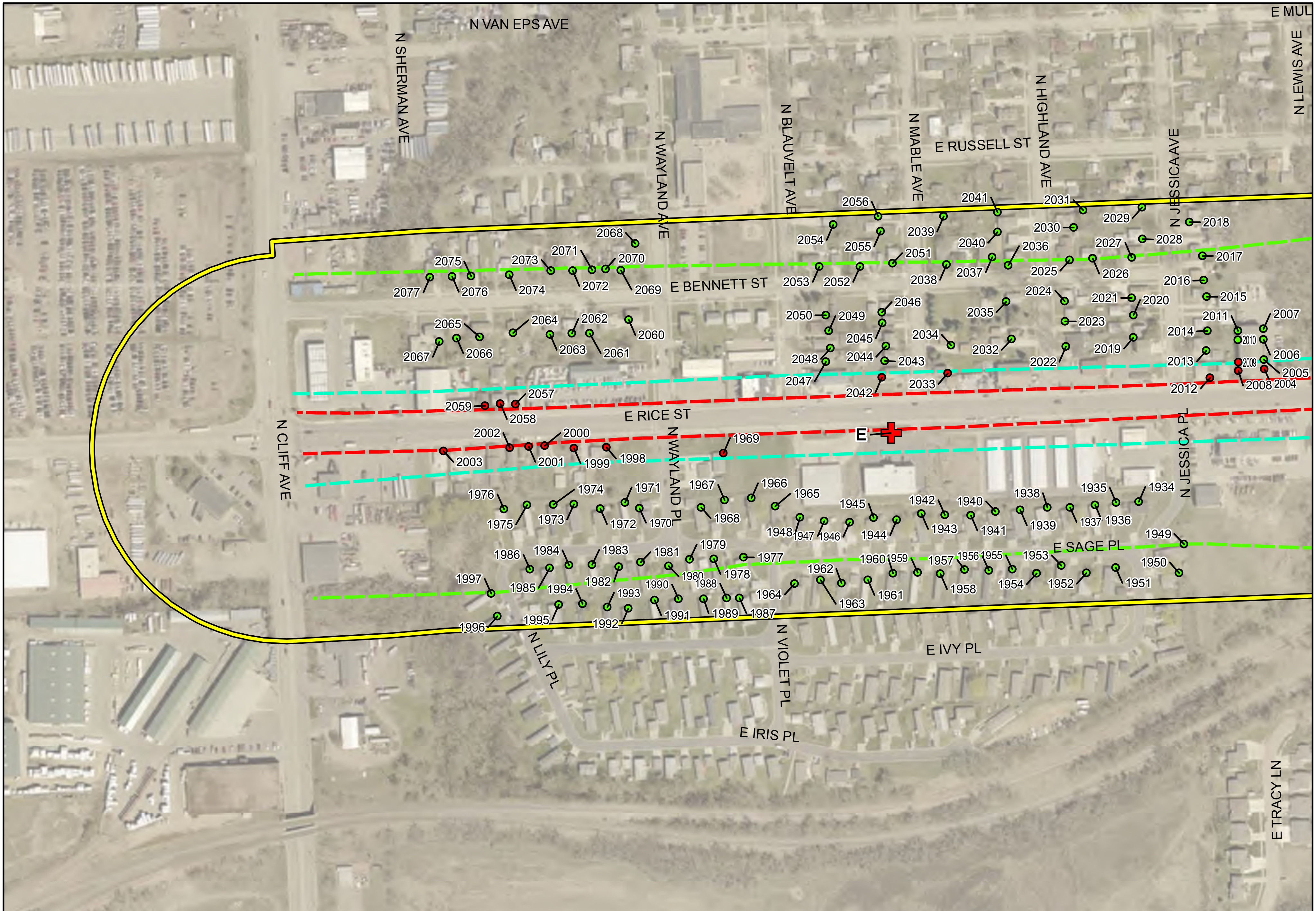

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I-229 Major Investment Corridor Study
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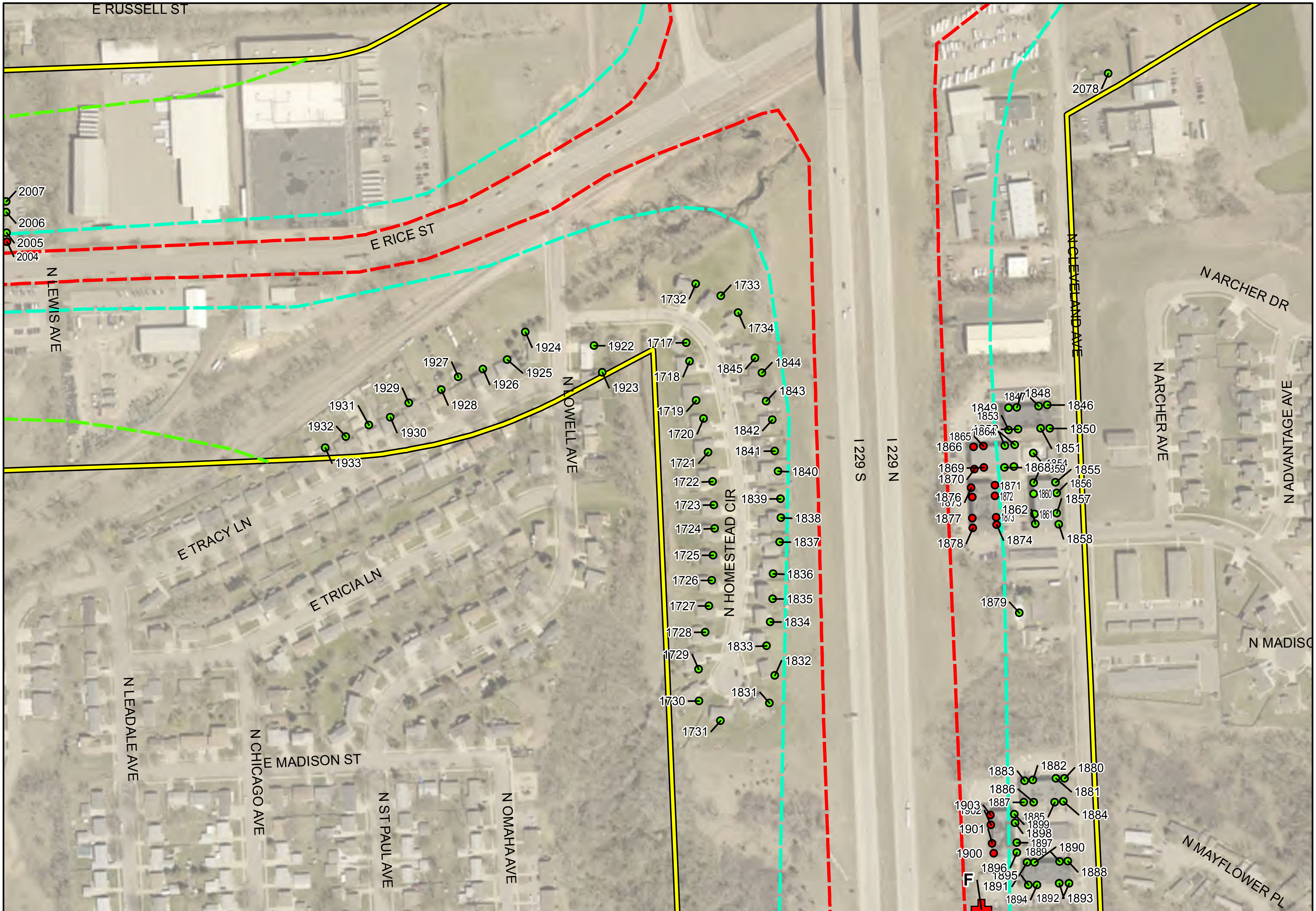

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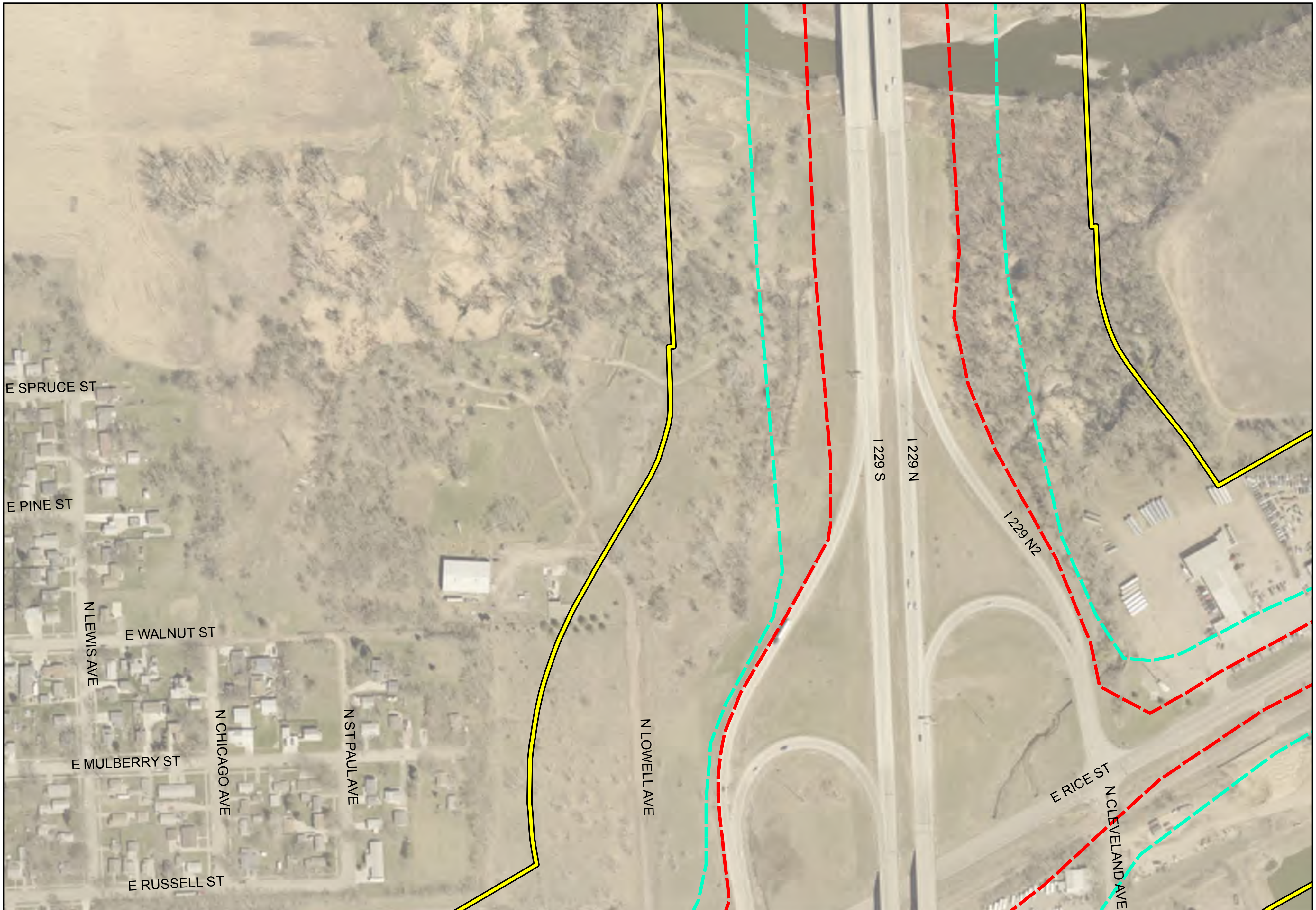

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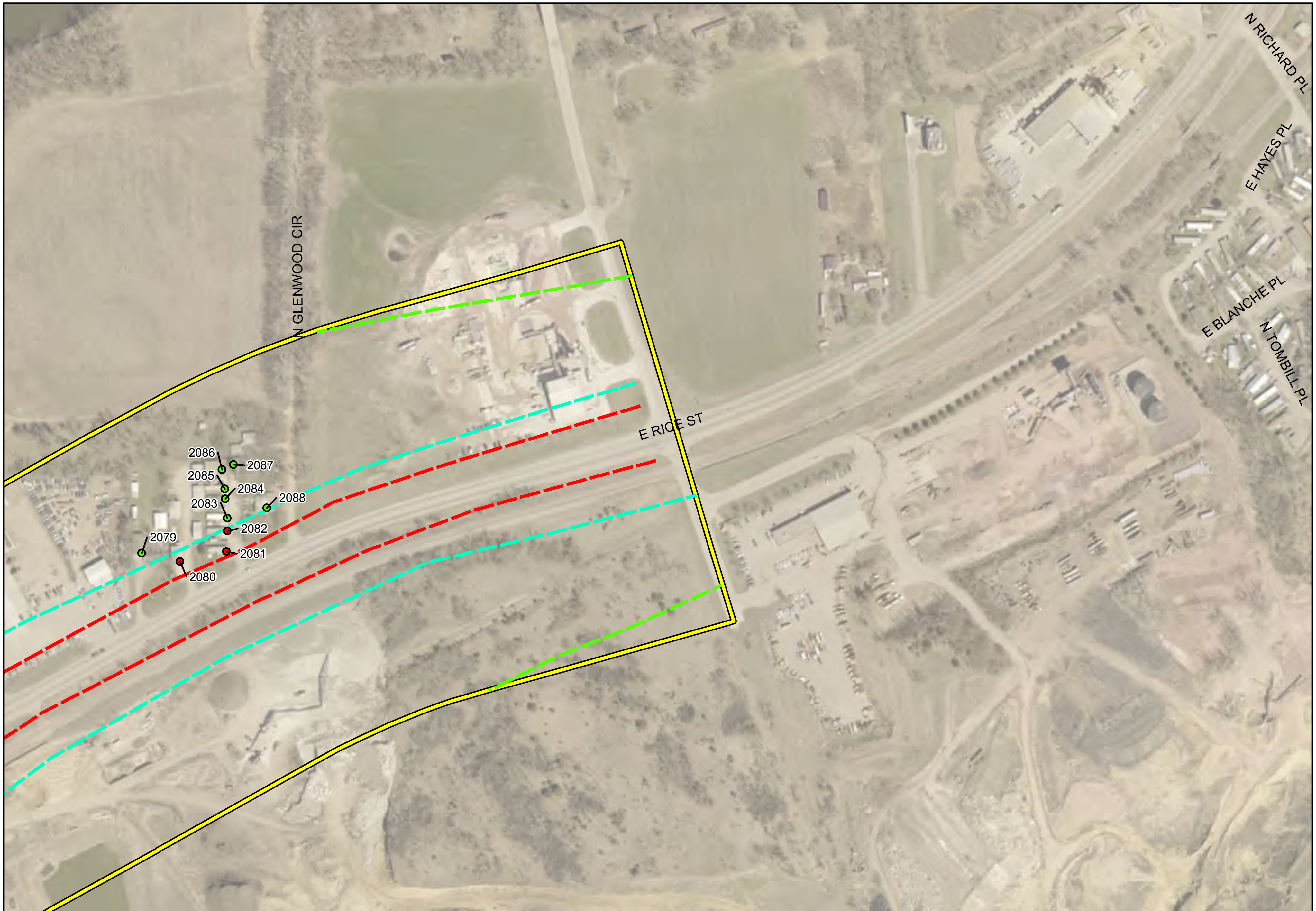

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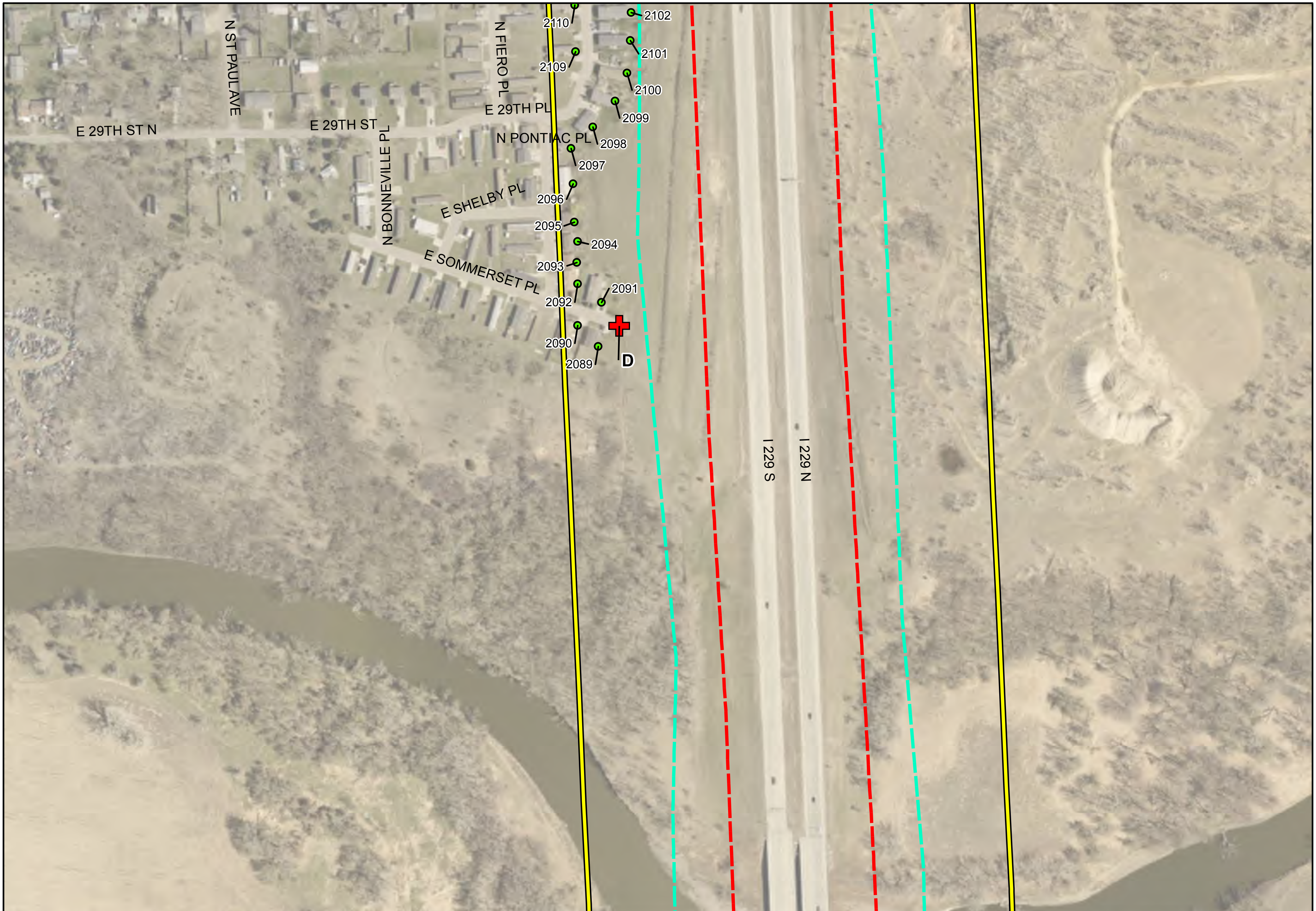

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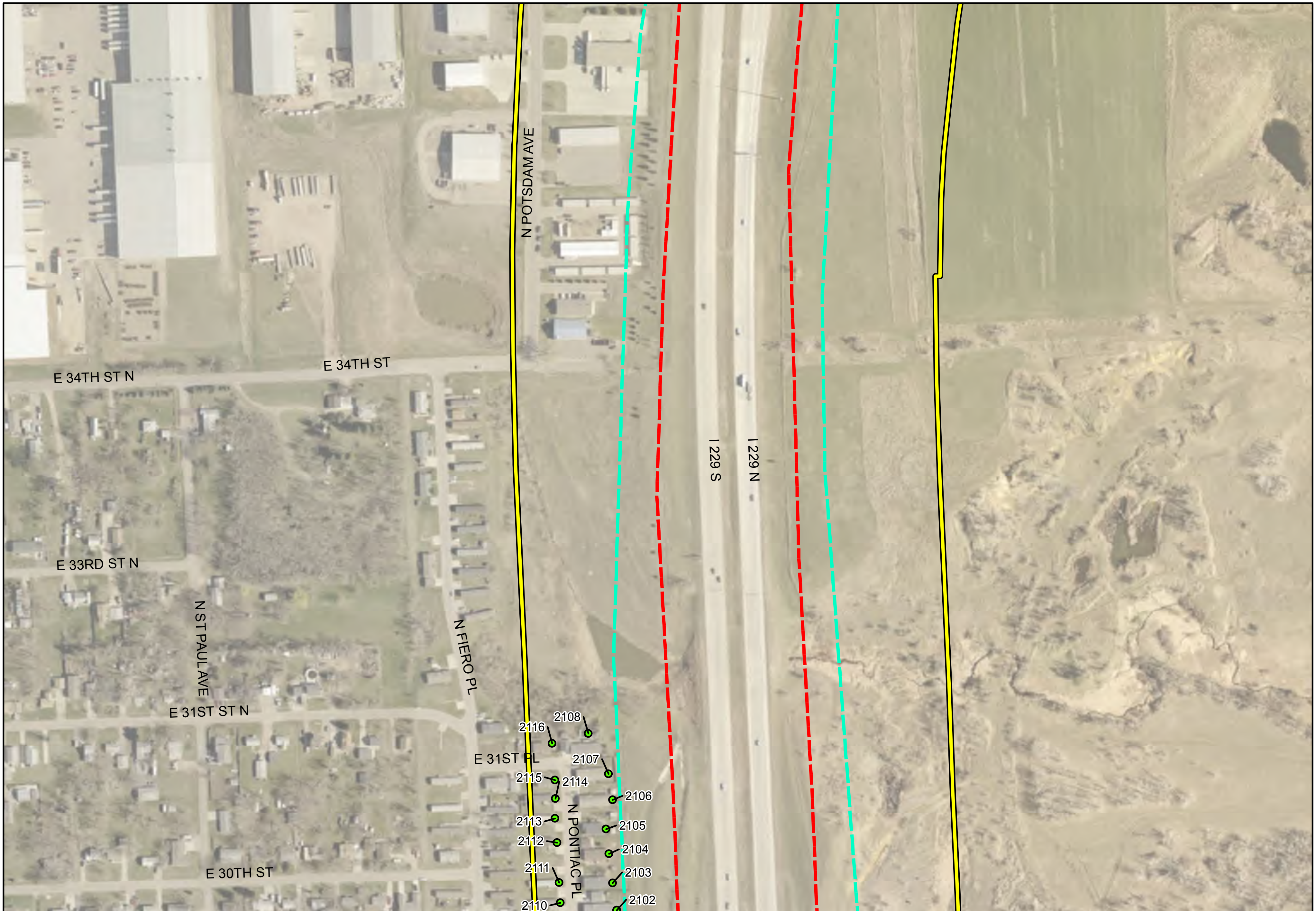

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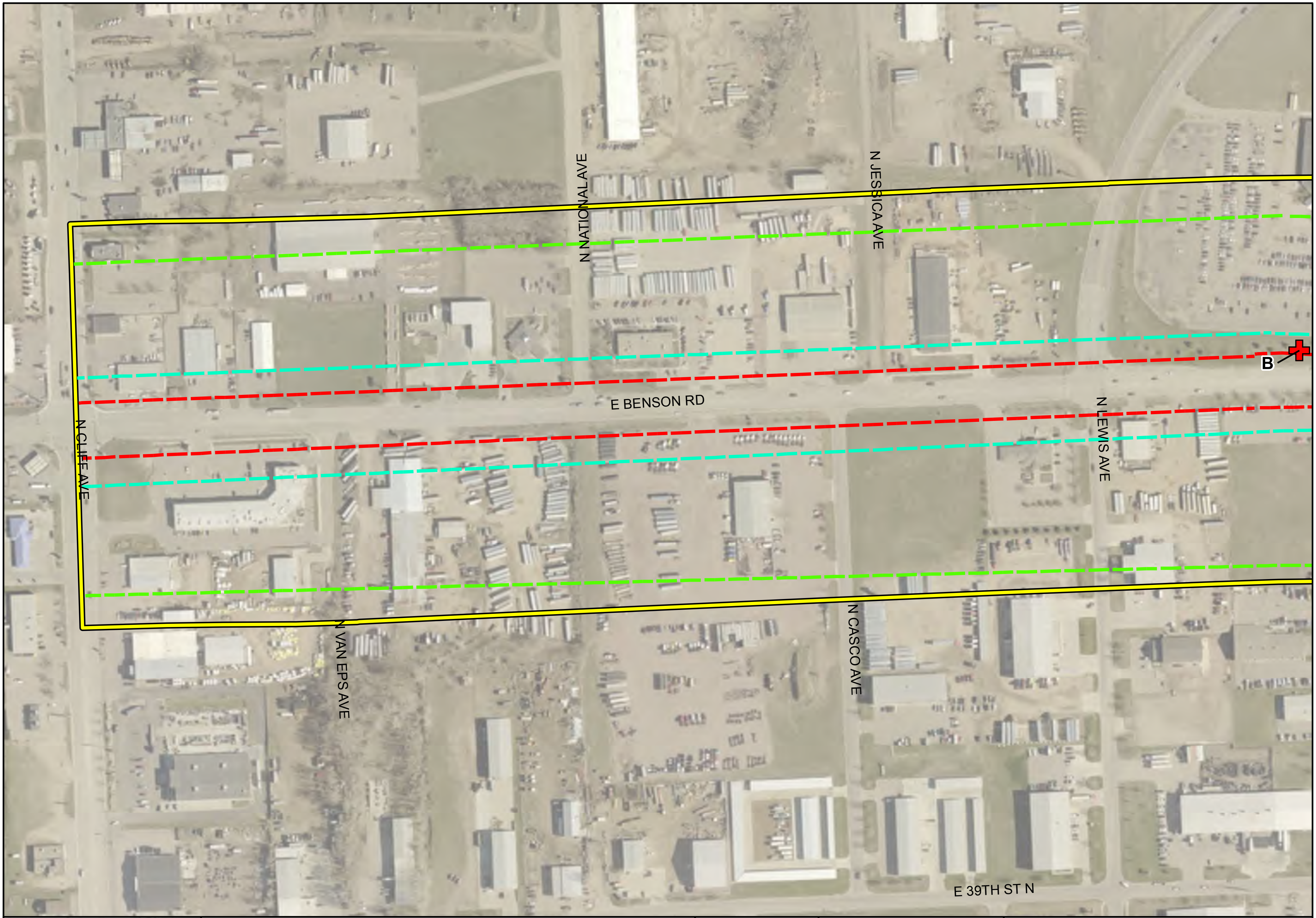

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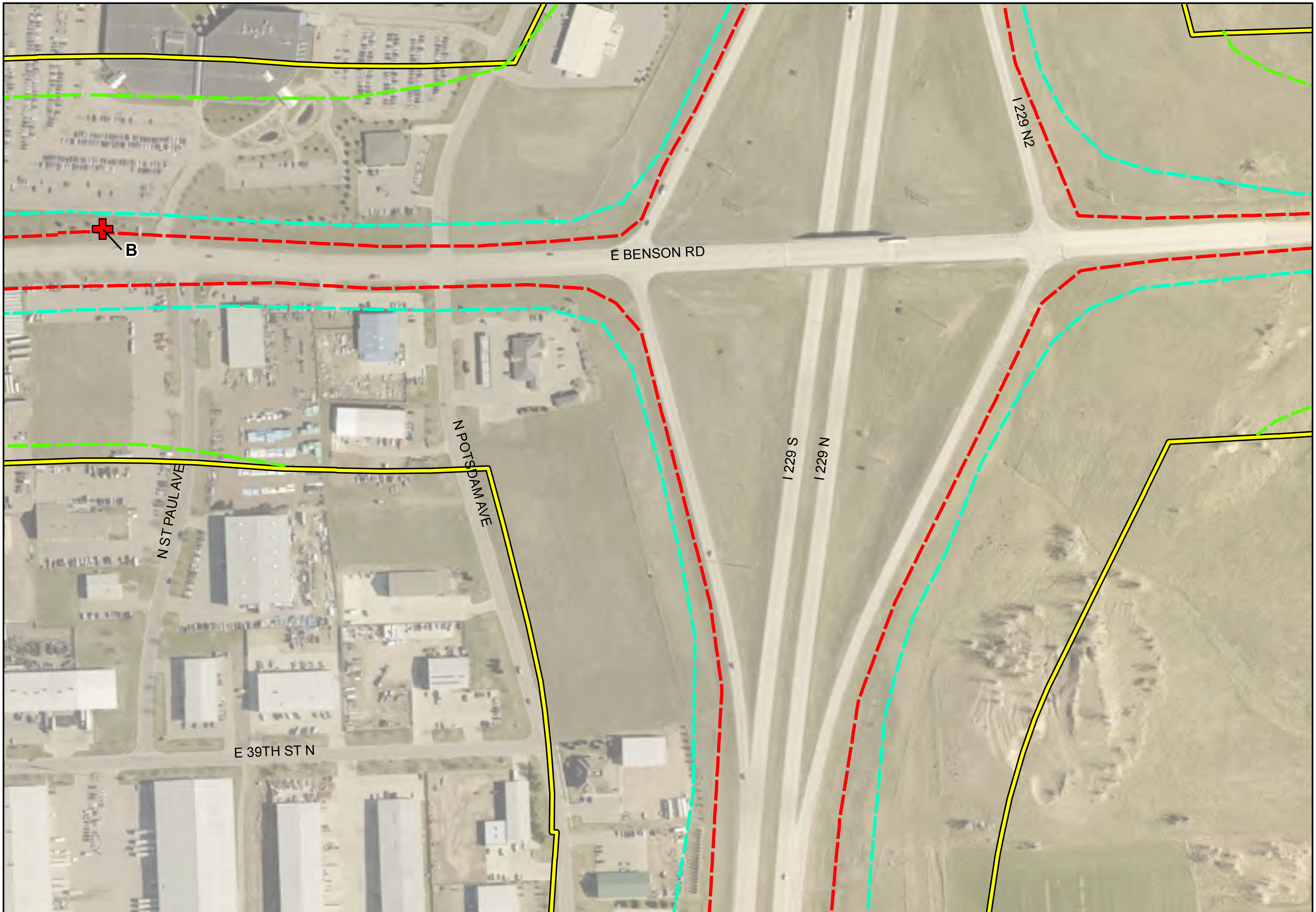

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I-229 Major Investment Corridor Study

Sub-Study #1

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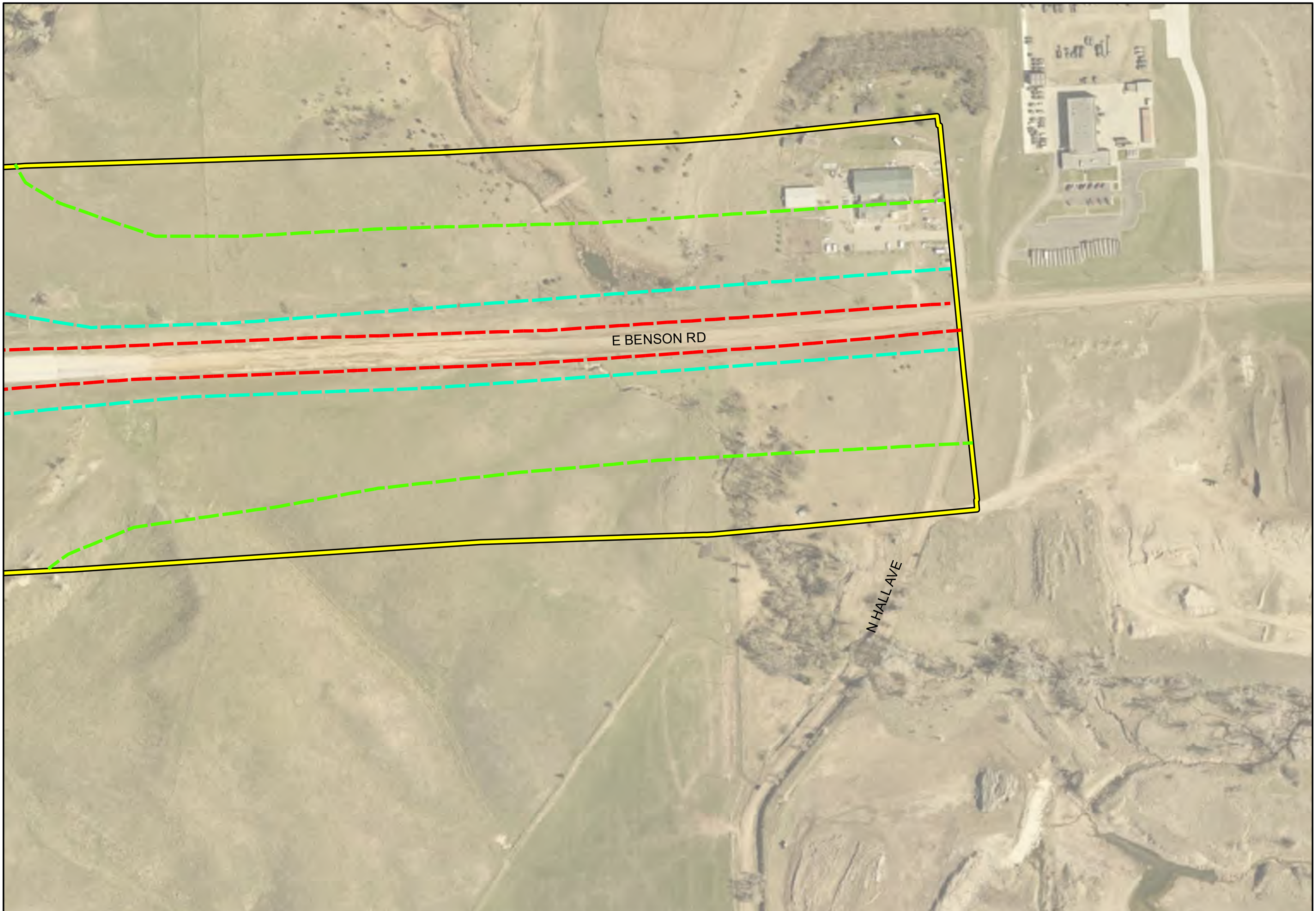

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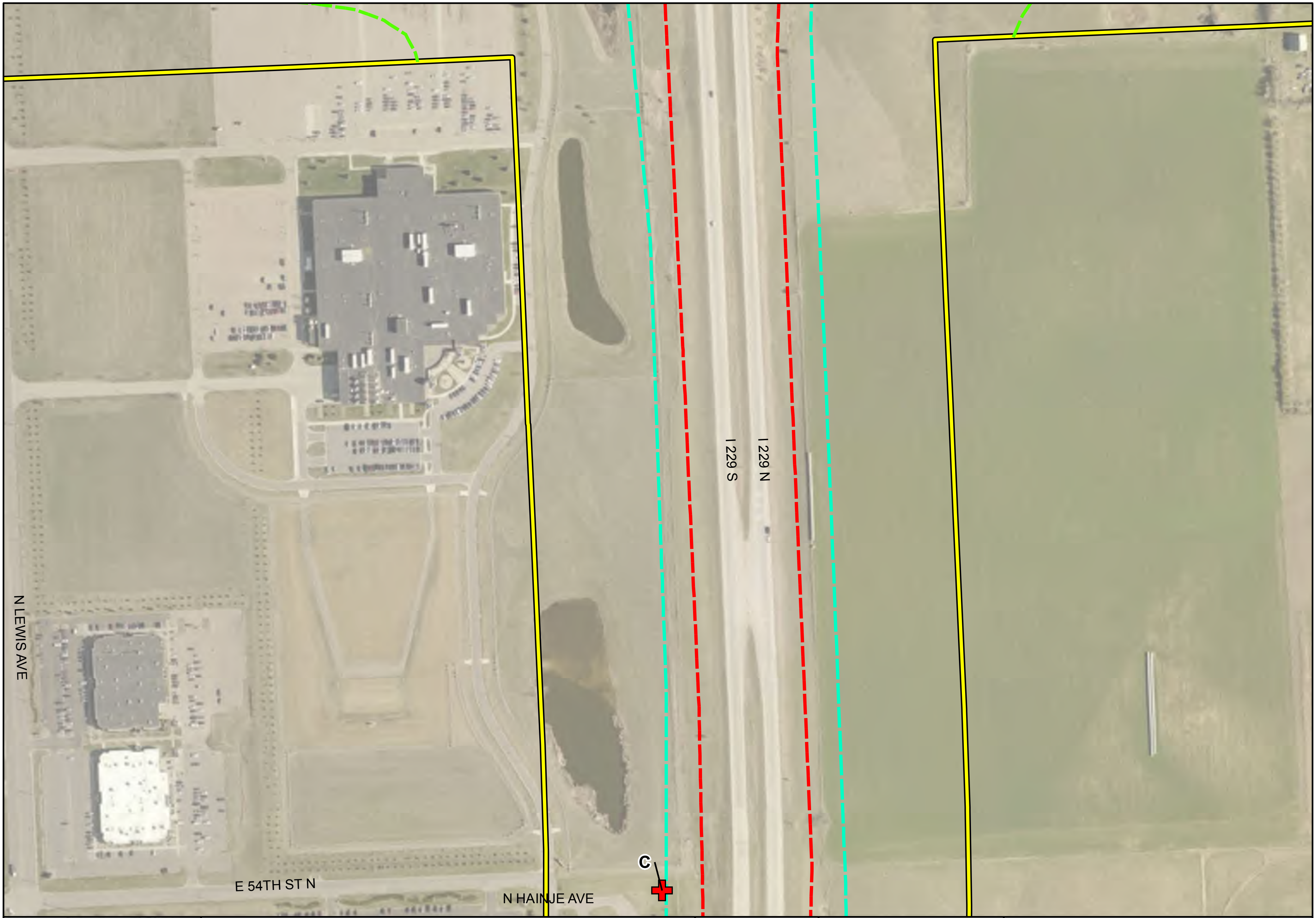

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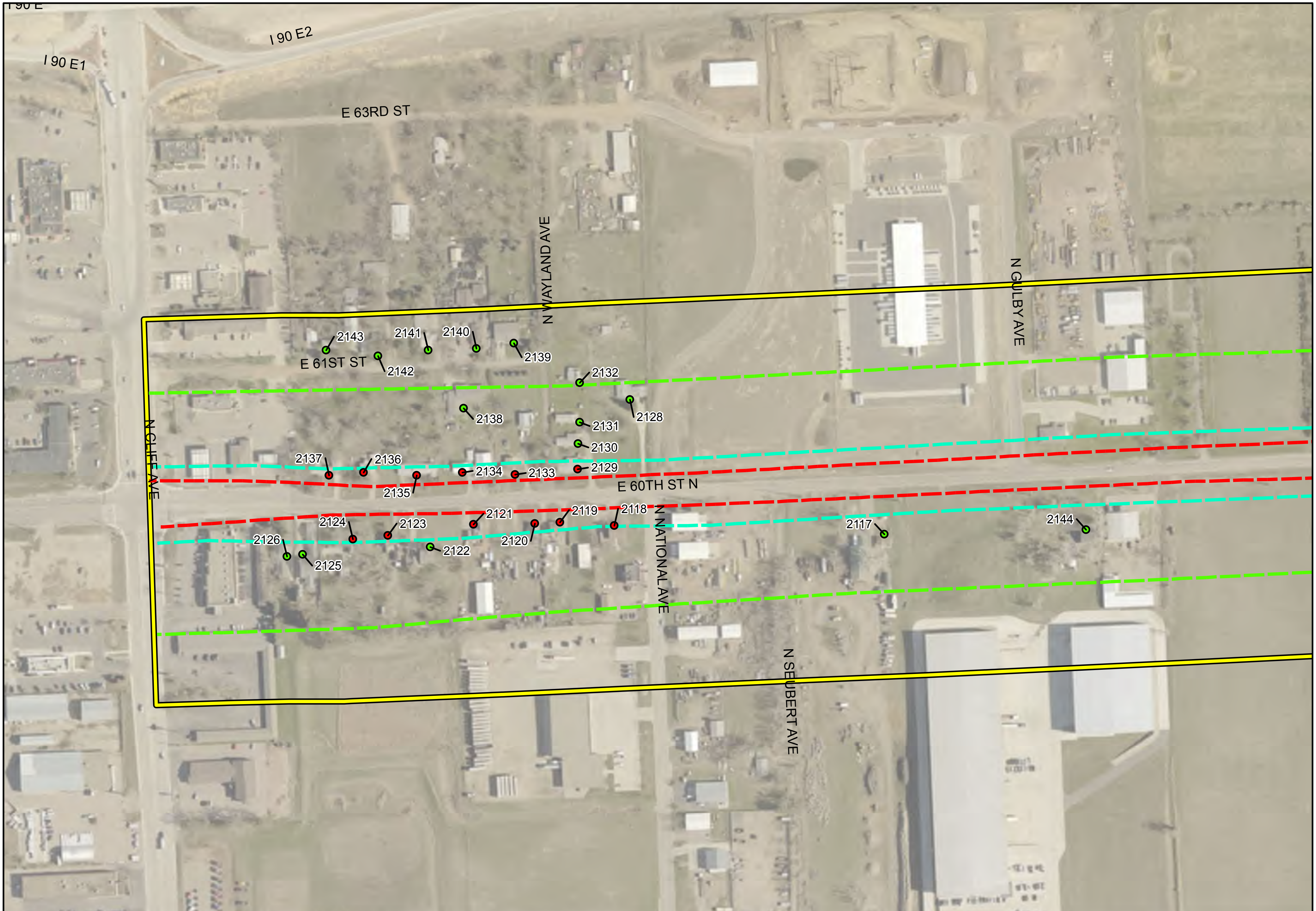

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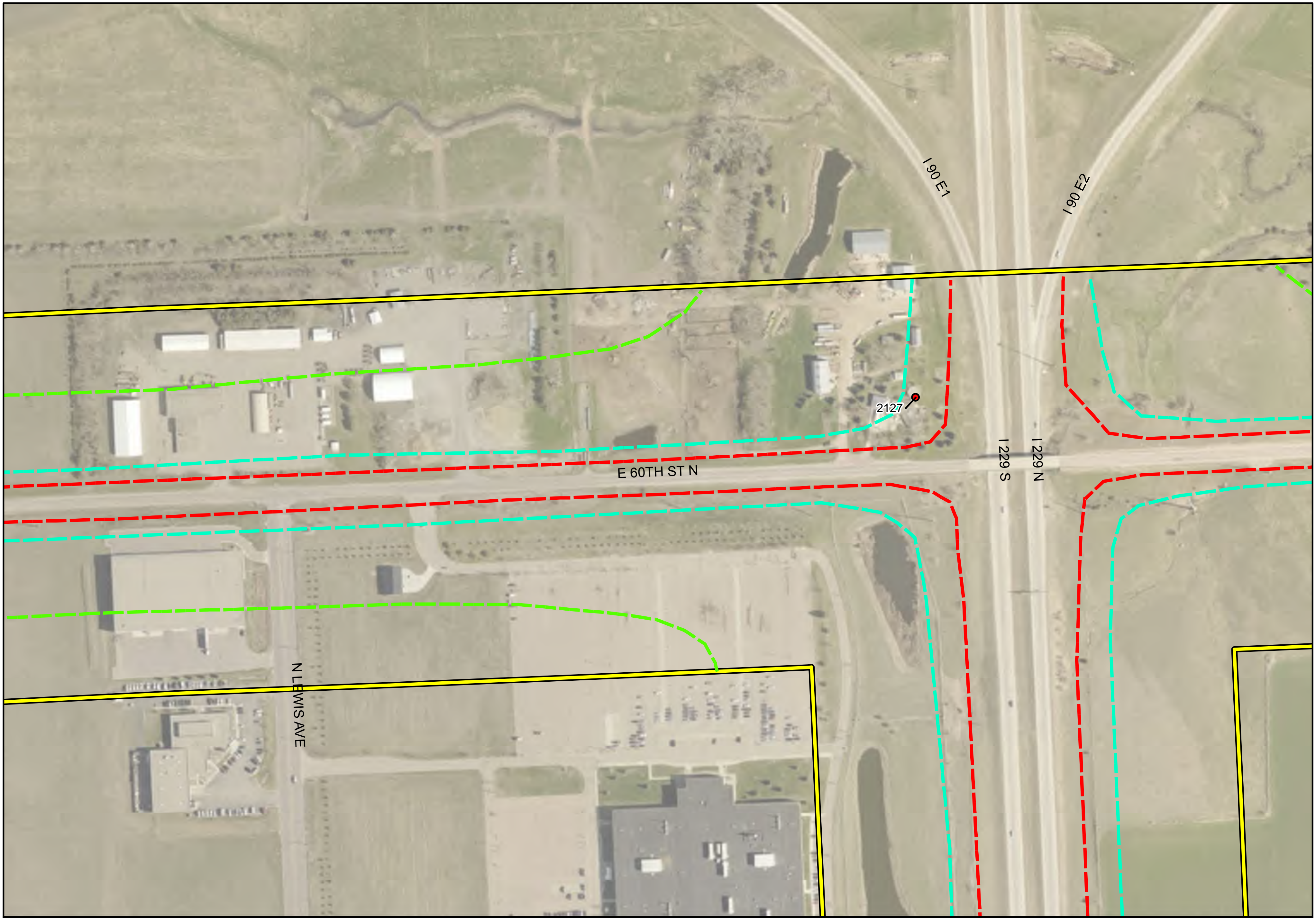
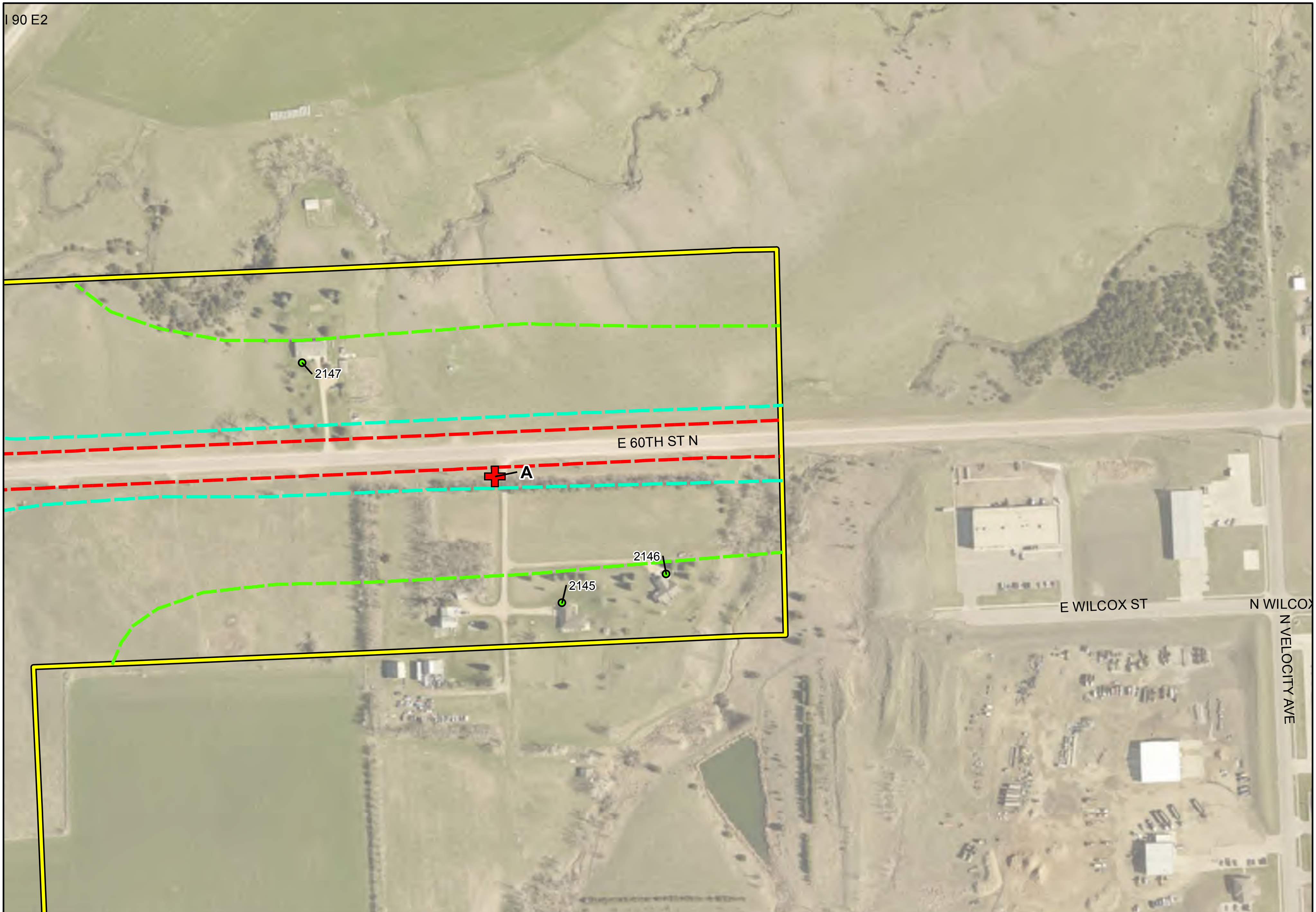
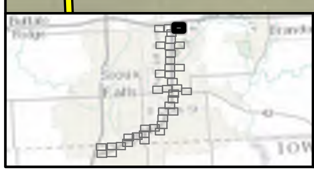


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 1 Concept Linework Cliff-2

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-2





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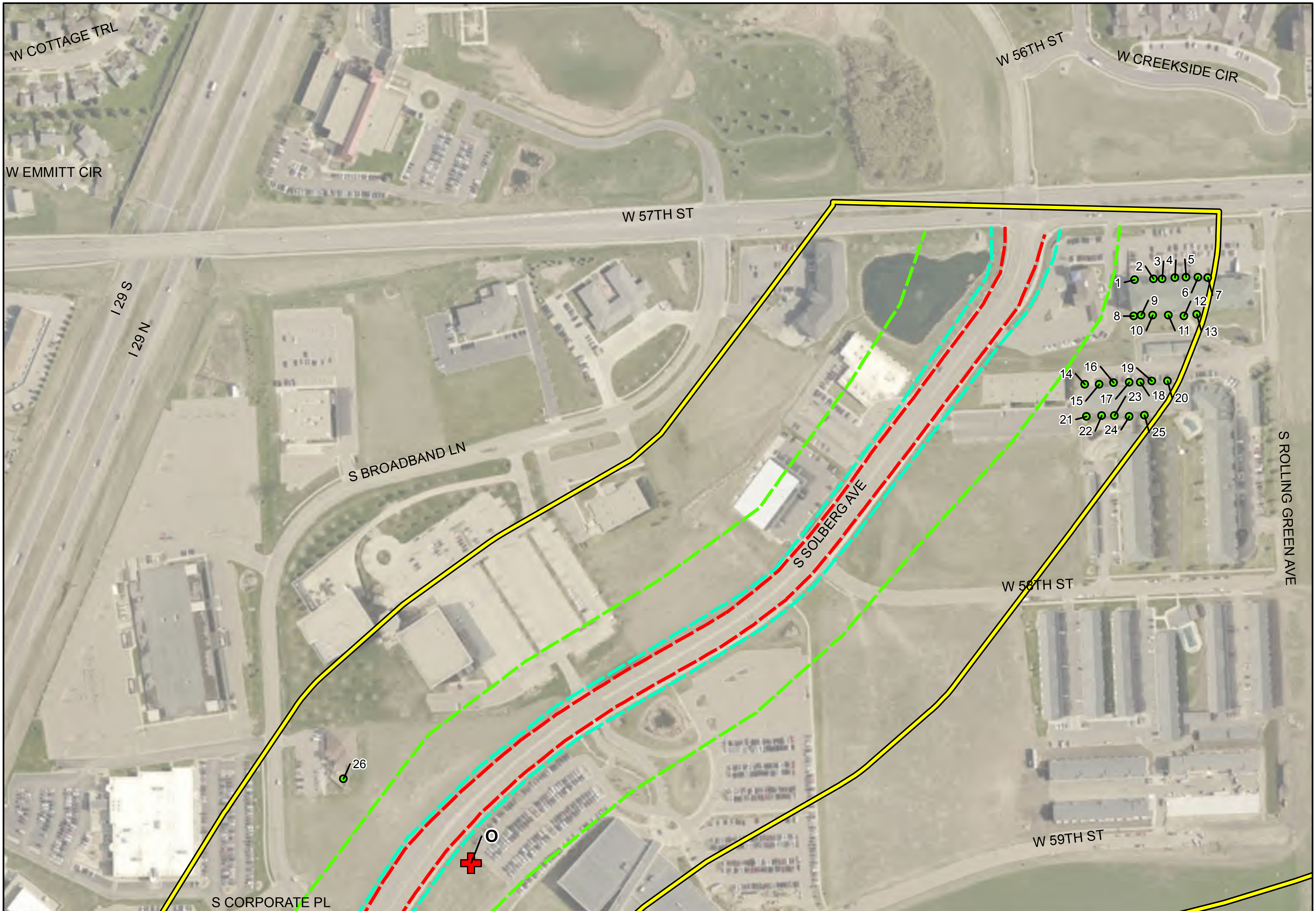
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-2



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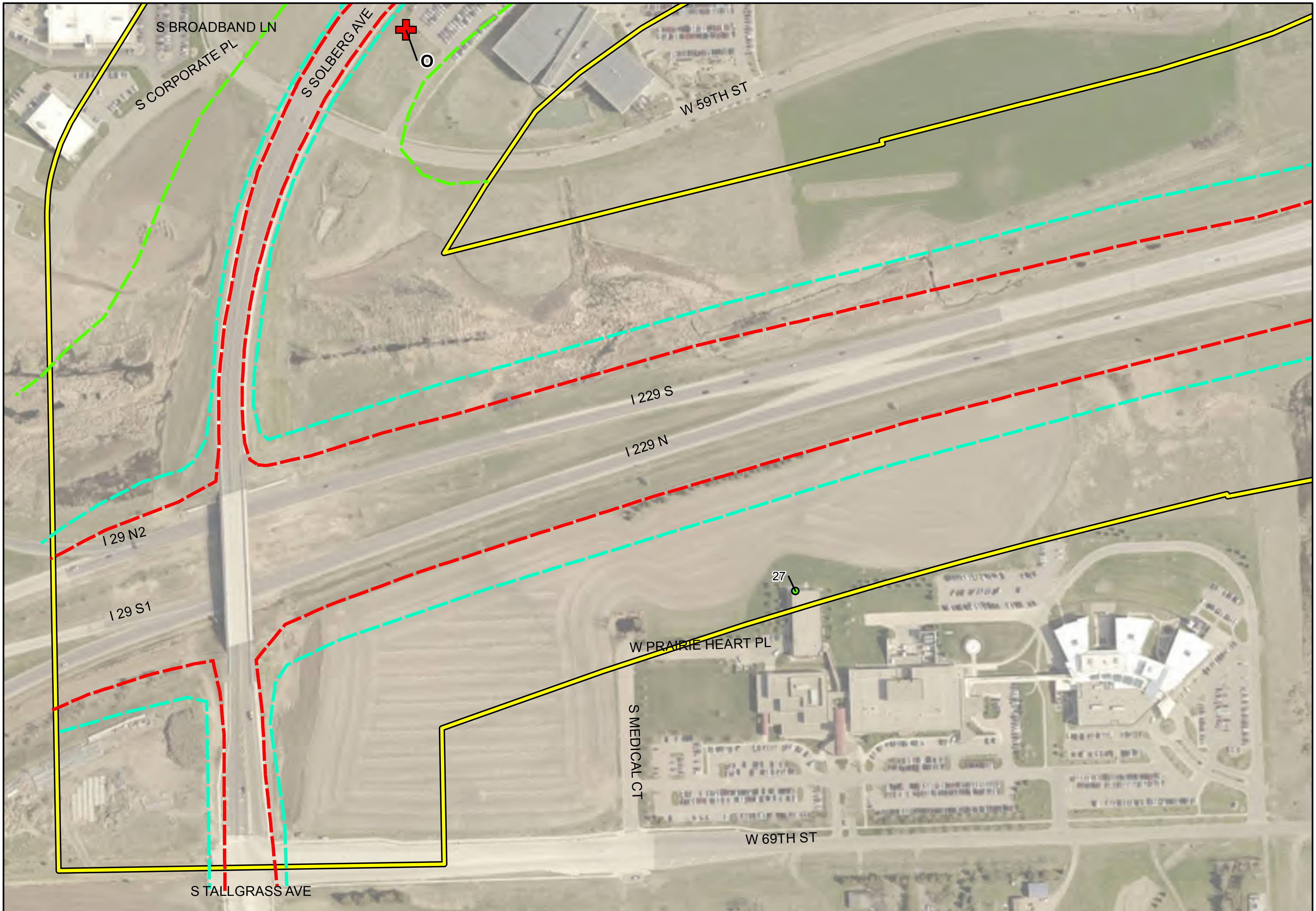
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-3



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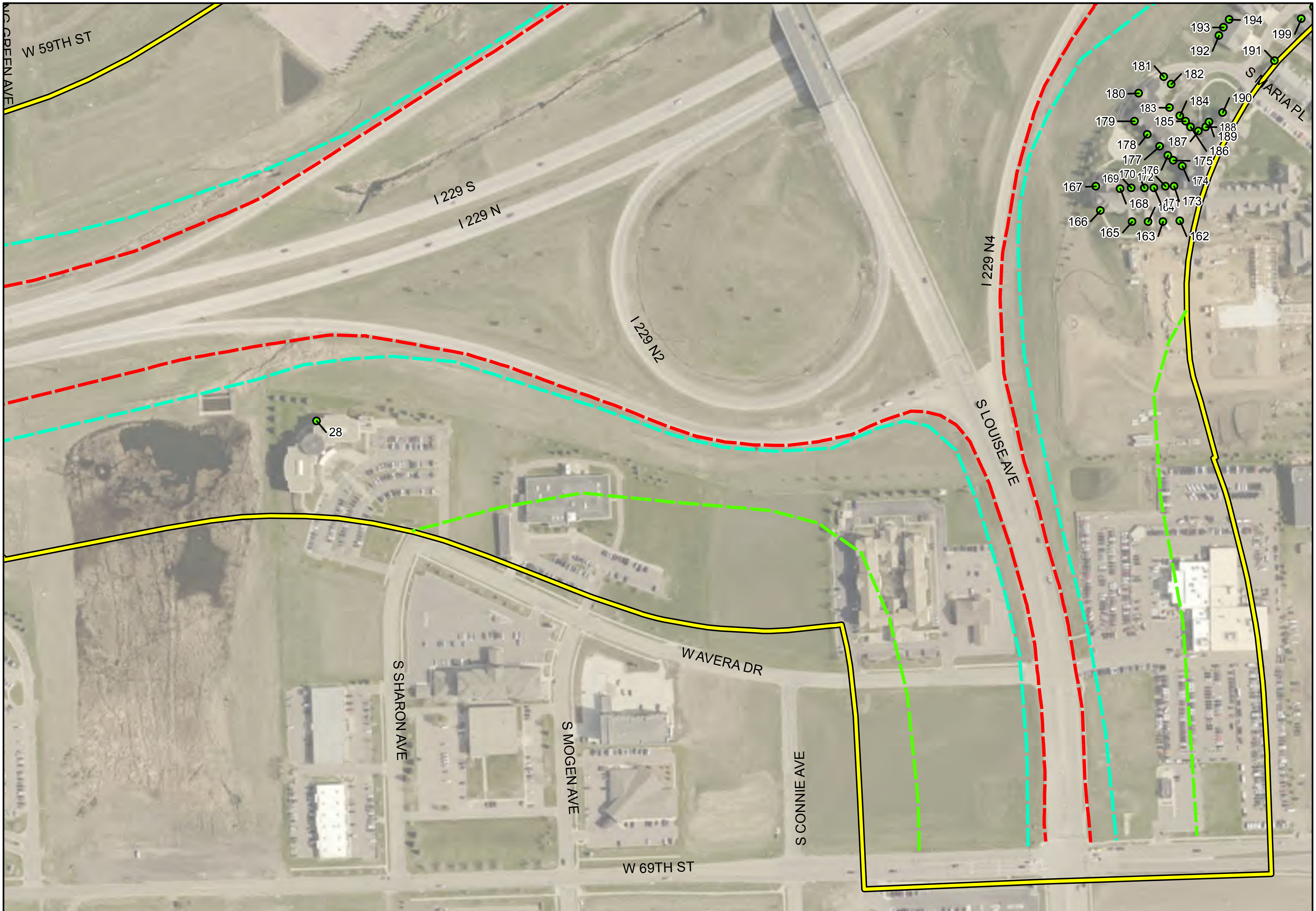
I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

Proposed Alternative Cliff-3



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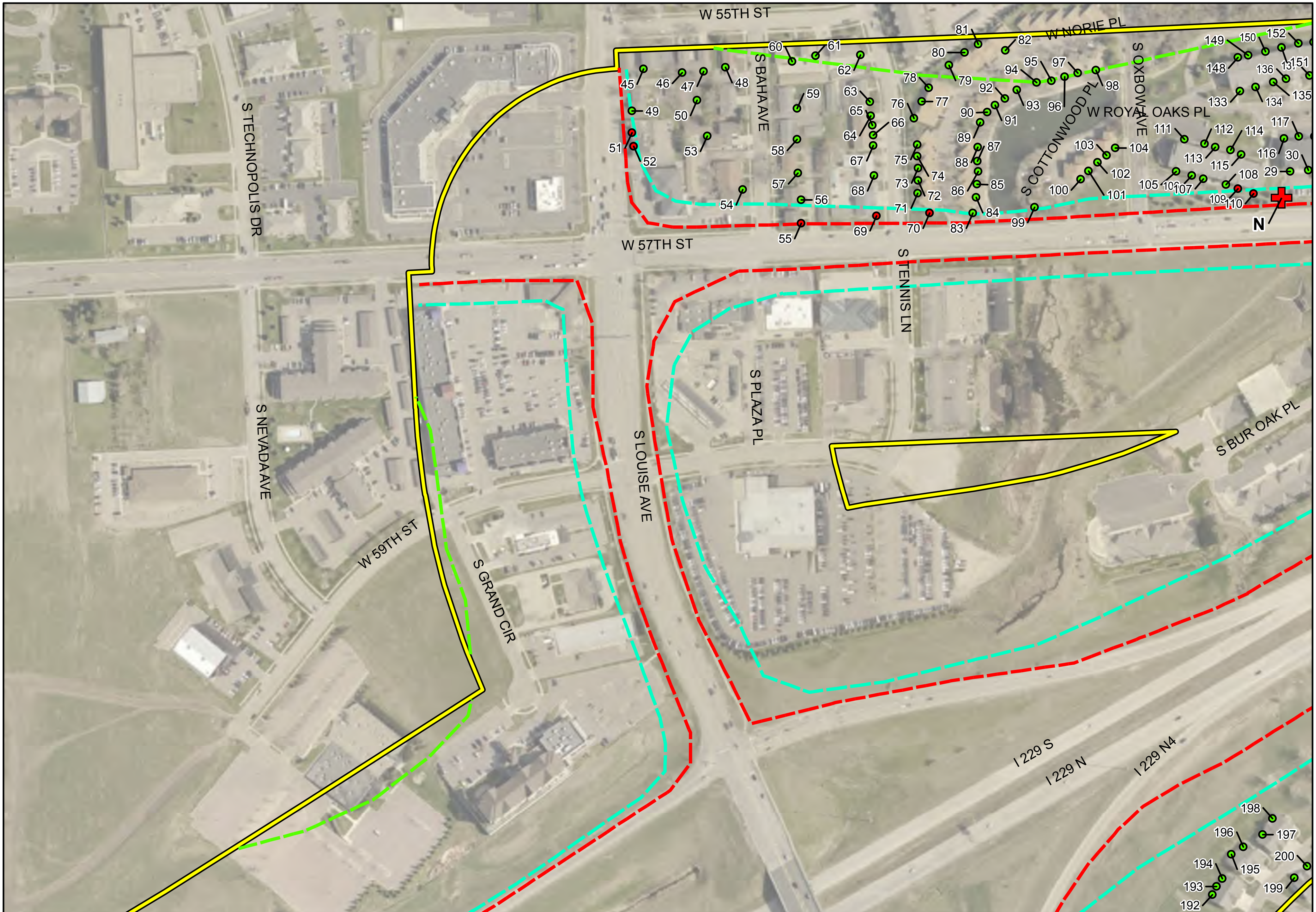
HDR

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-3



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Sub-Study #1
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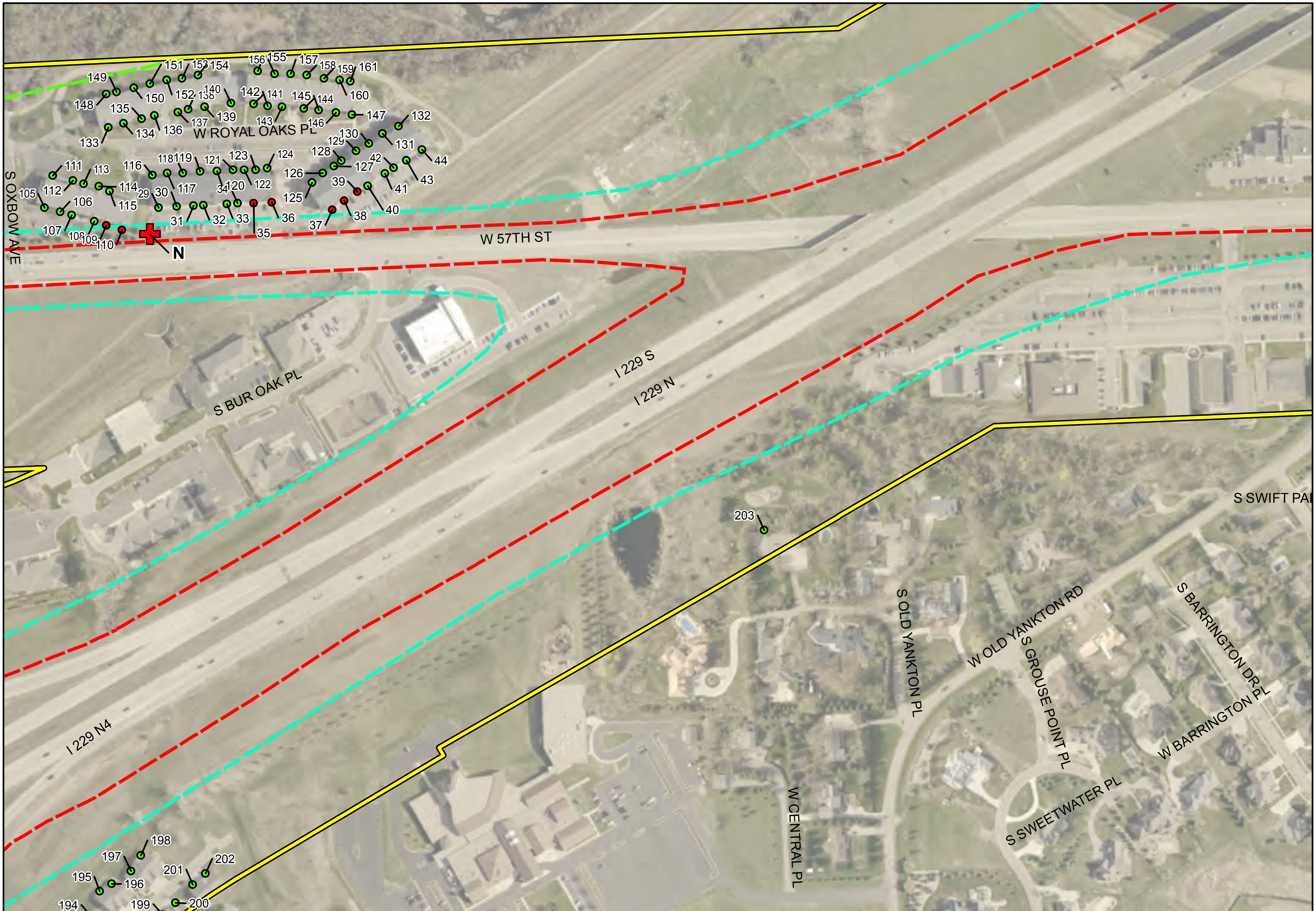

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I-229 Major Investment Corridor Study
Sub-Study #1
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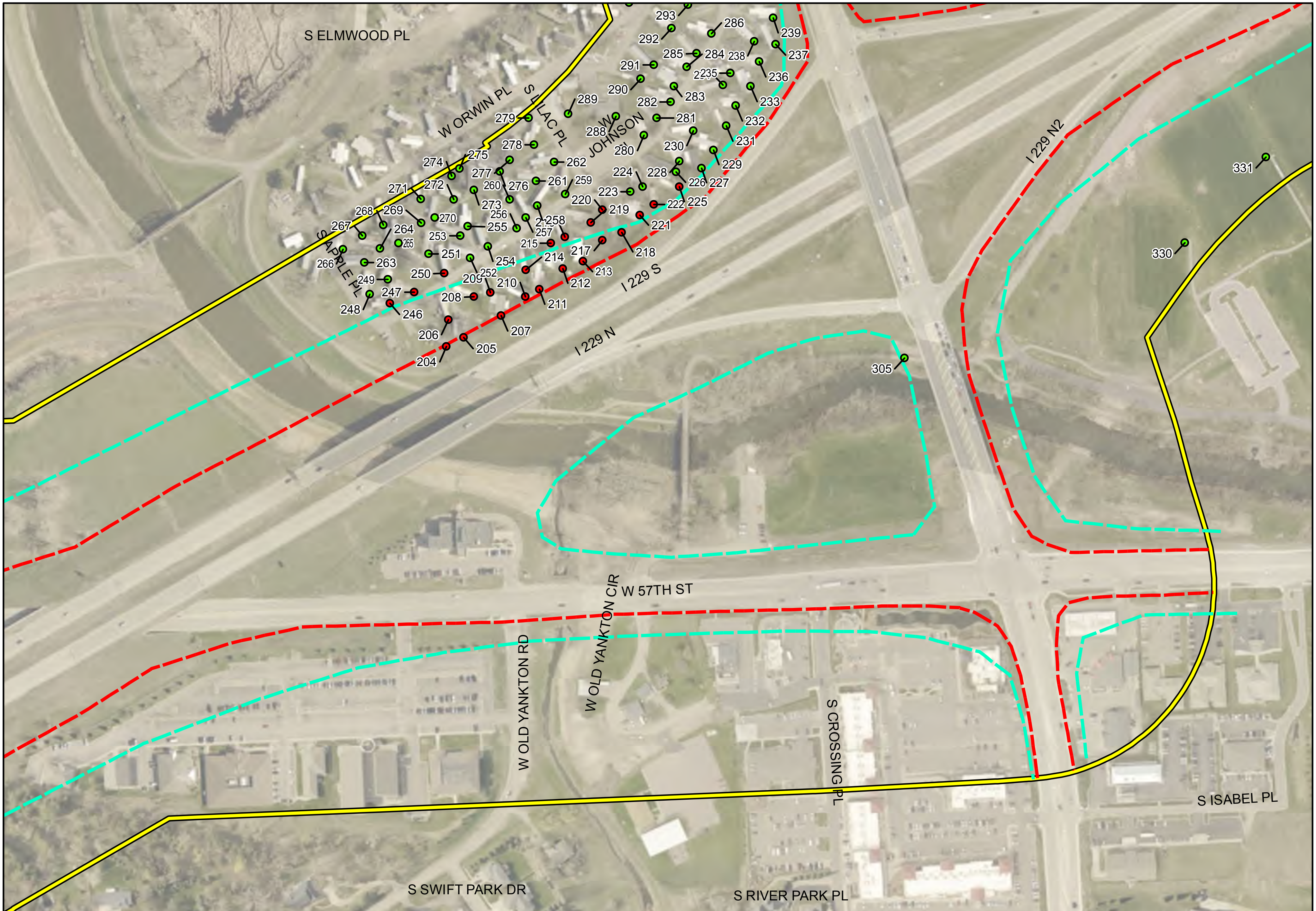

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I-229 Major Investment Corridor Study
Sub-Study #1
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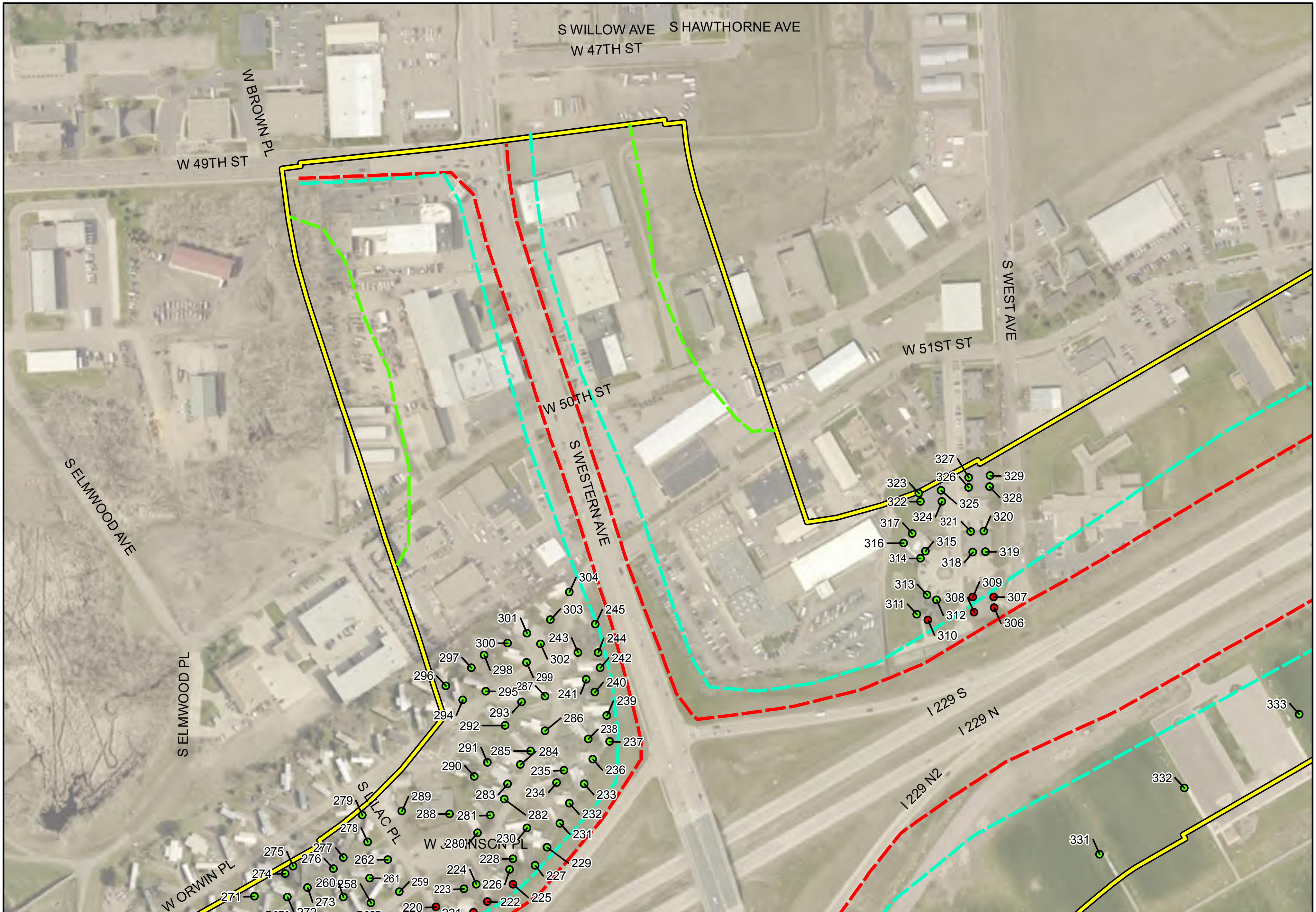

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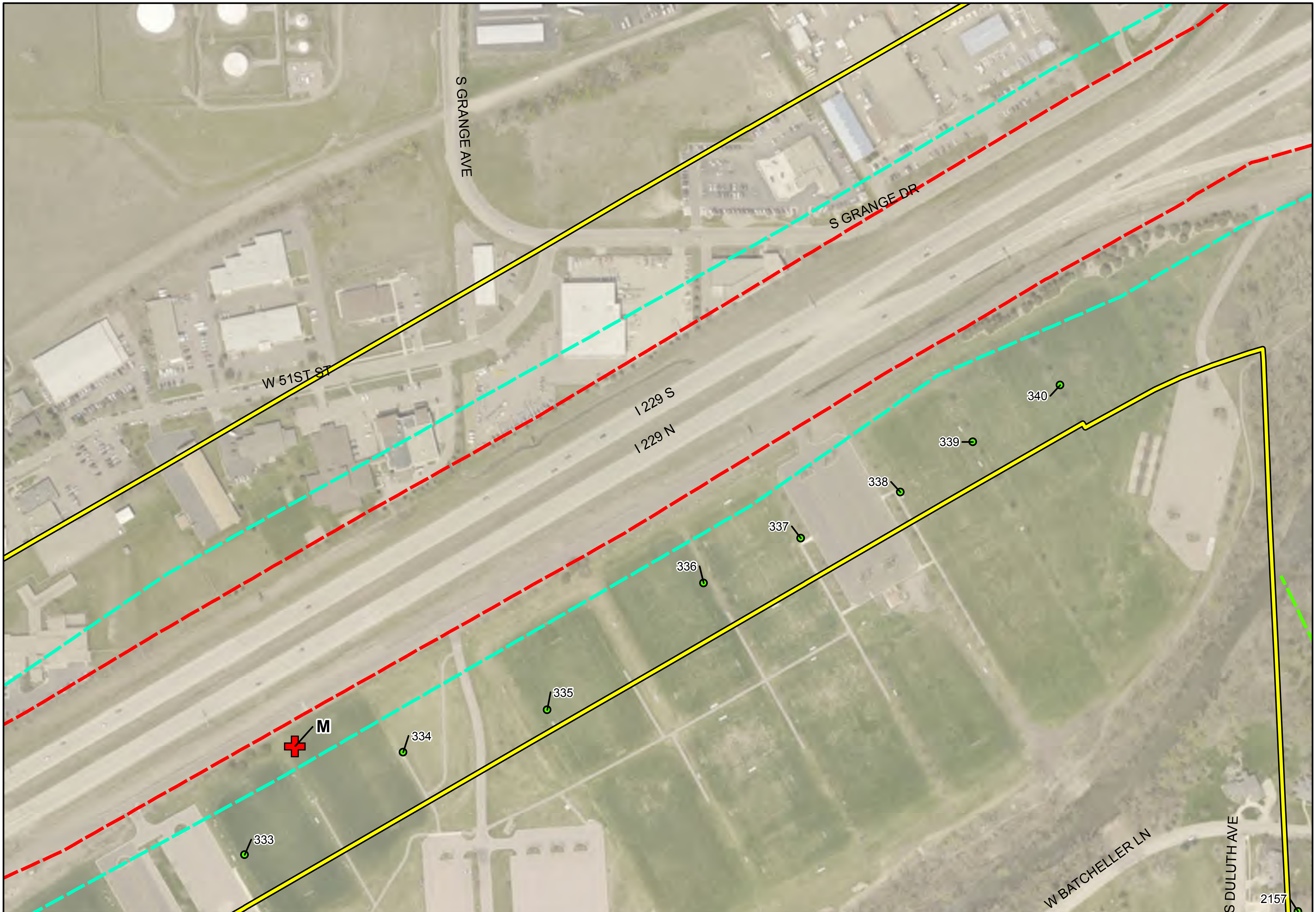

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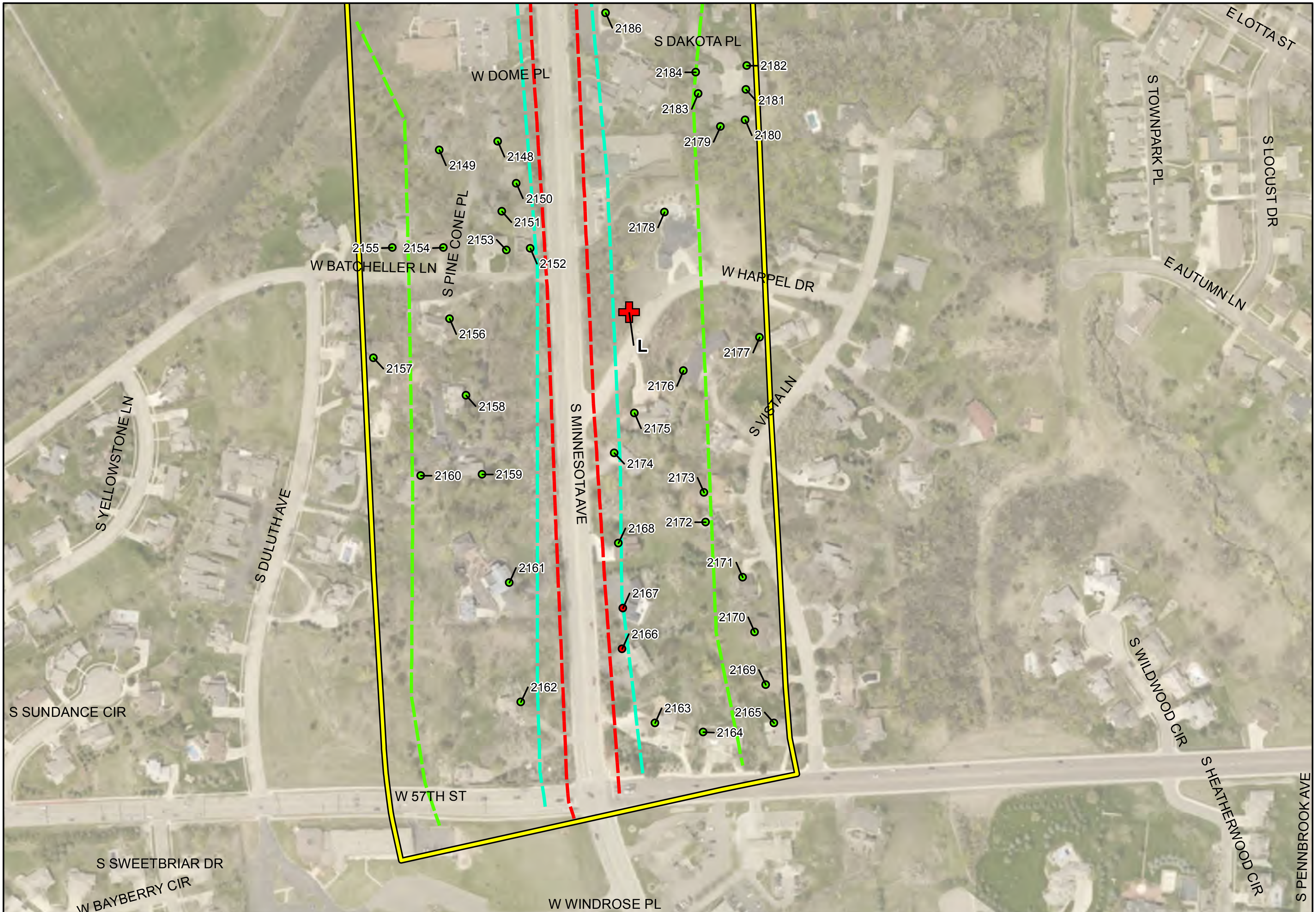

I-229 Major Investment Corridor Study
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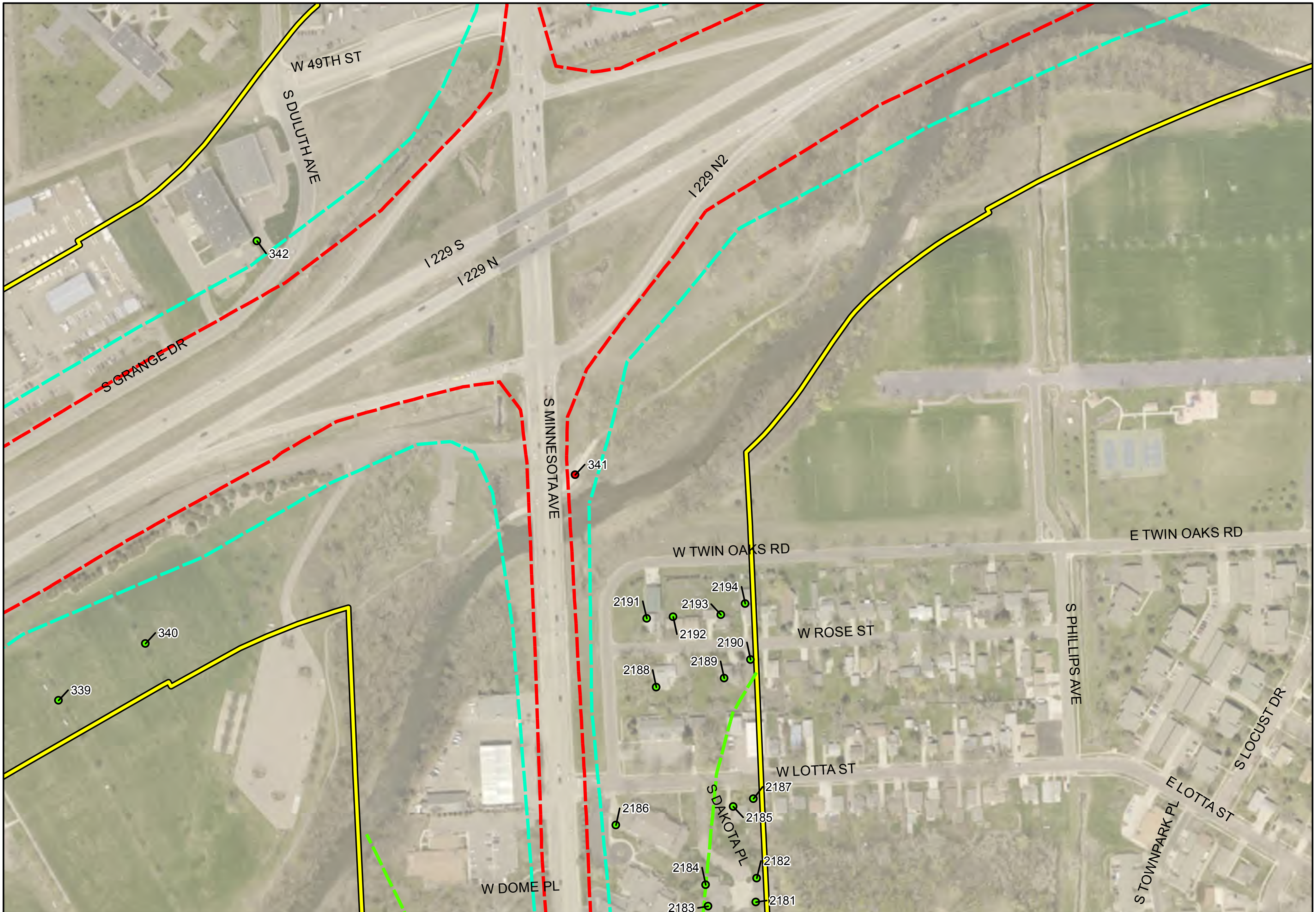

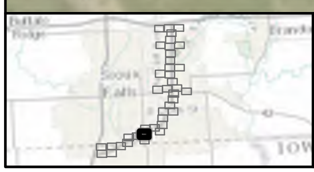

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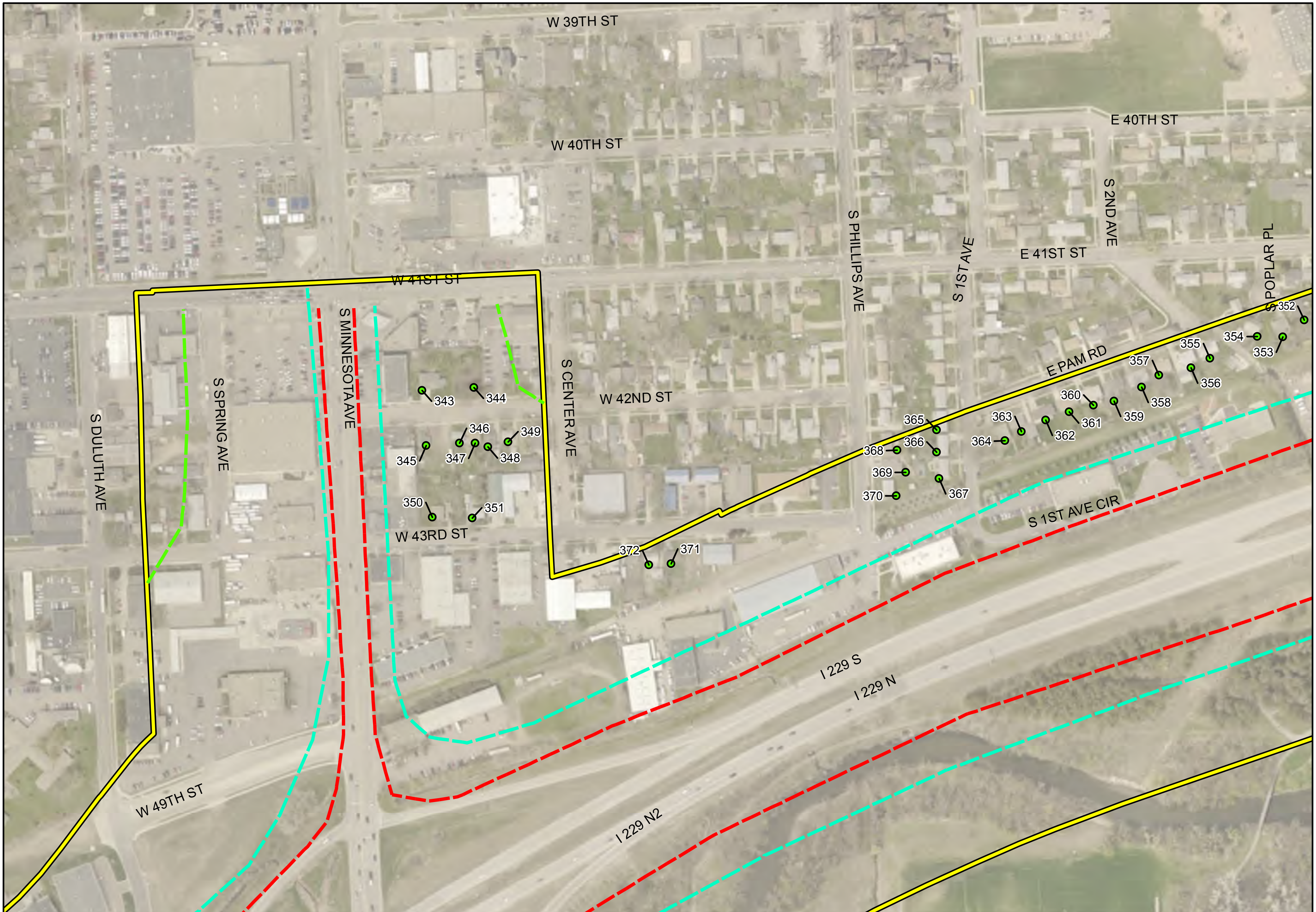

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I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

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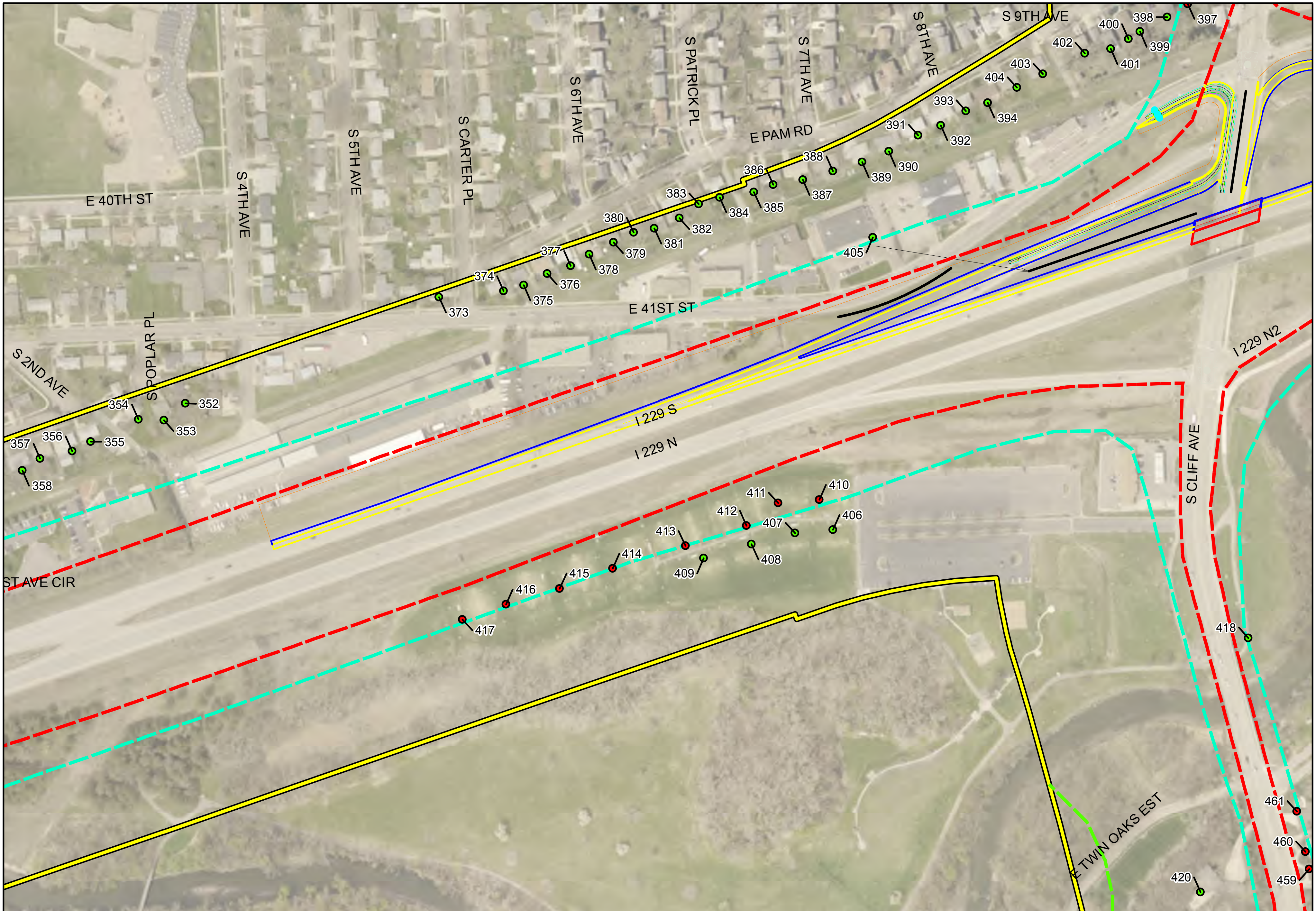

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Sub-Study #1
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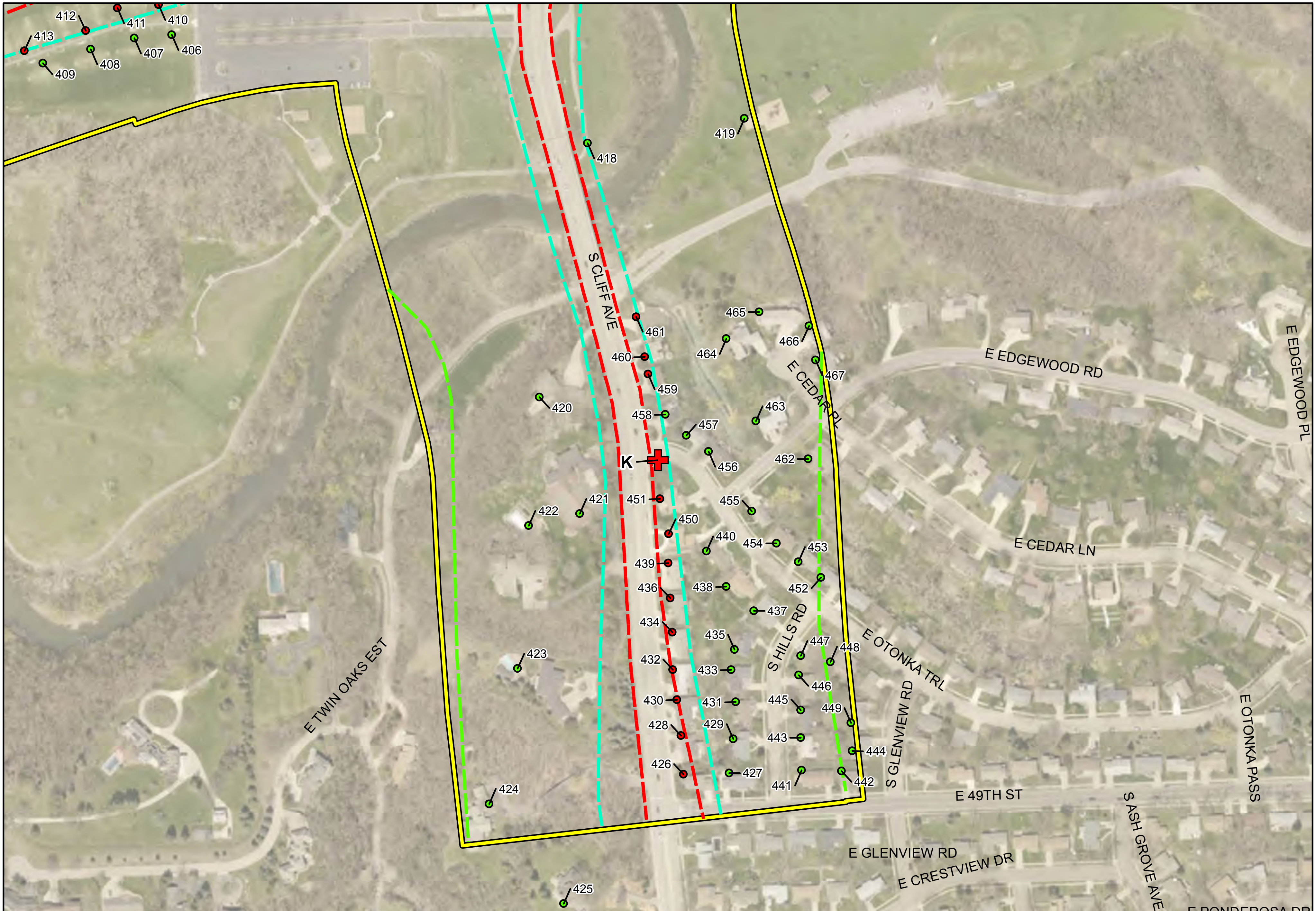

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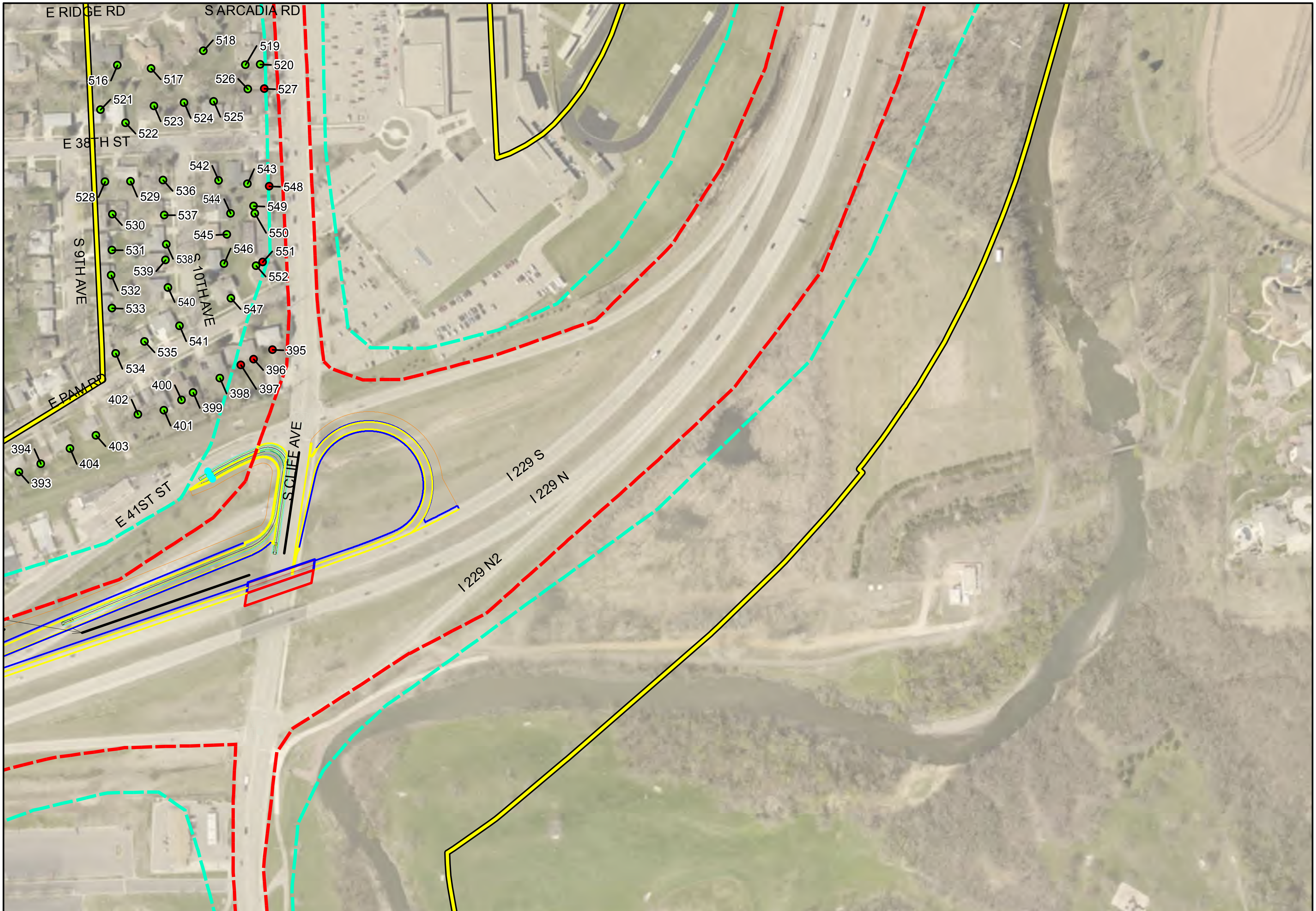

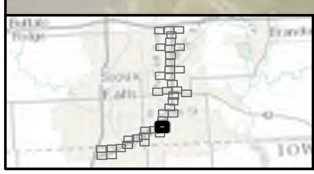

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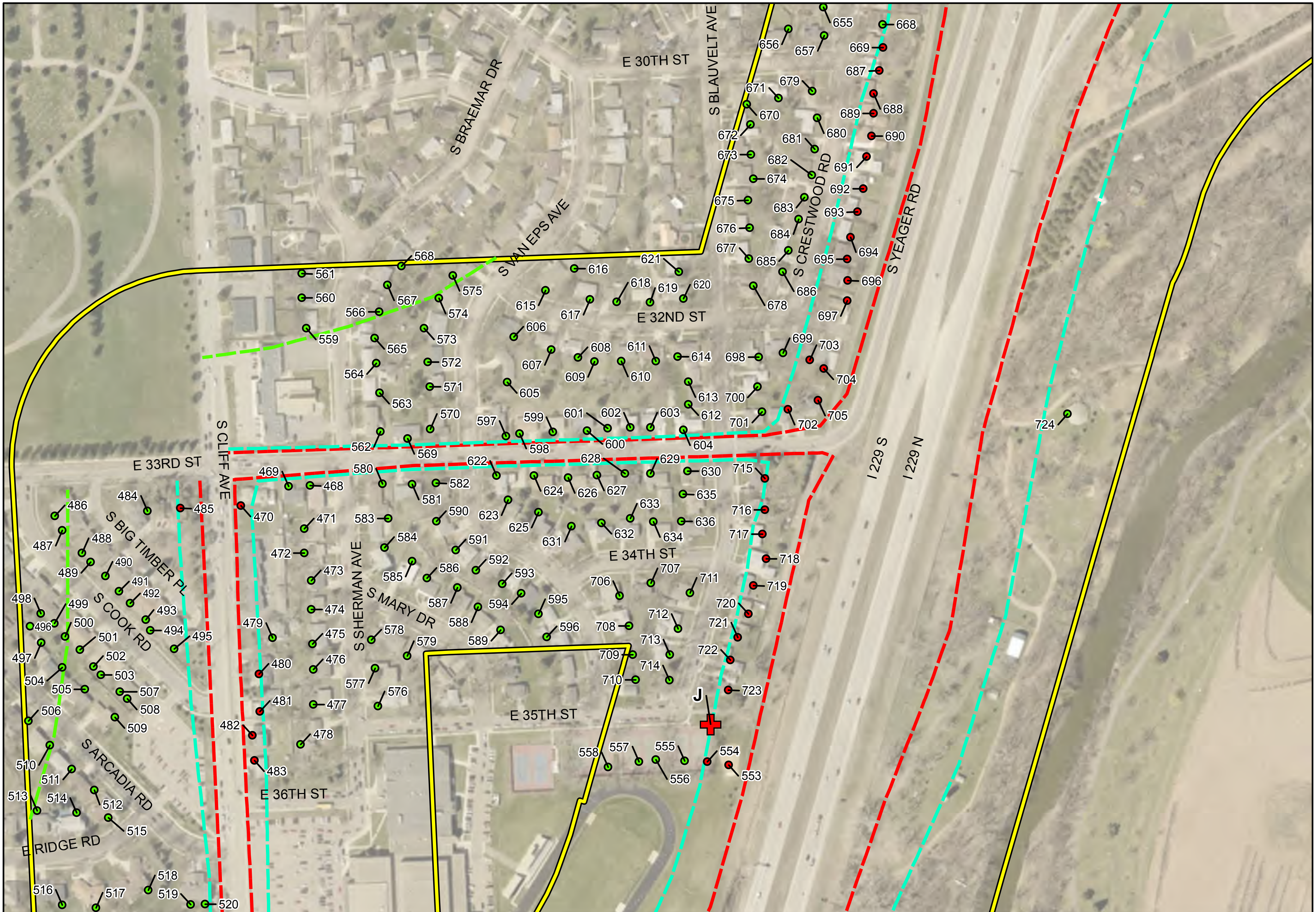

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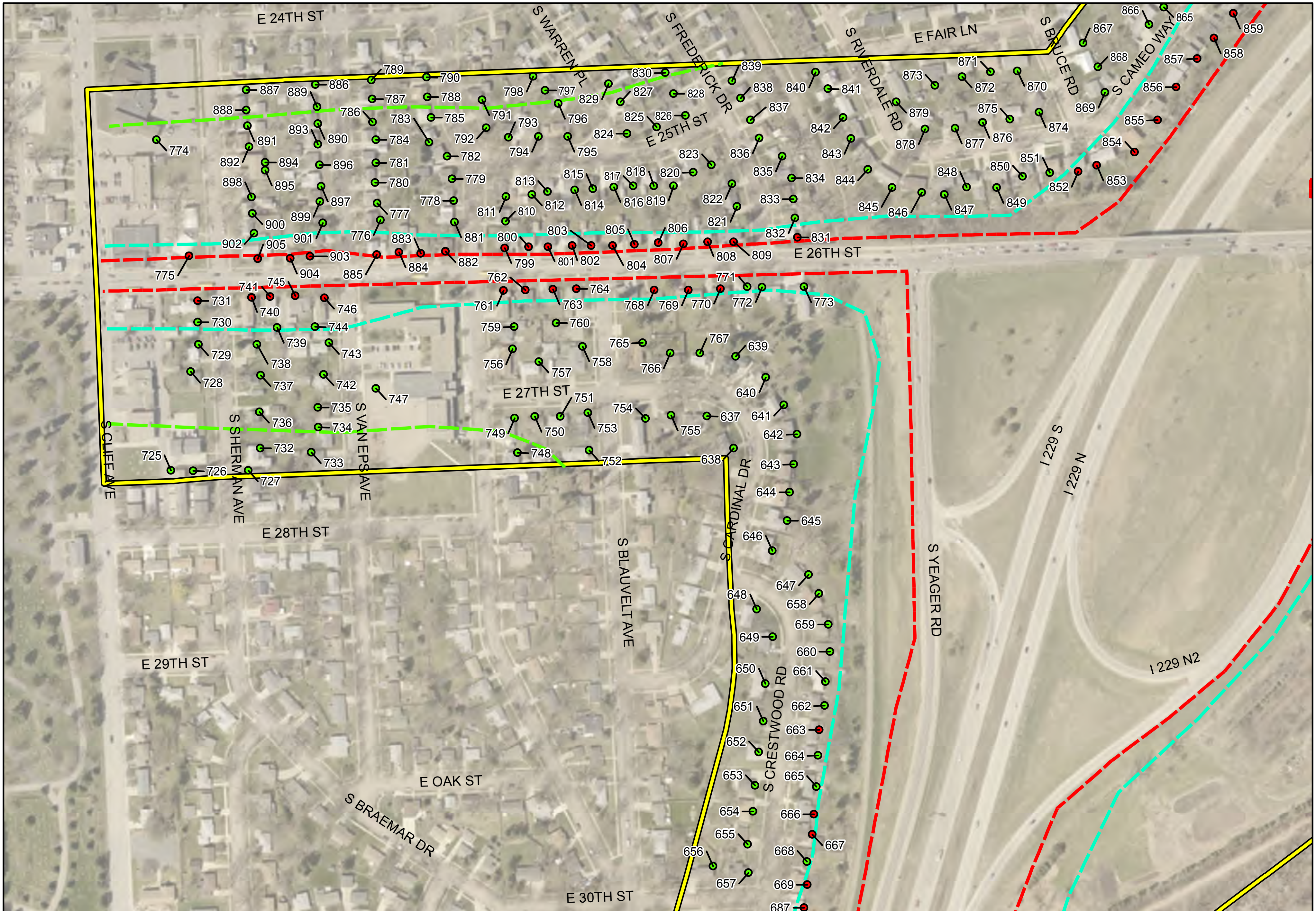

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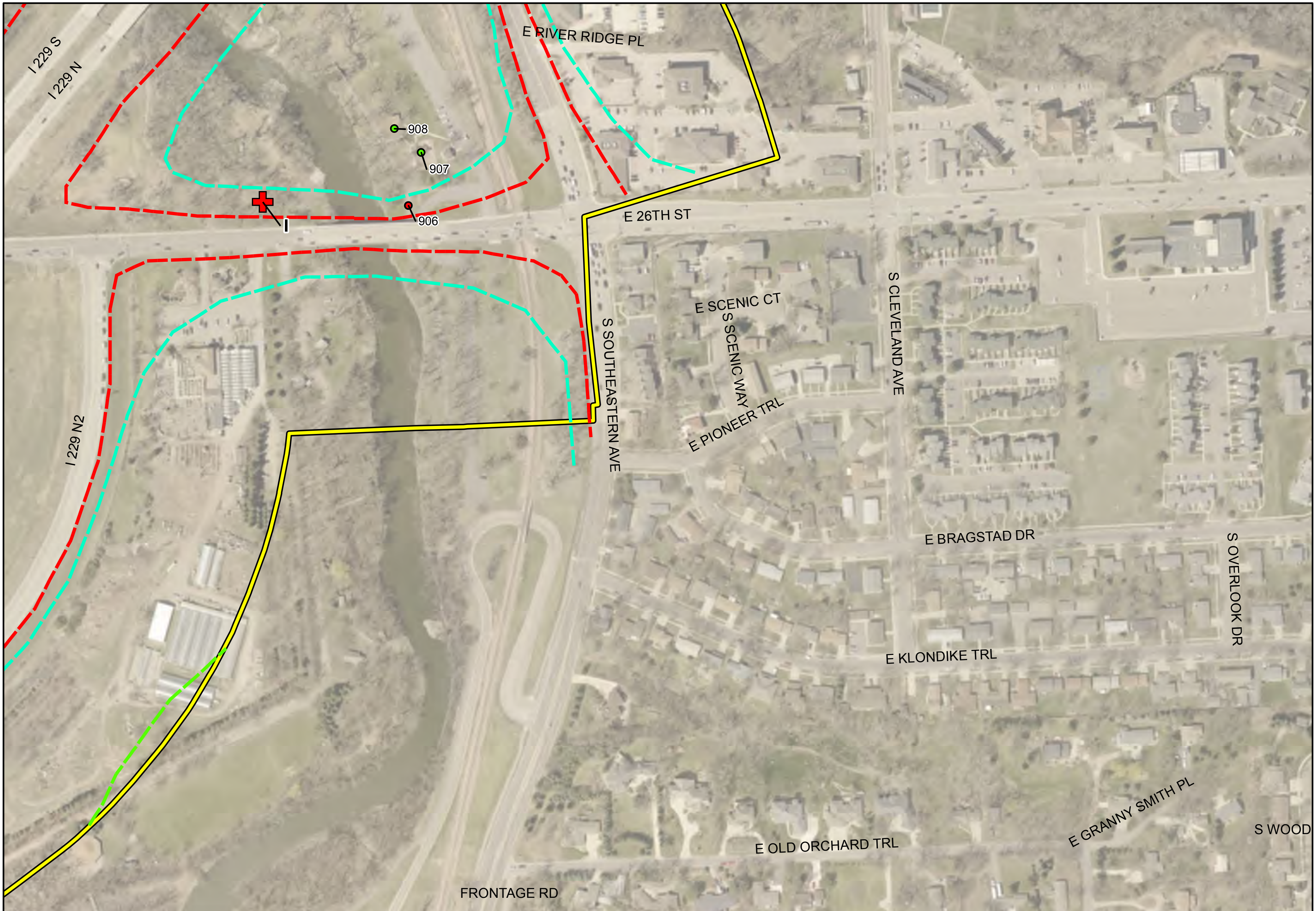

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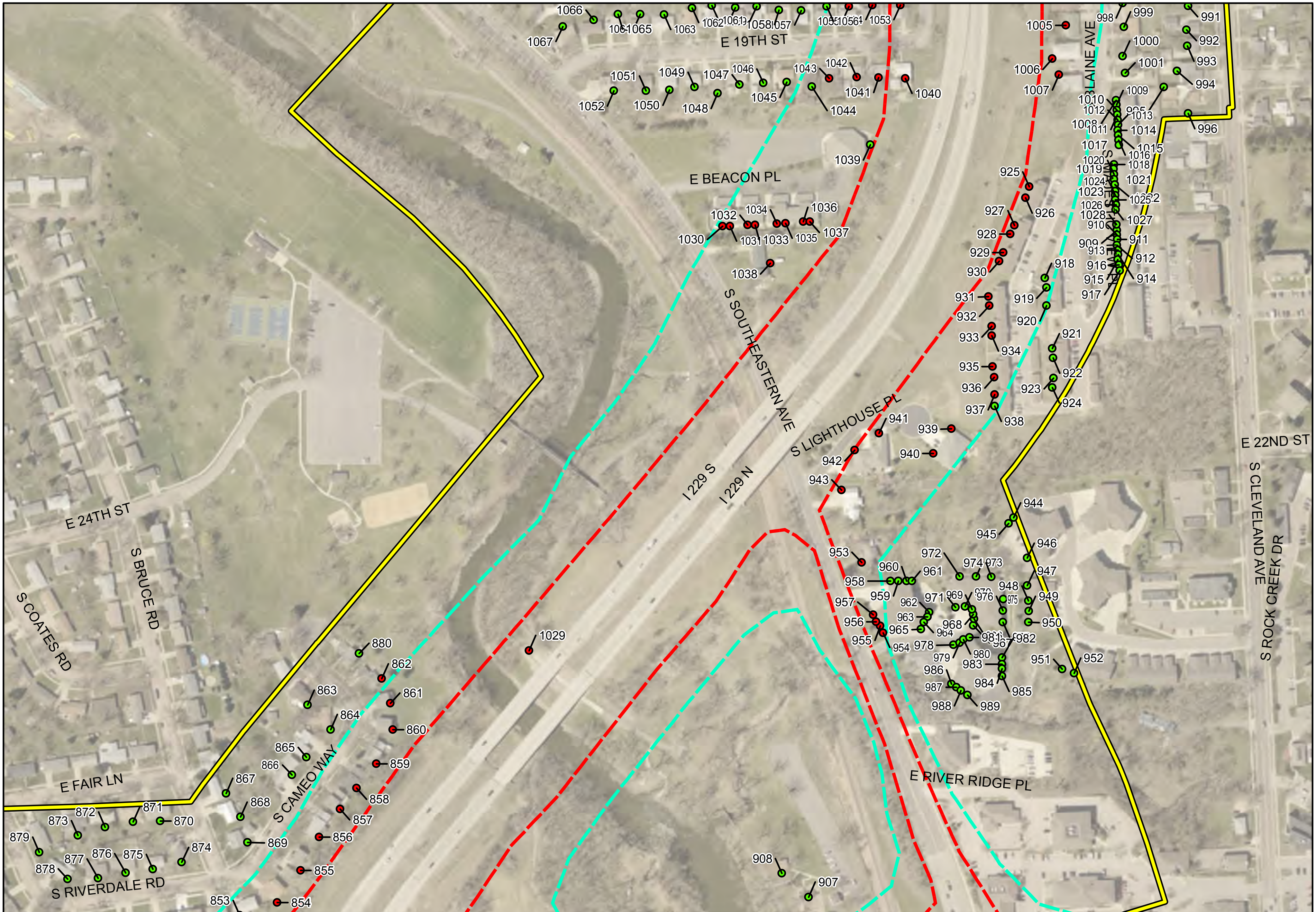

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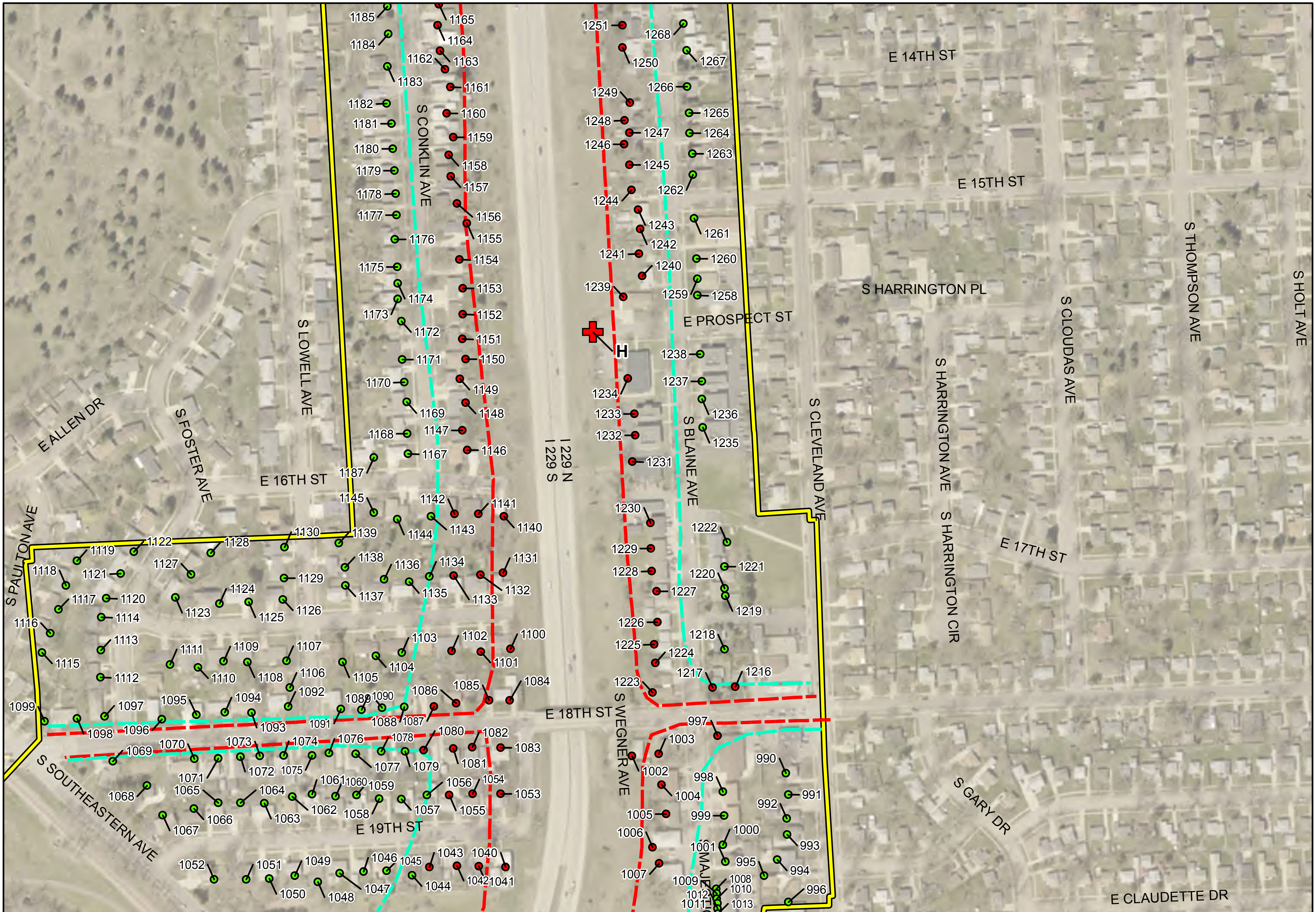

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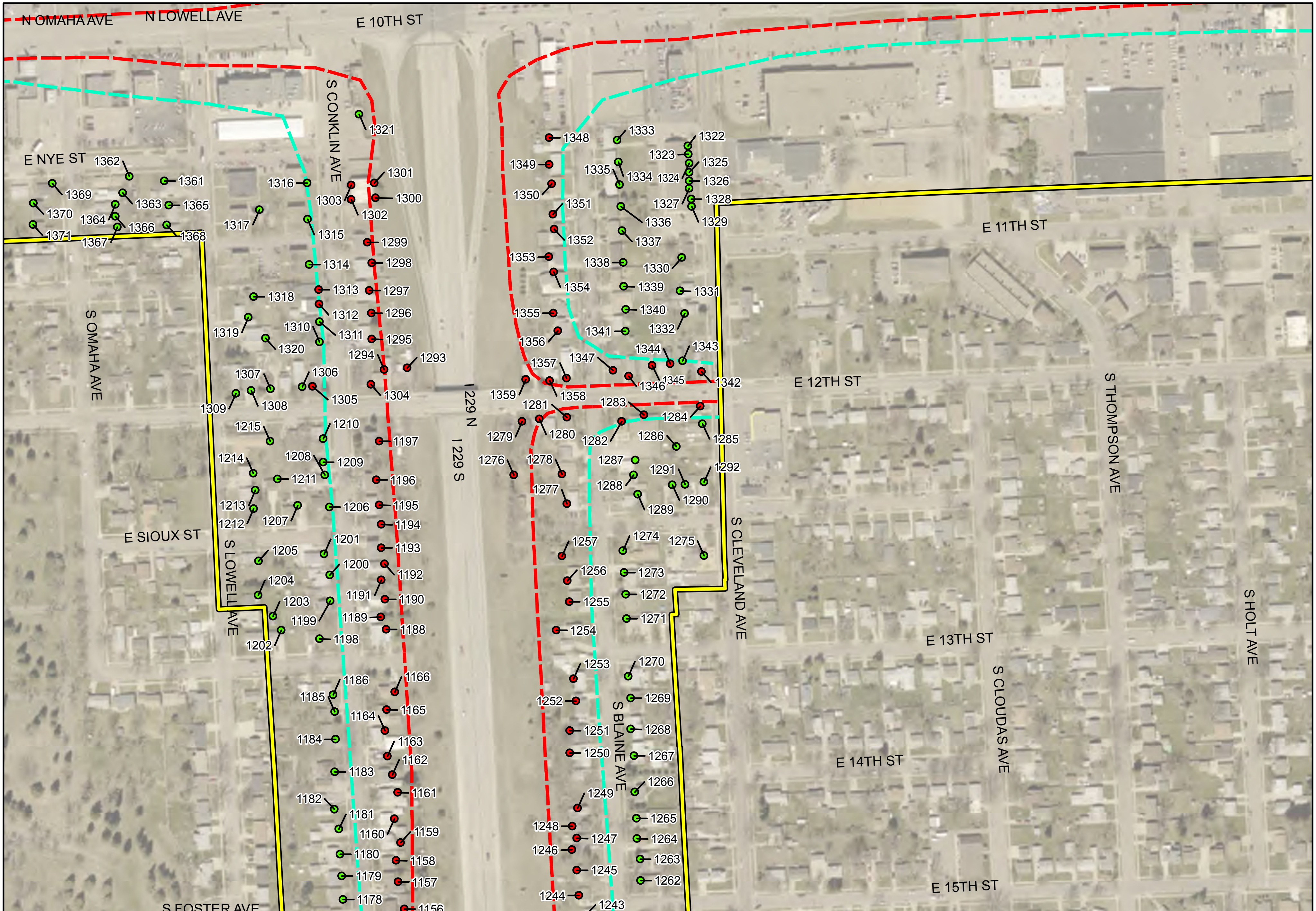

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I-229 Major Investment Corridor Study
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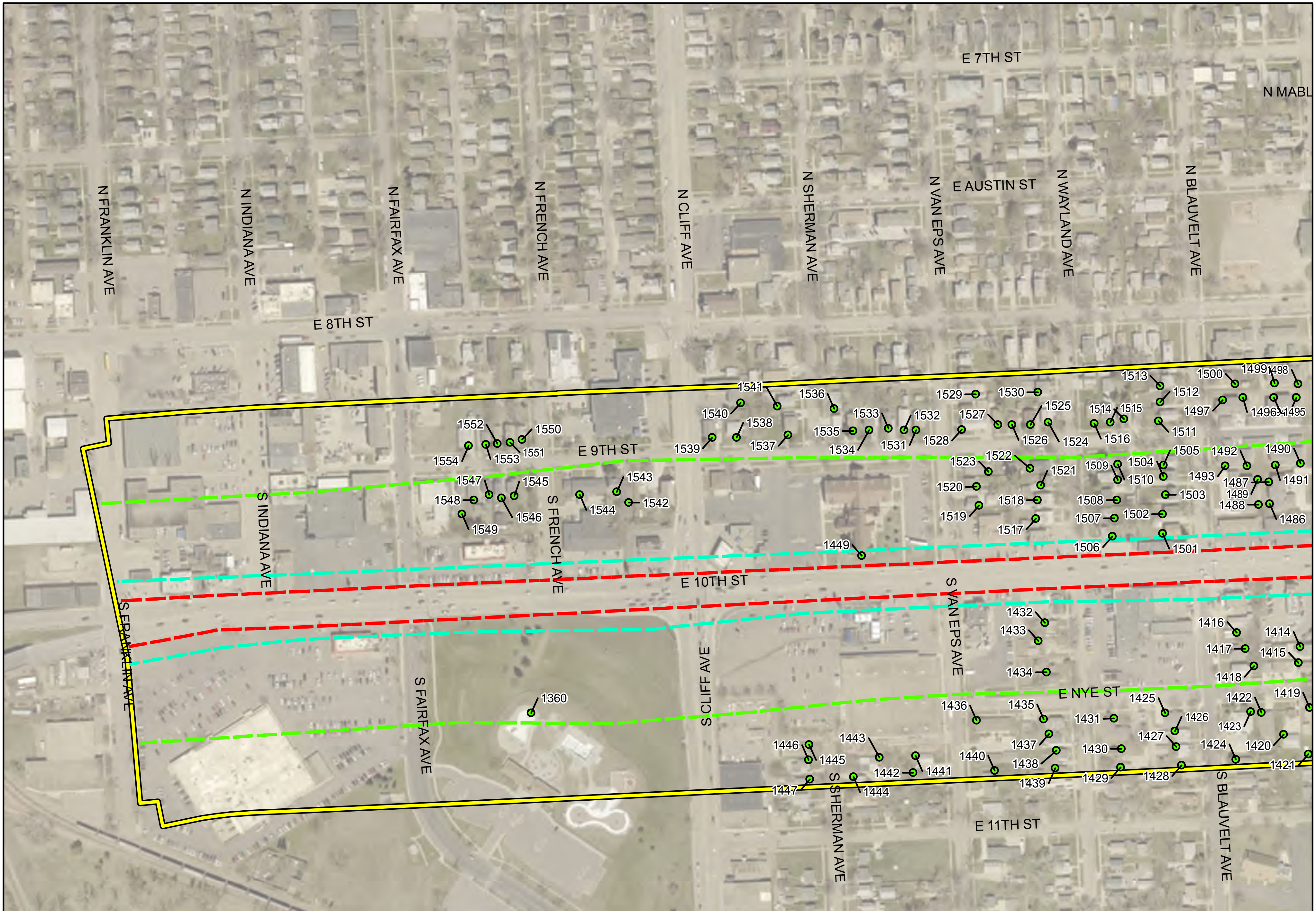

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I-229 Major Investment Corridor Study
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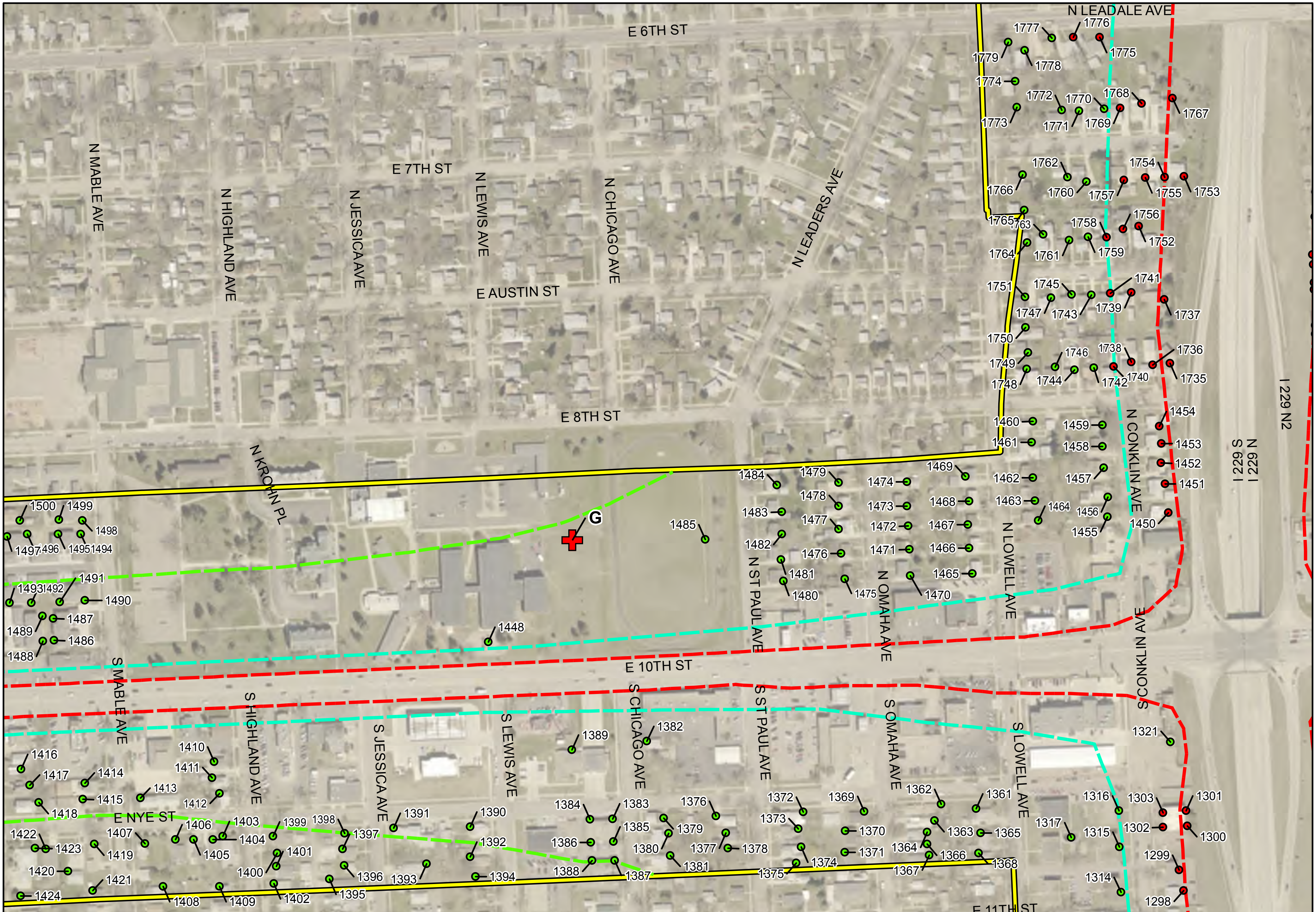

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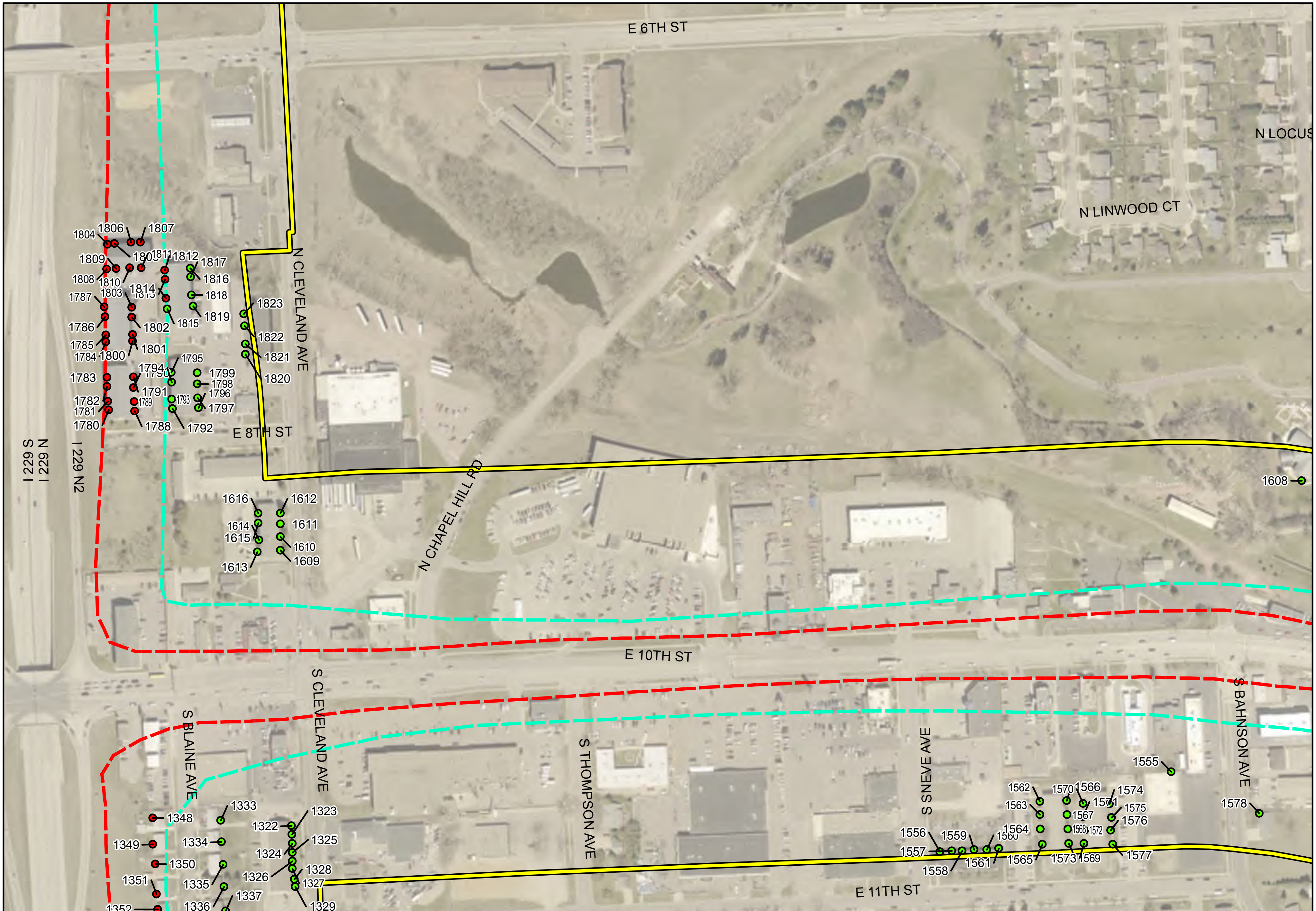

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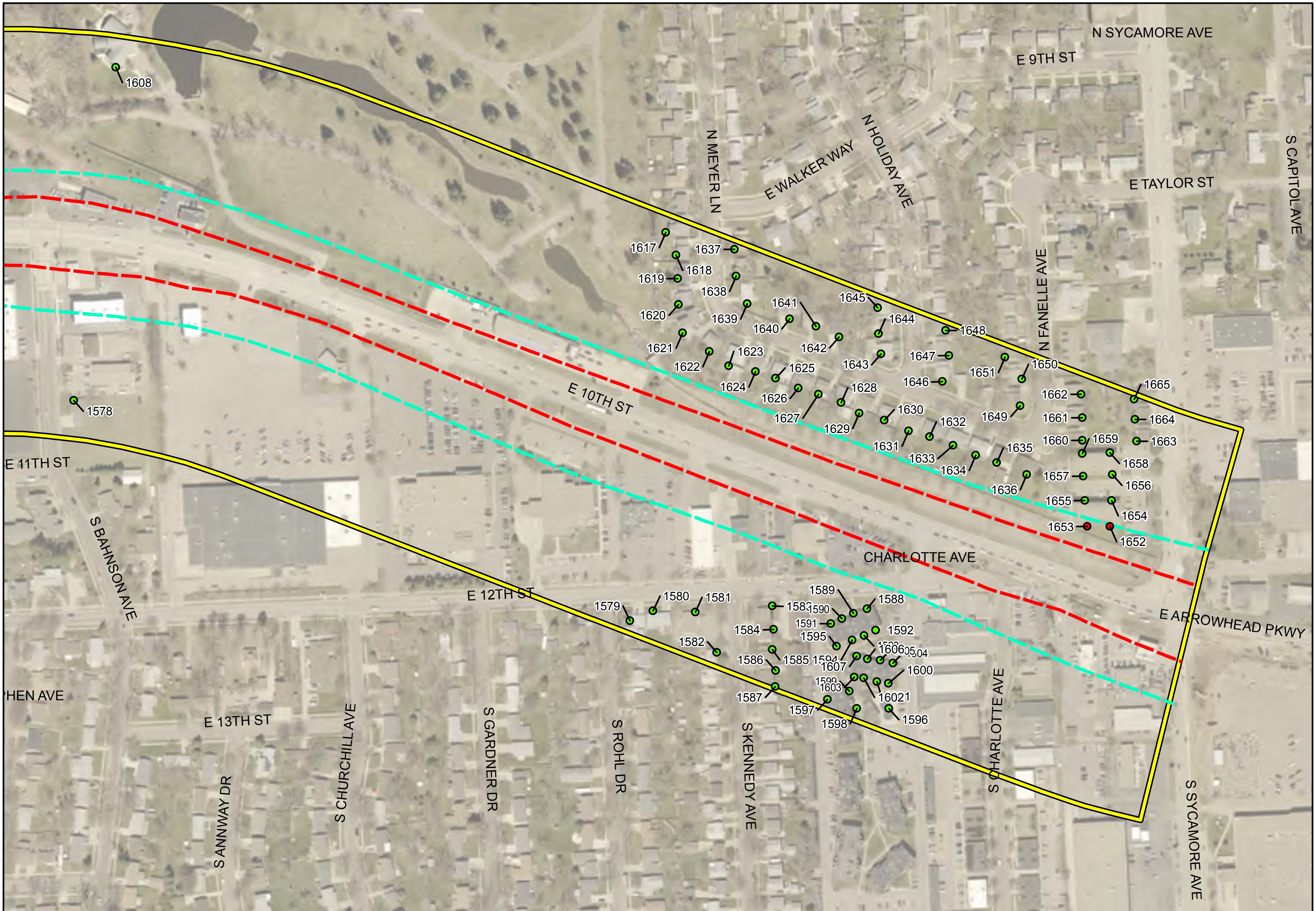

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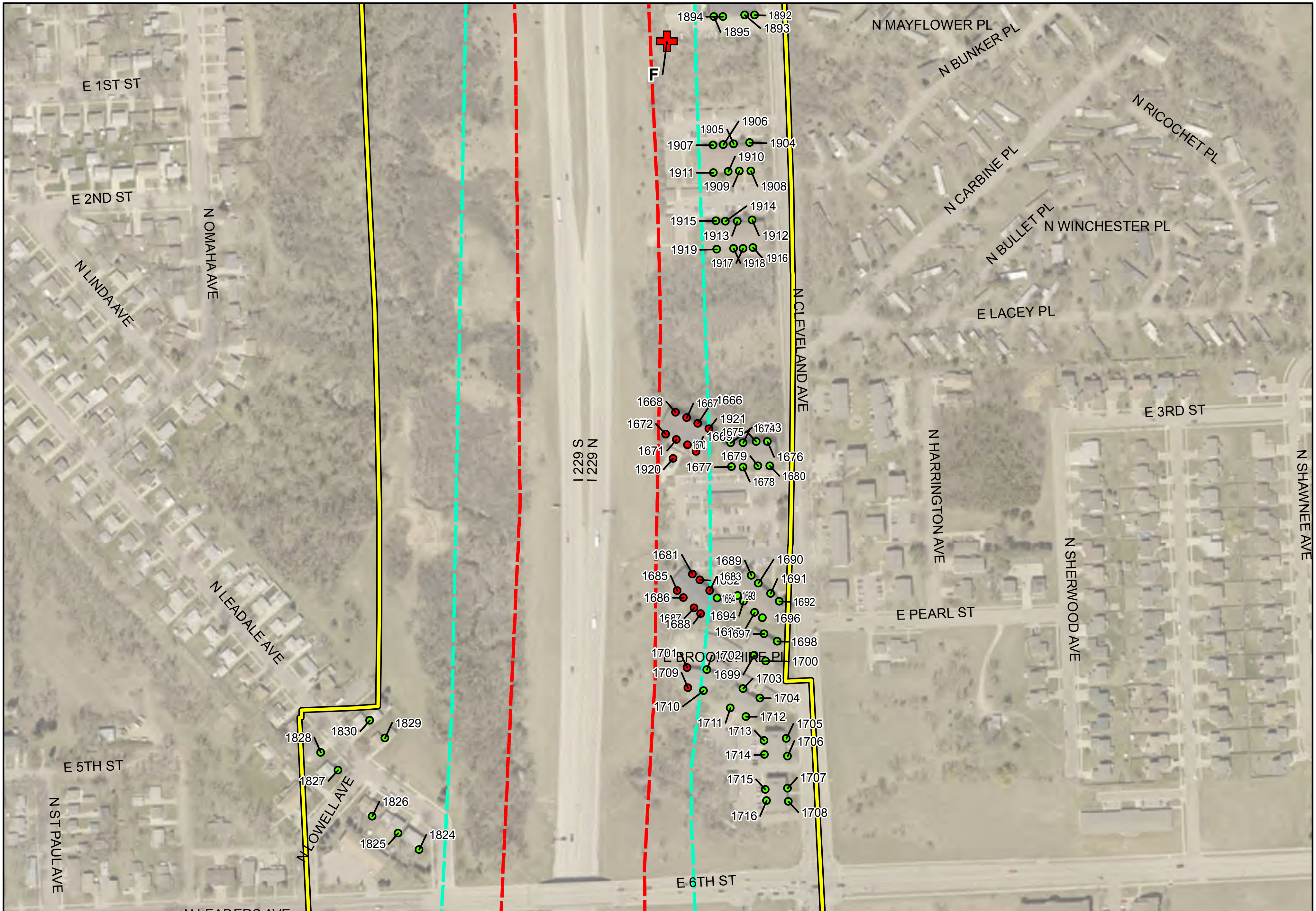

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I-229 Major Investment Corridor Study

Sub-Study #1

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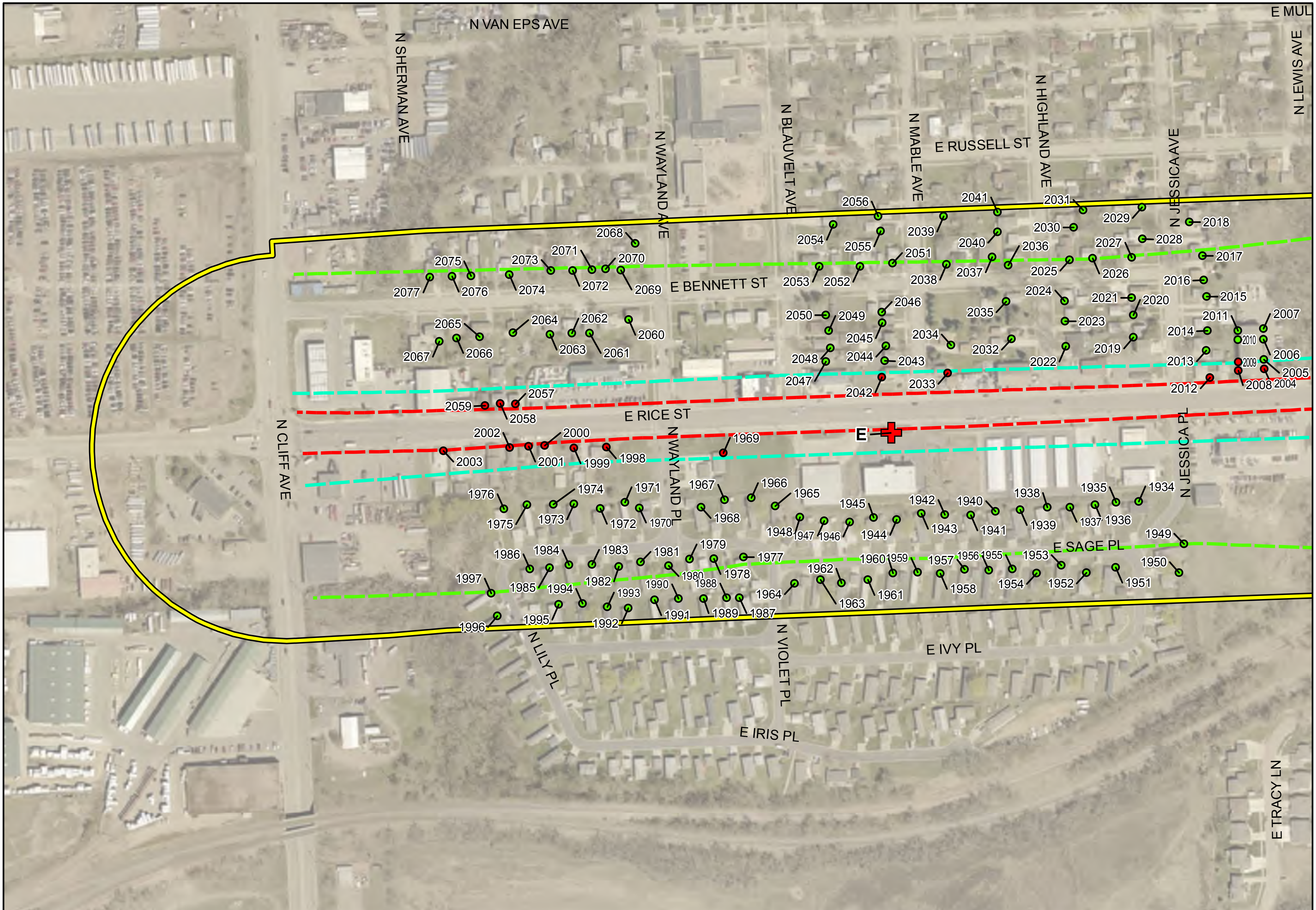

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I-229 Major Investment Corridor Study

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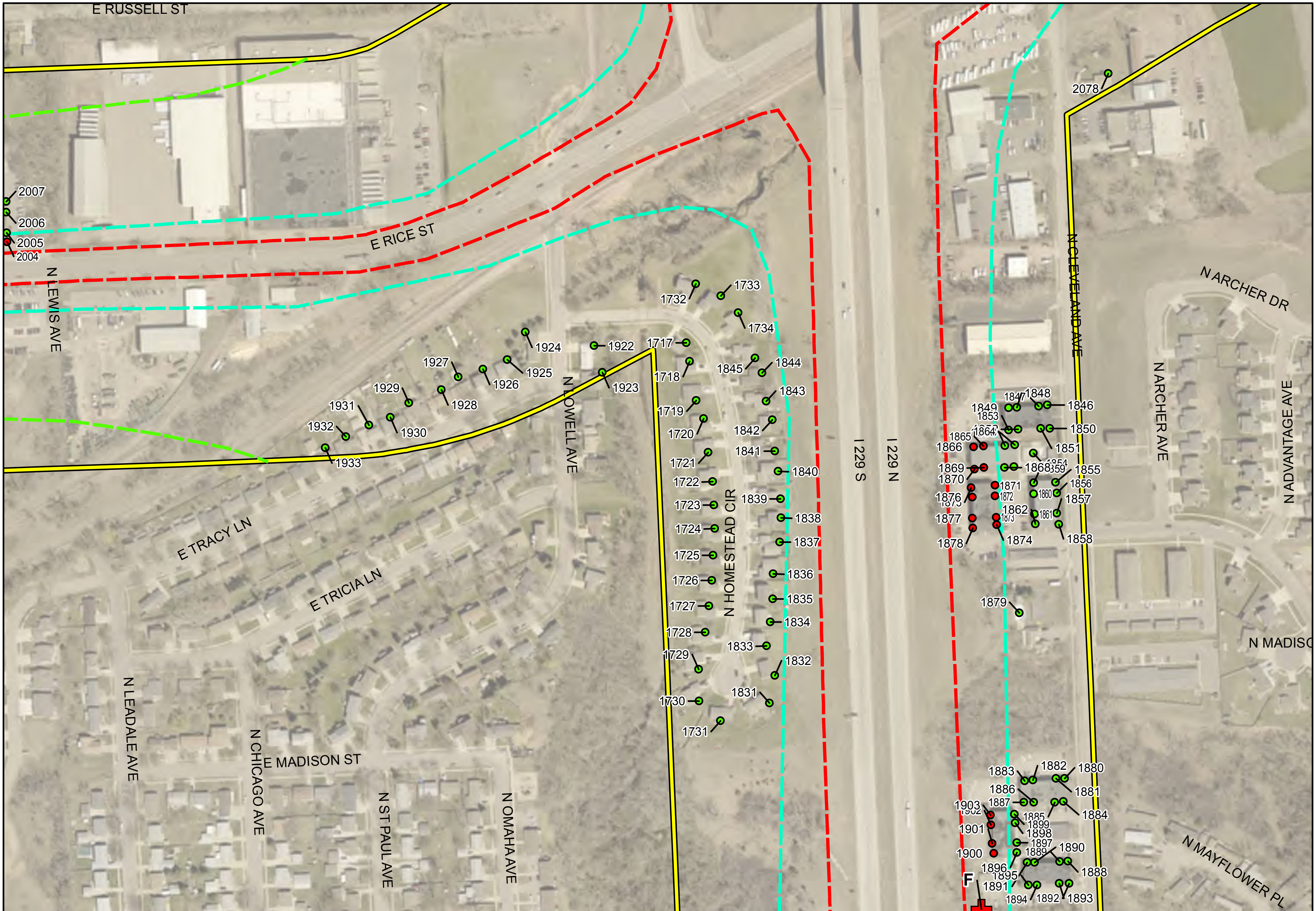

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I-229 Major Investment Corridor Study
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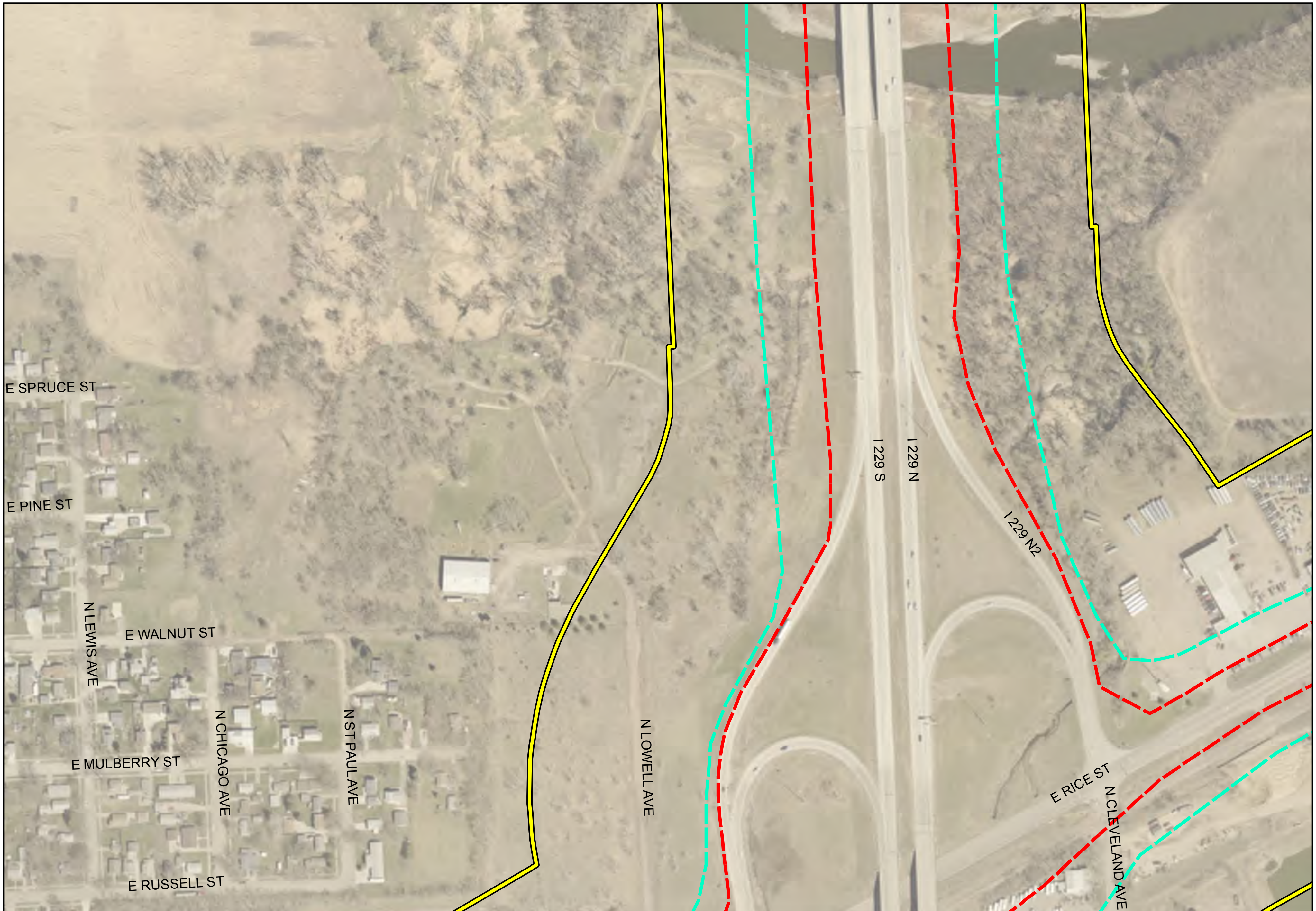

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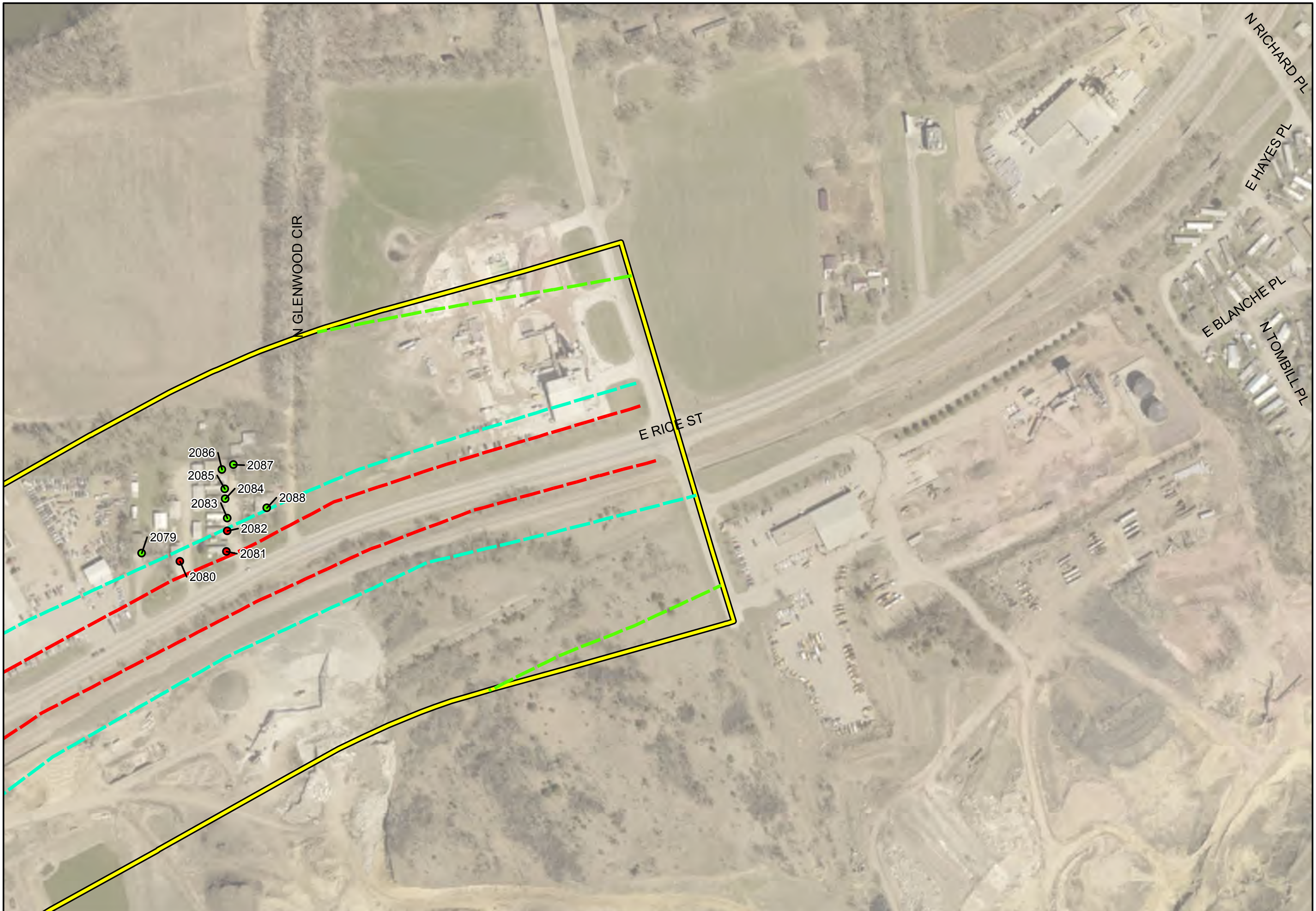

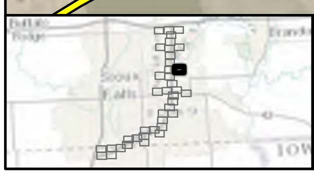

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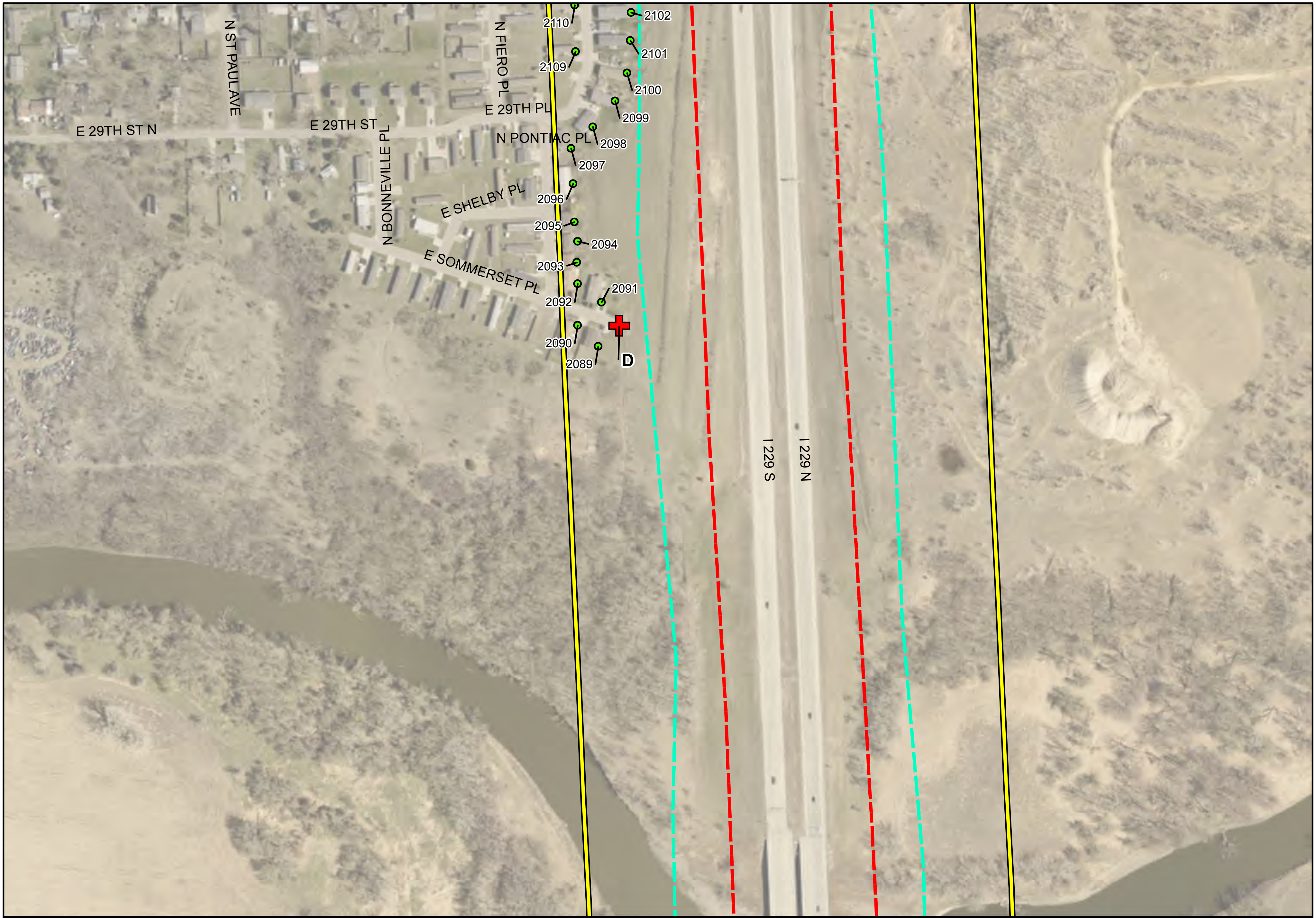

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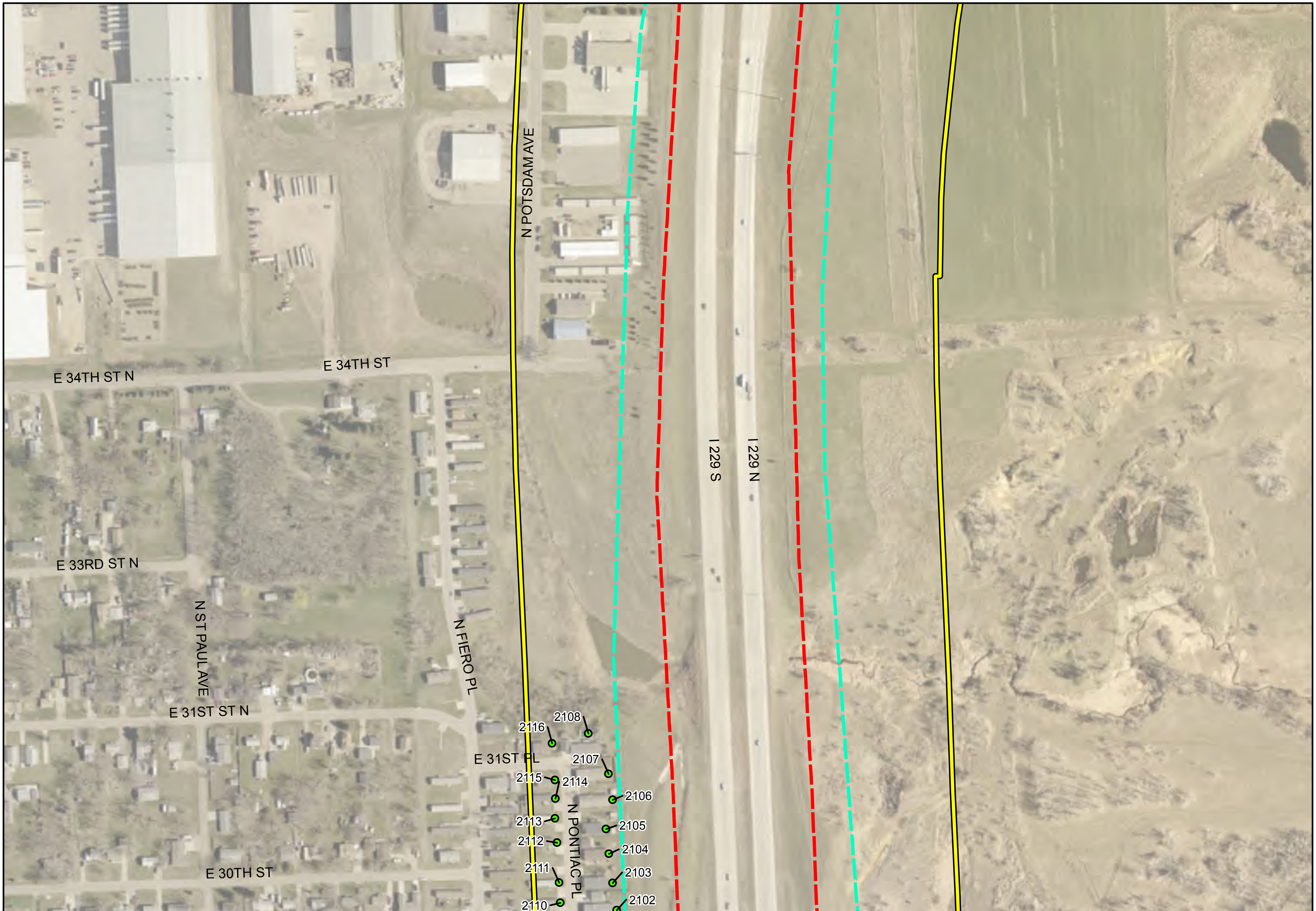

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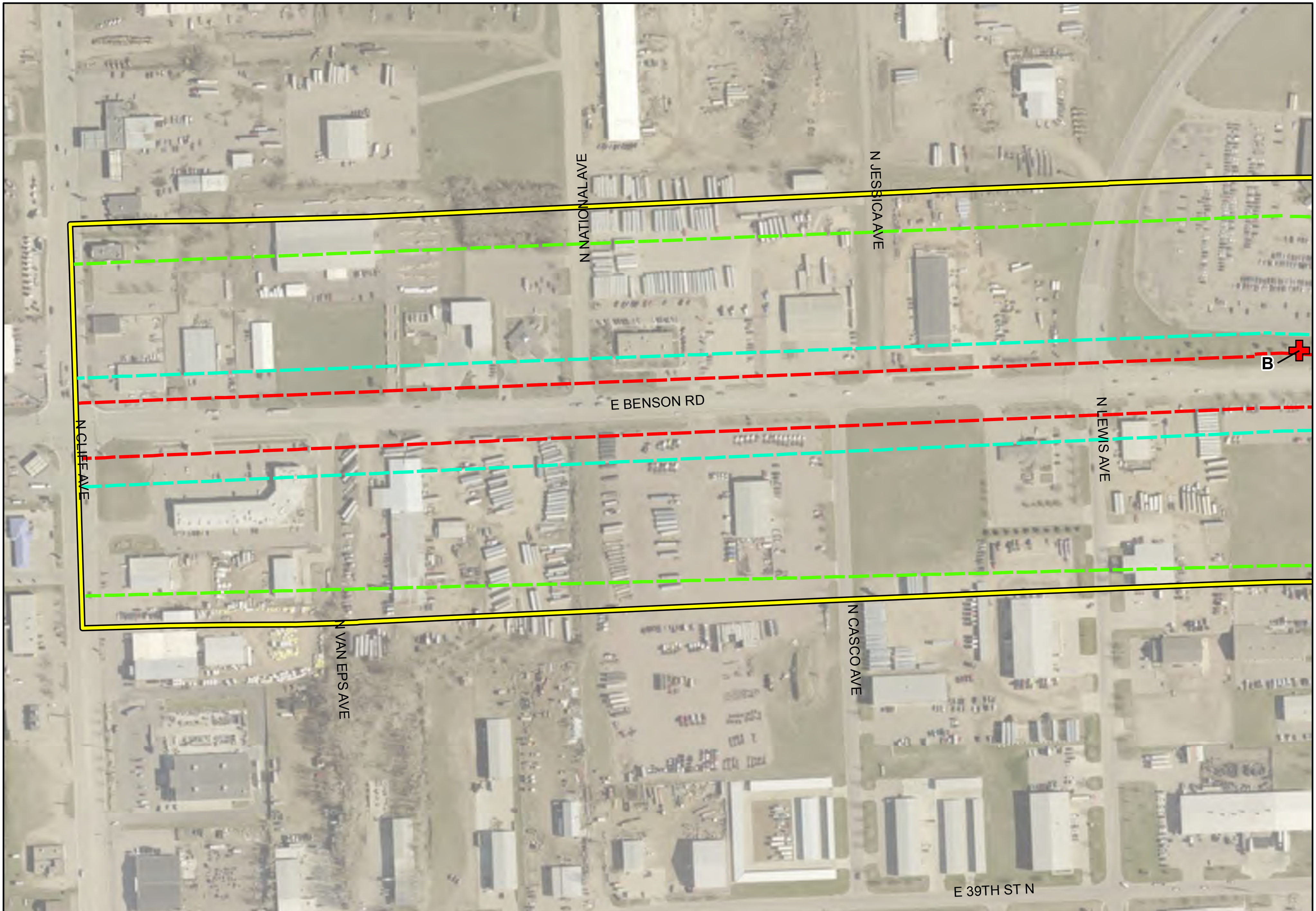

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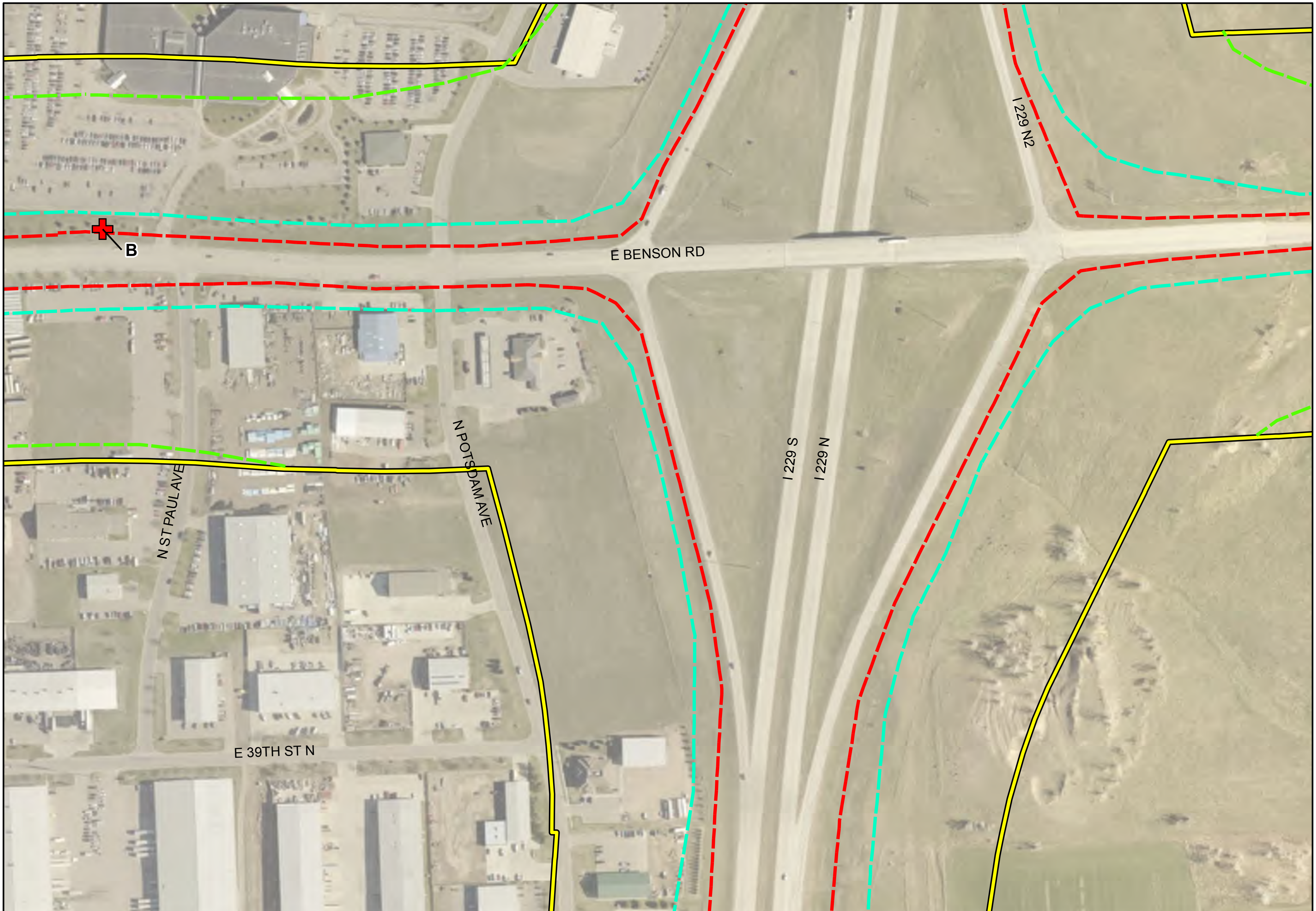

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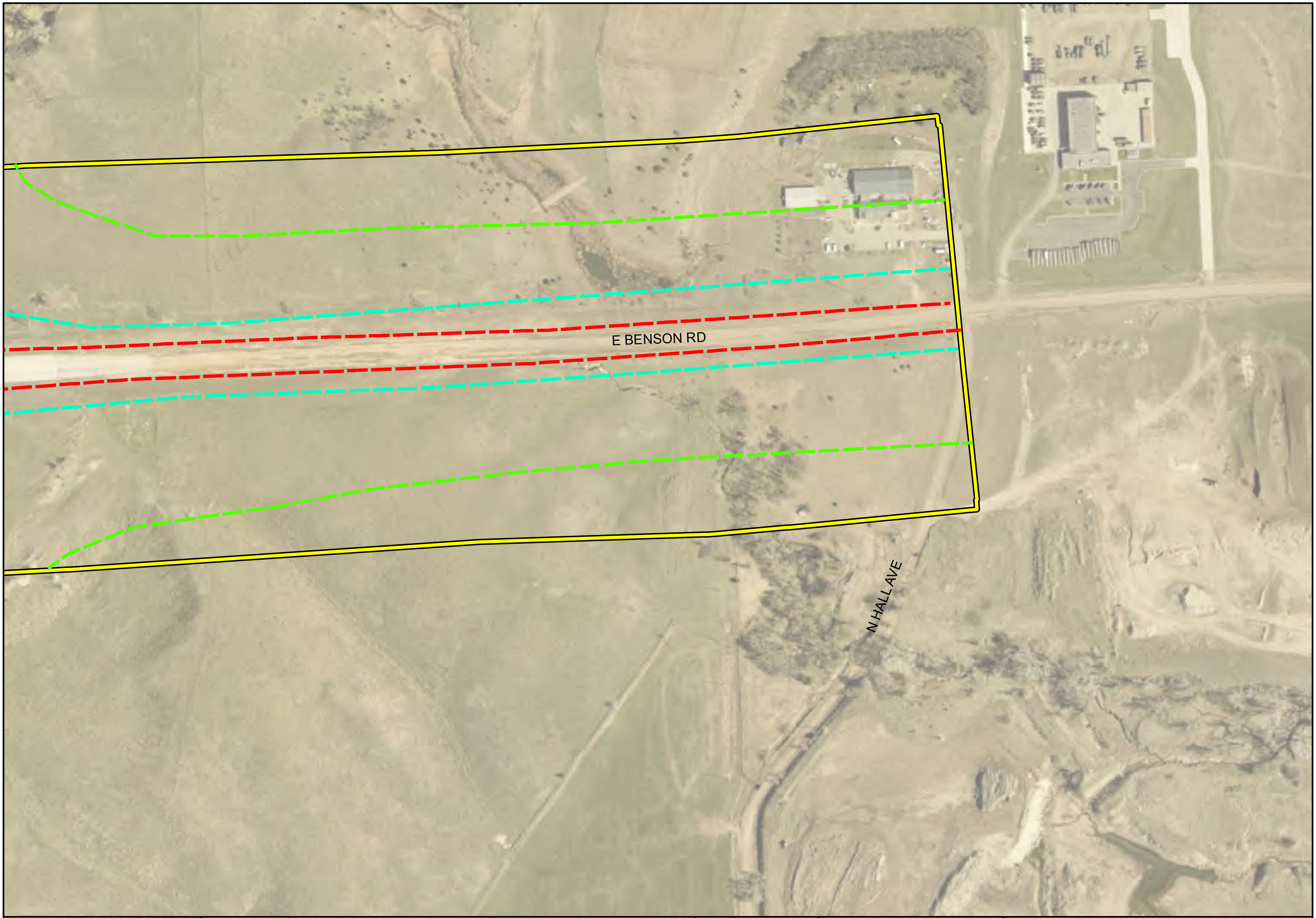

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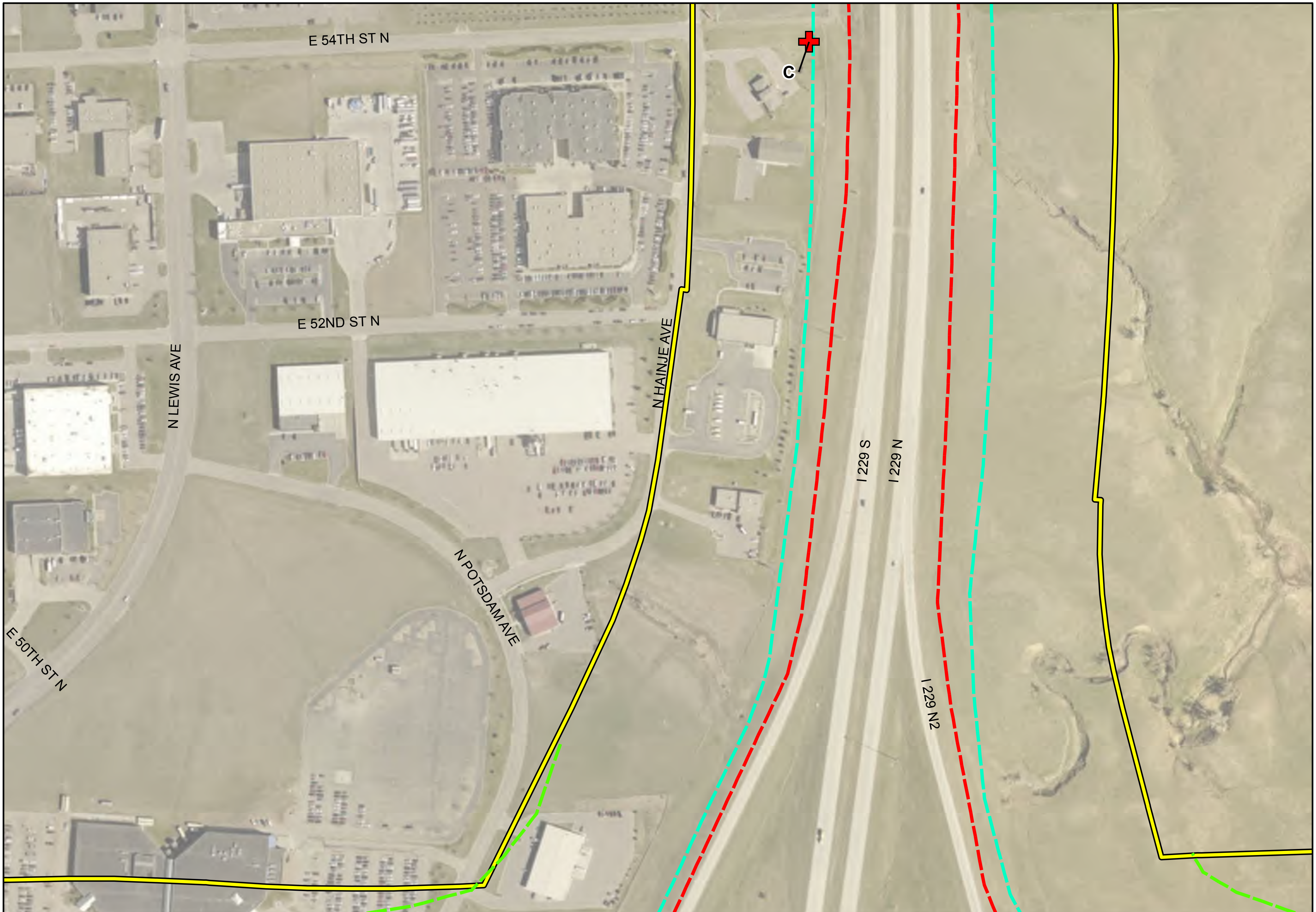

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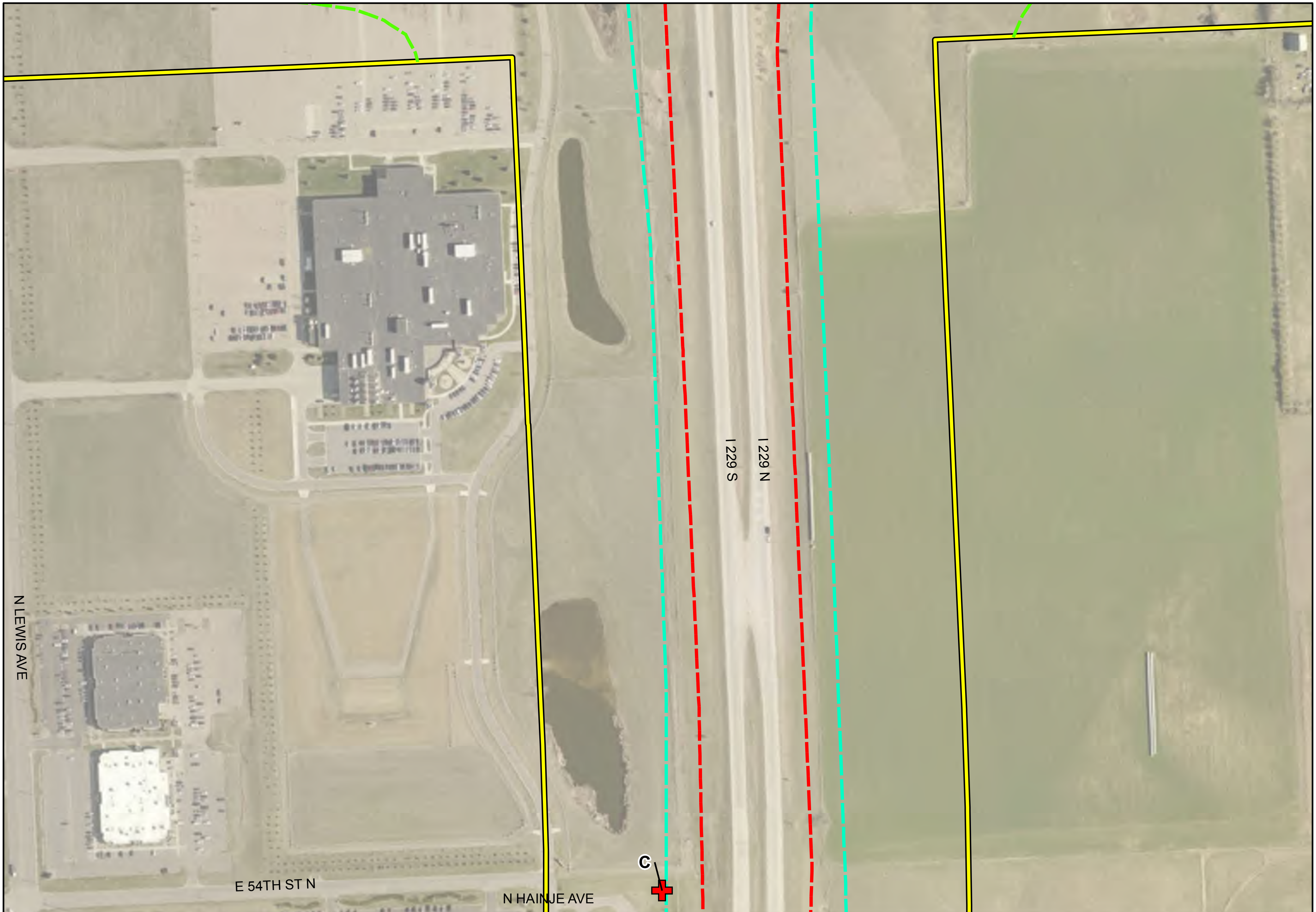
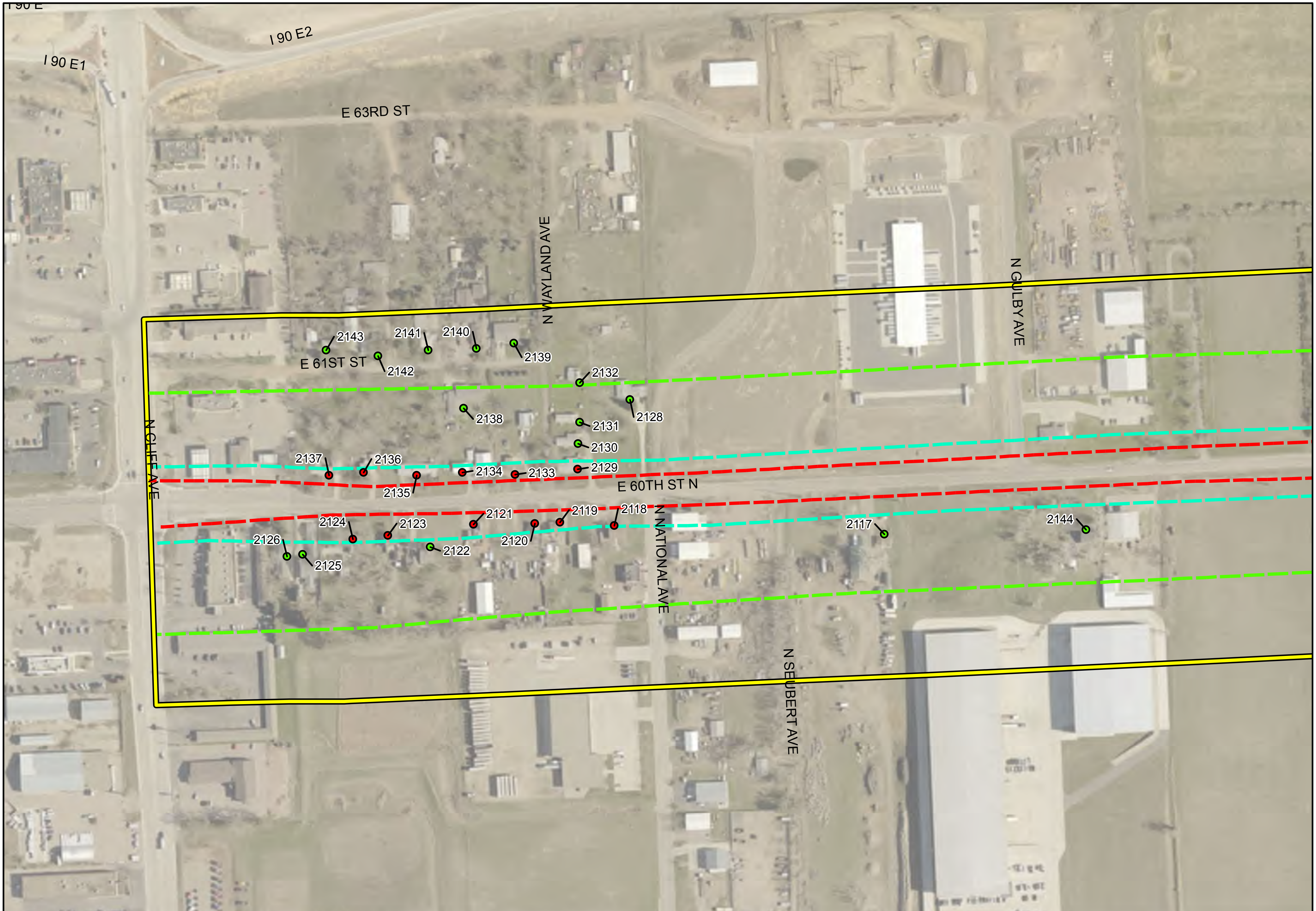


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 1 Concept Linework Cliff-3

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-3



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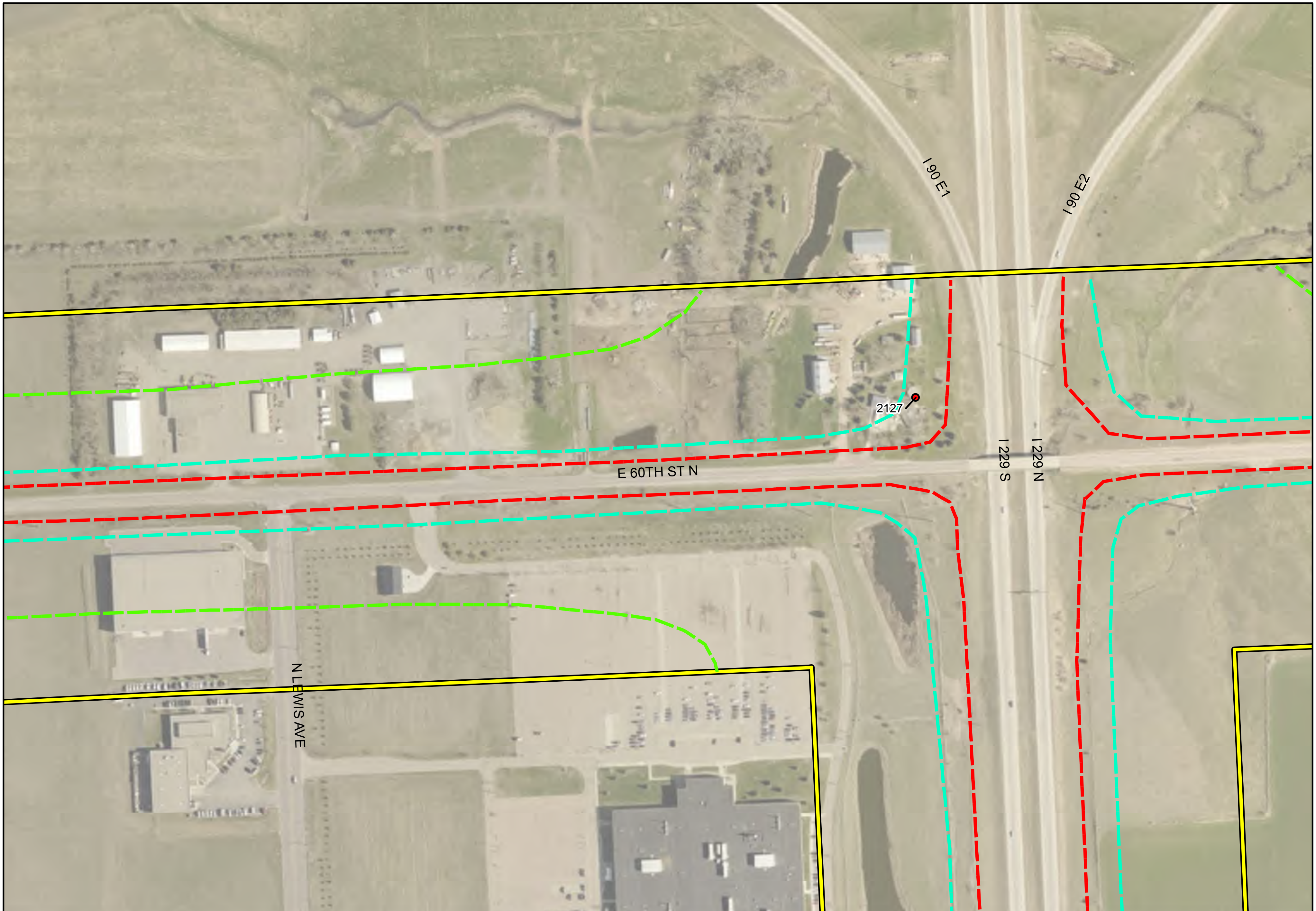
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-3



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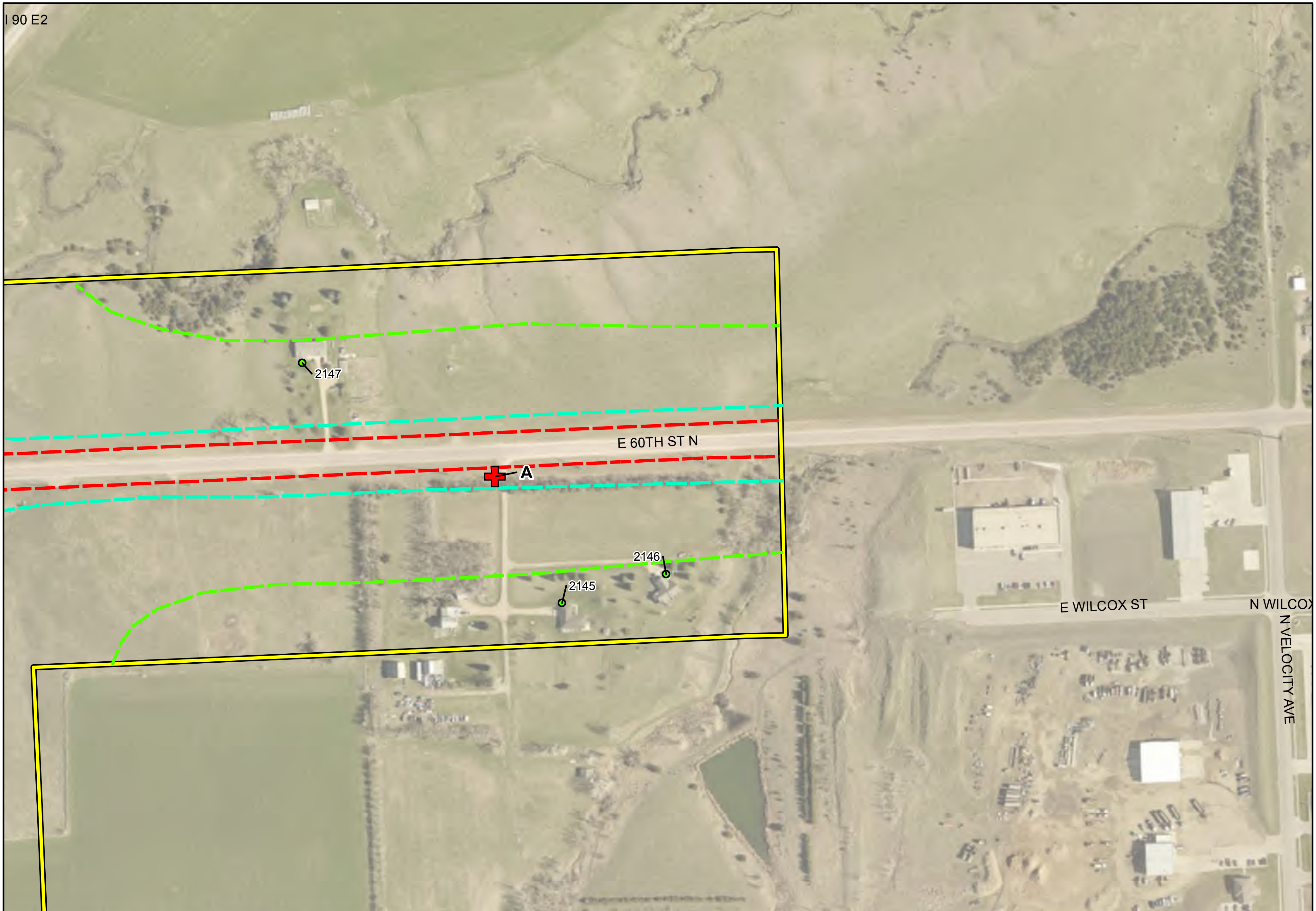
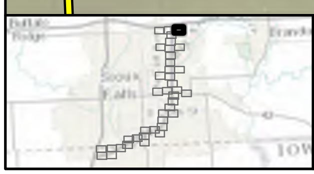
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-3





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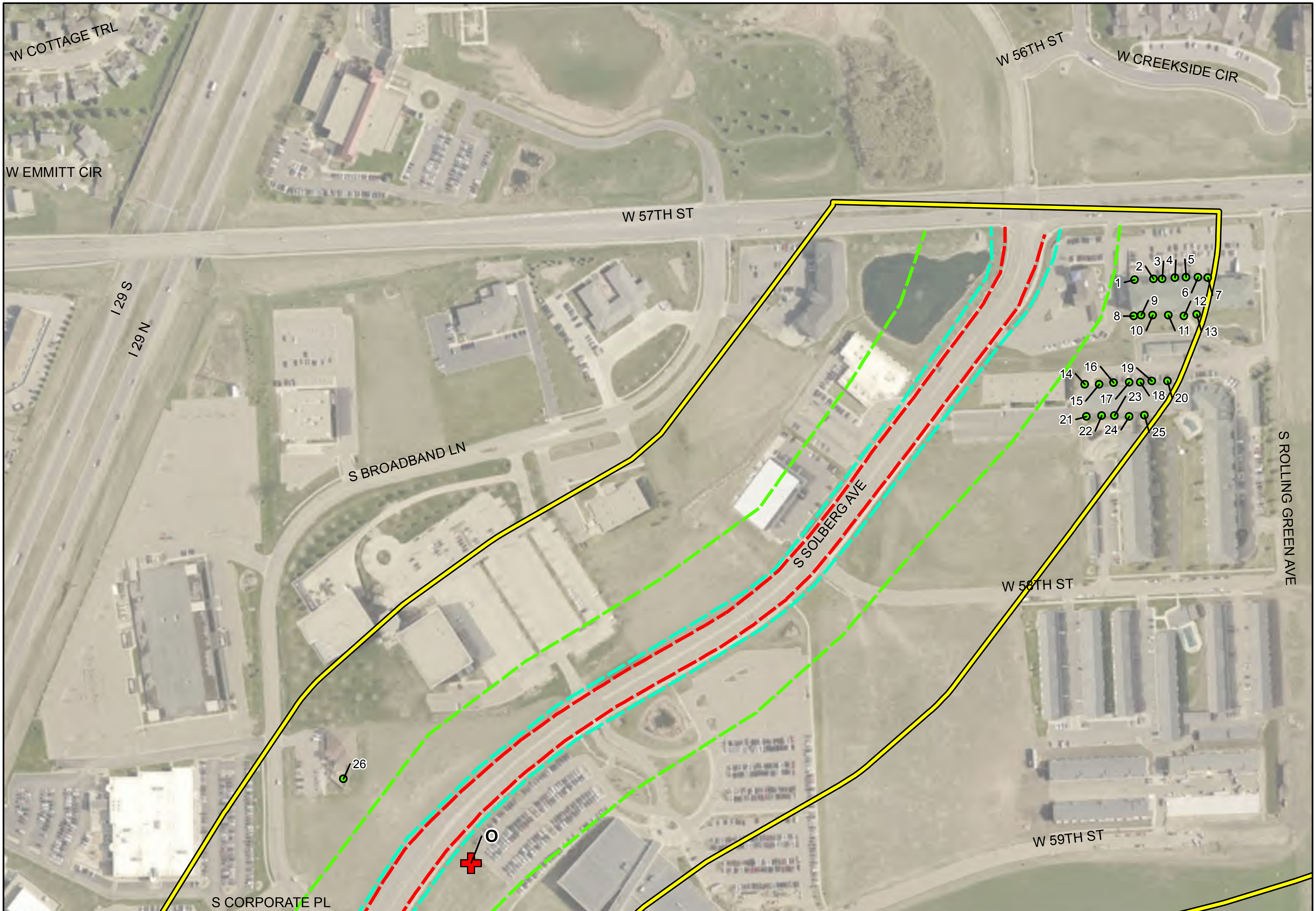
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Cliff-3



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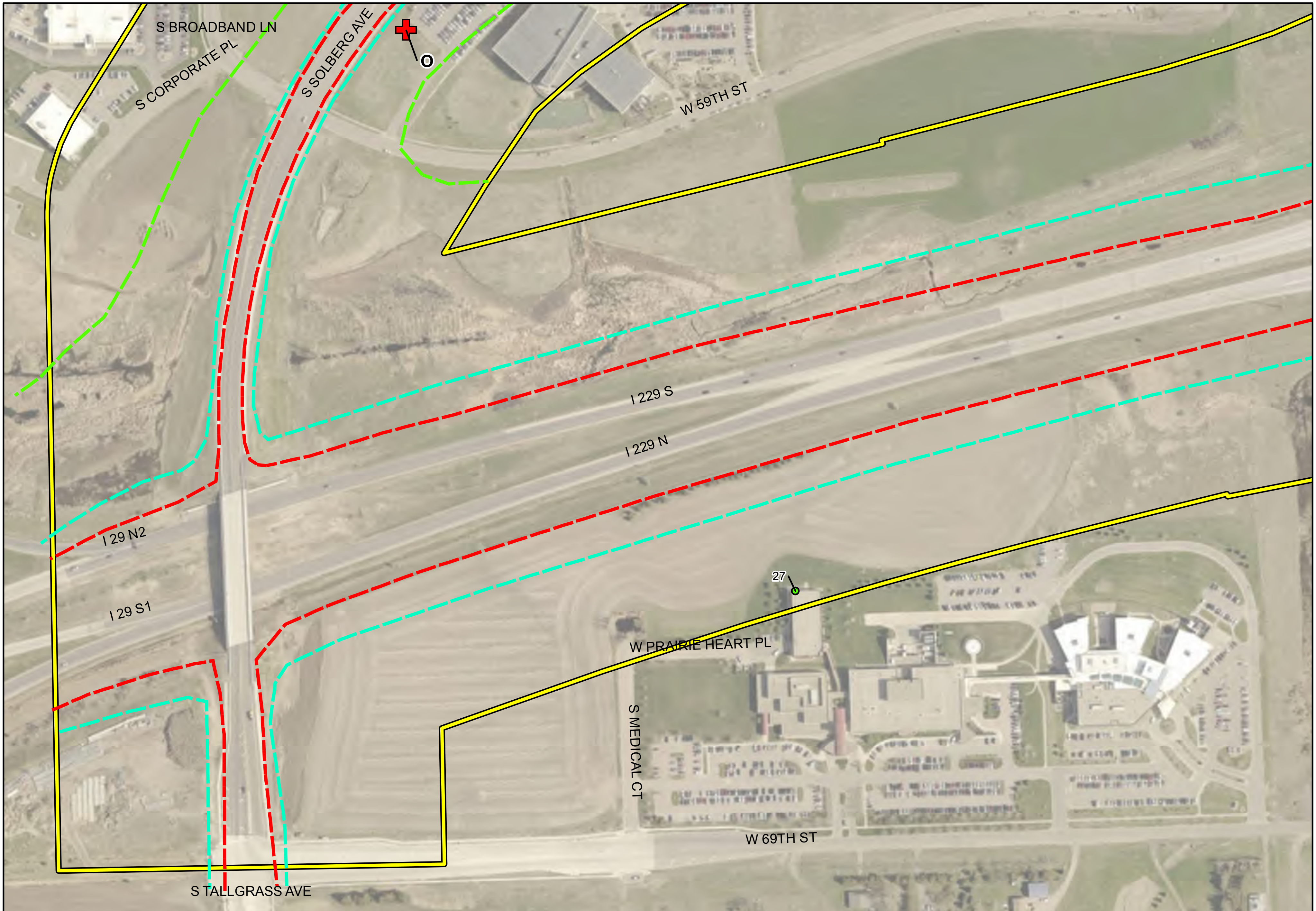
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Rice-1



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I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
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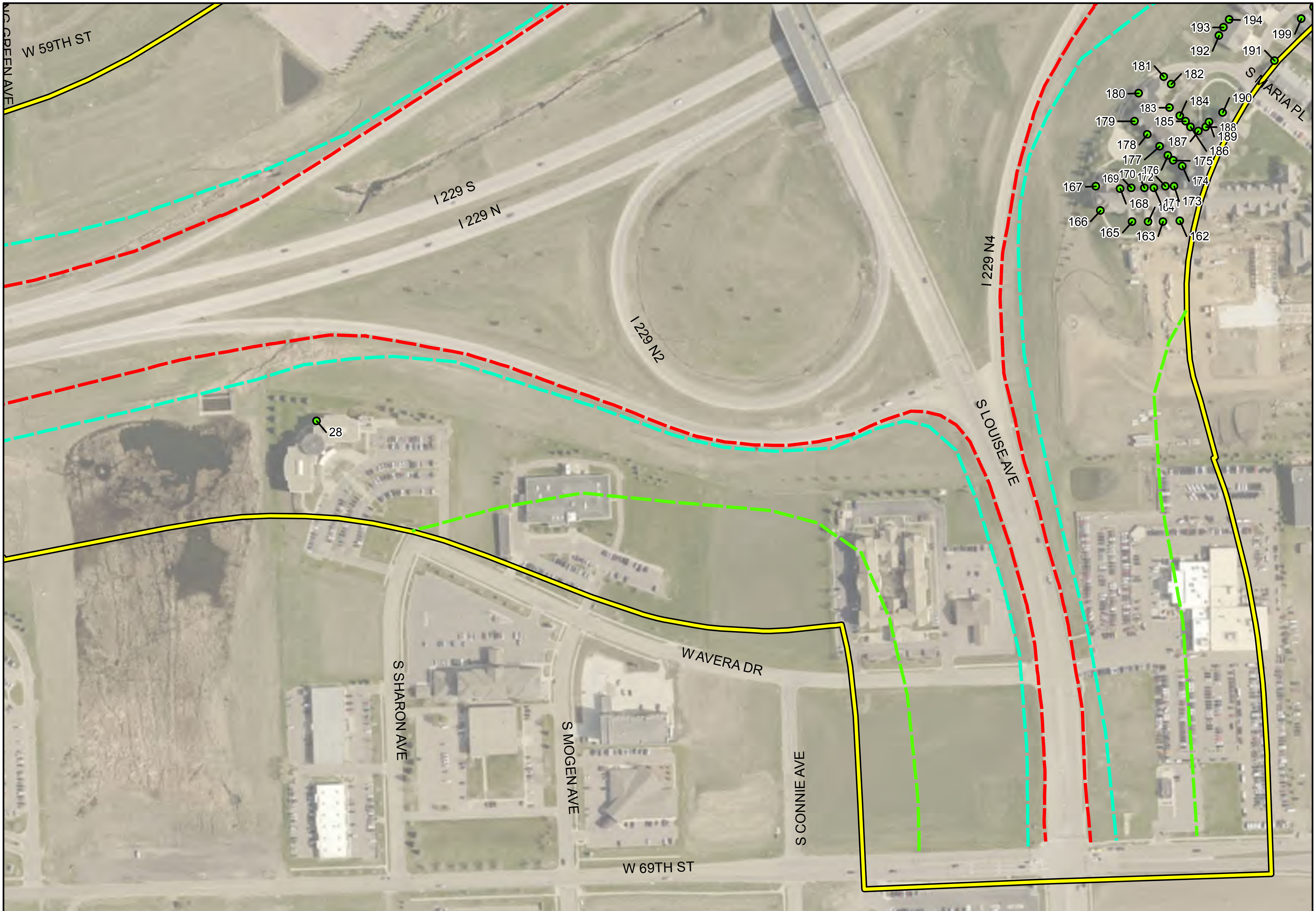

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I-229 Major Investment Corridor Study
Sub-Study #1
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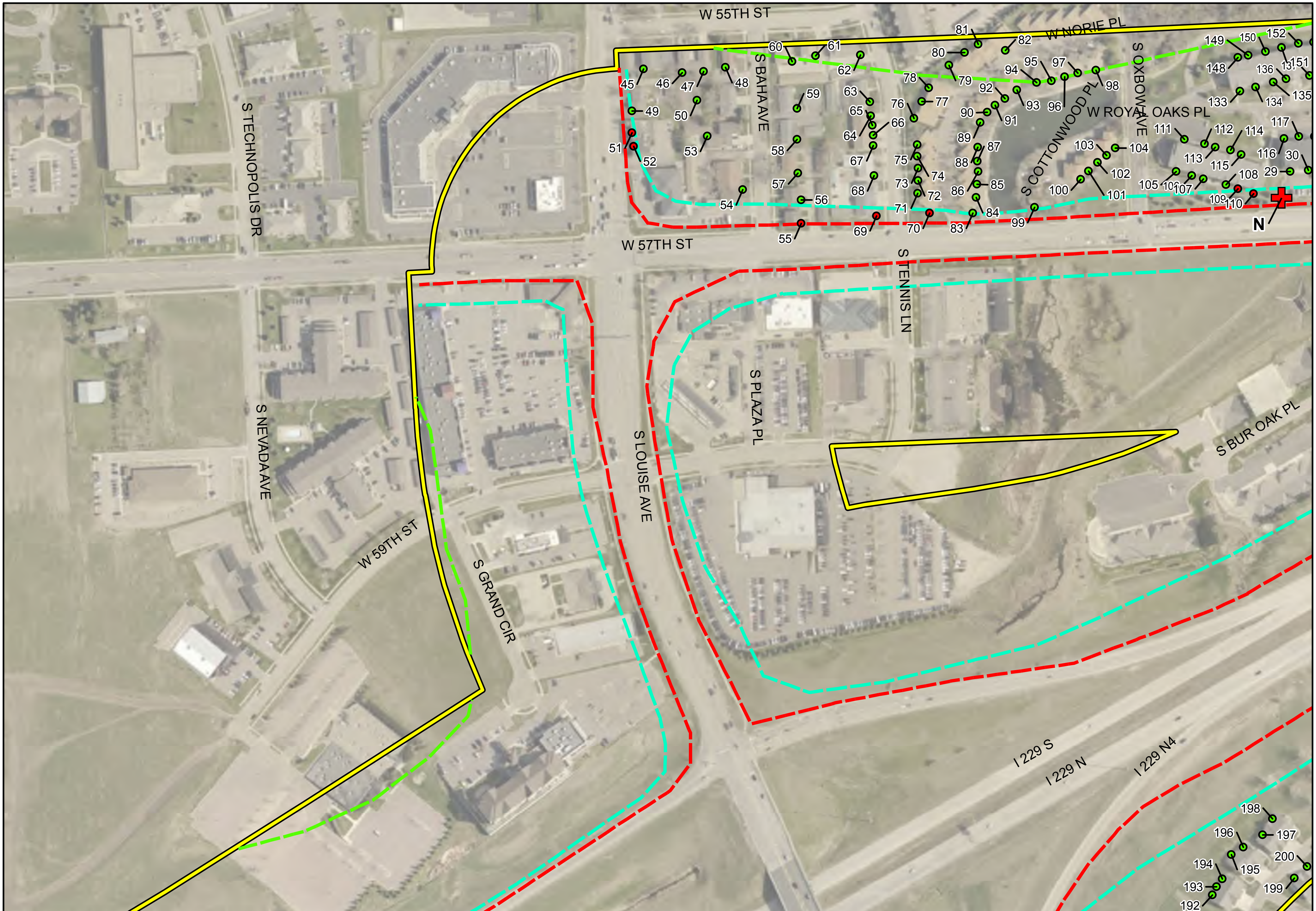
Proposed Alternative Rice-1



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I-229 Major Investment Corridor Study
Sub-Study #1
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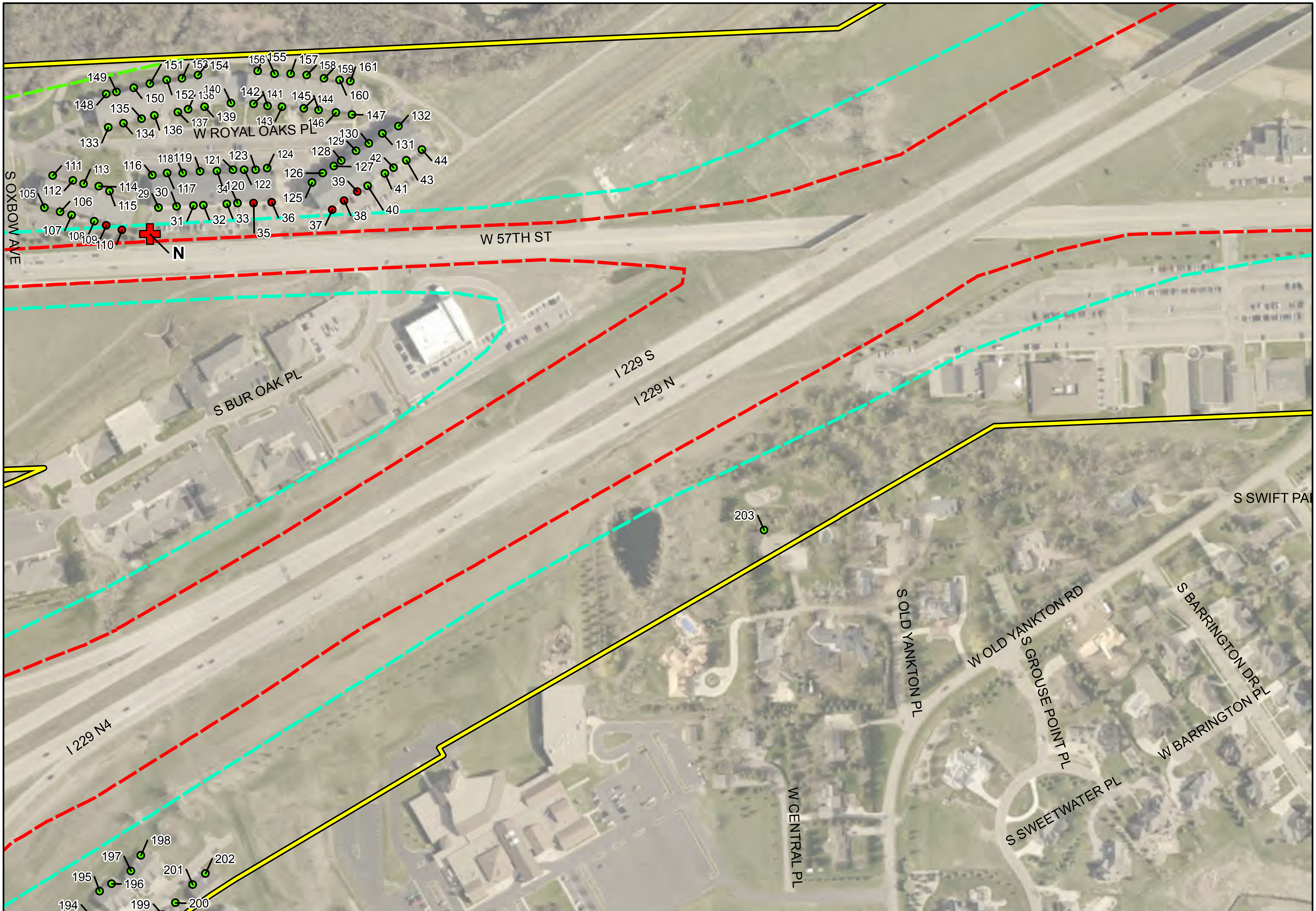

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I-229 Major Investment Corridor Study
Sub-Study #1
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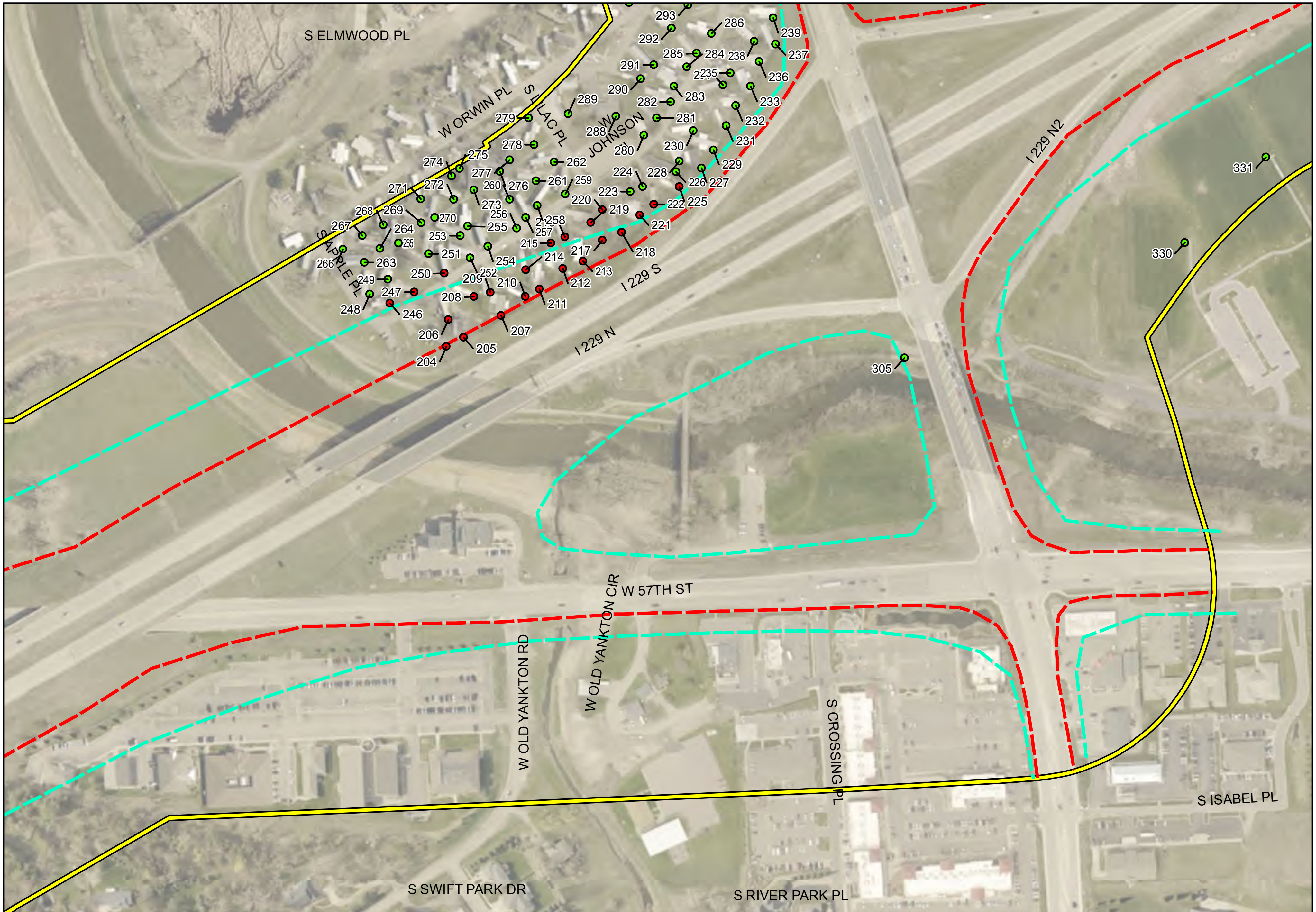

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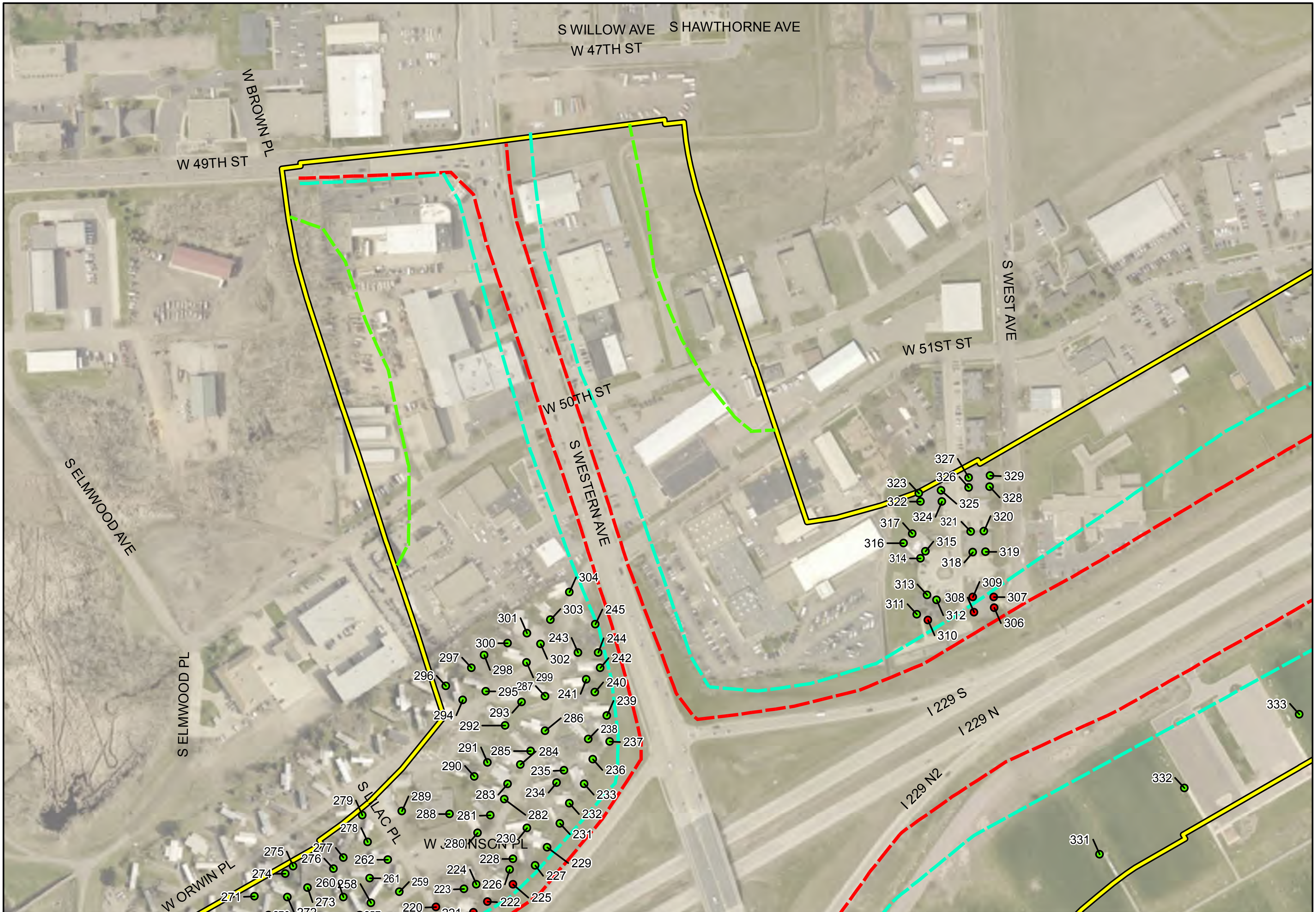

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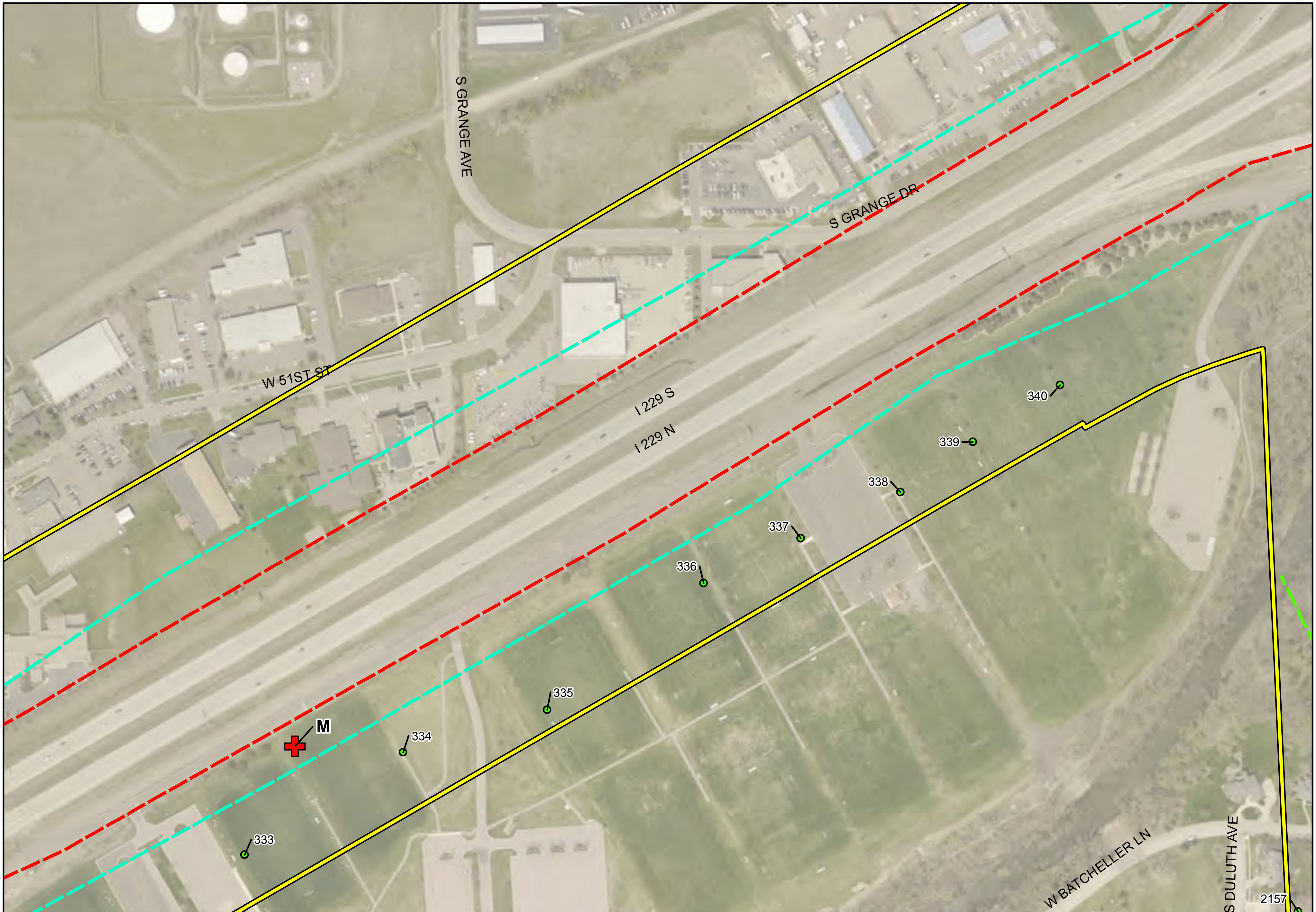

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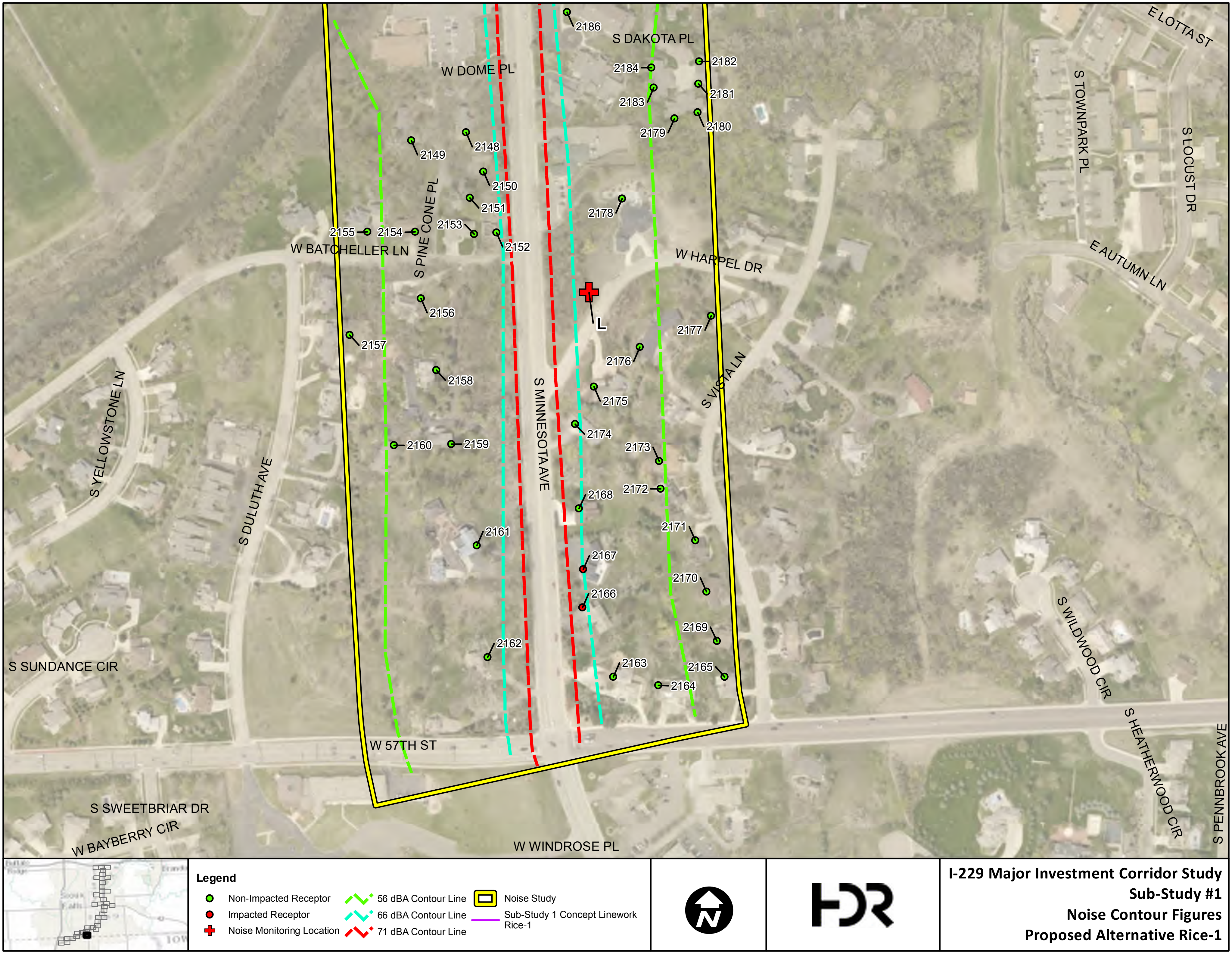
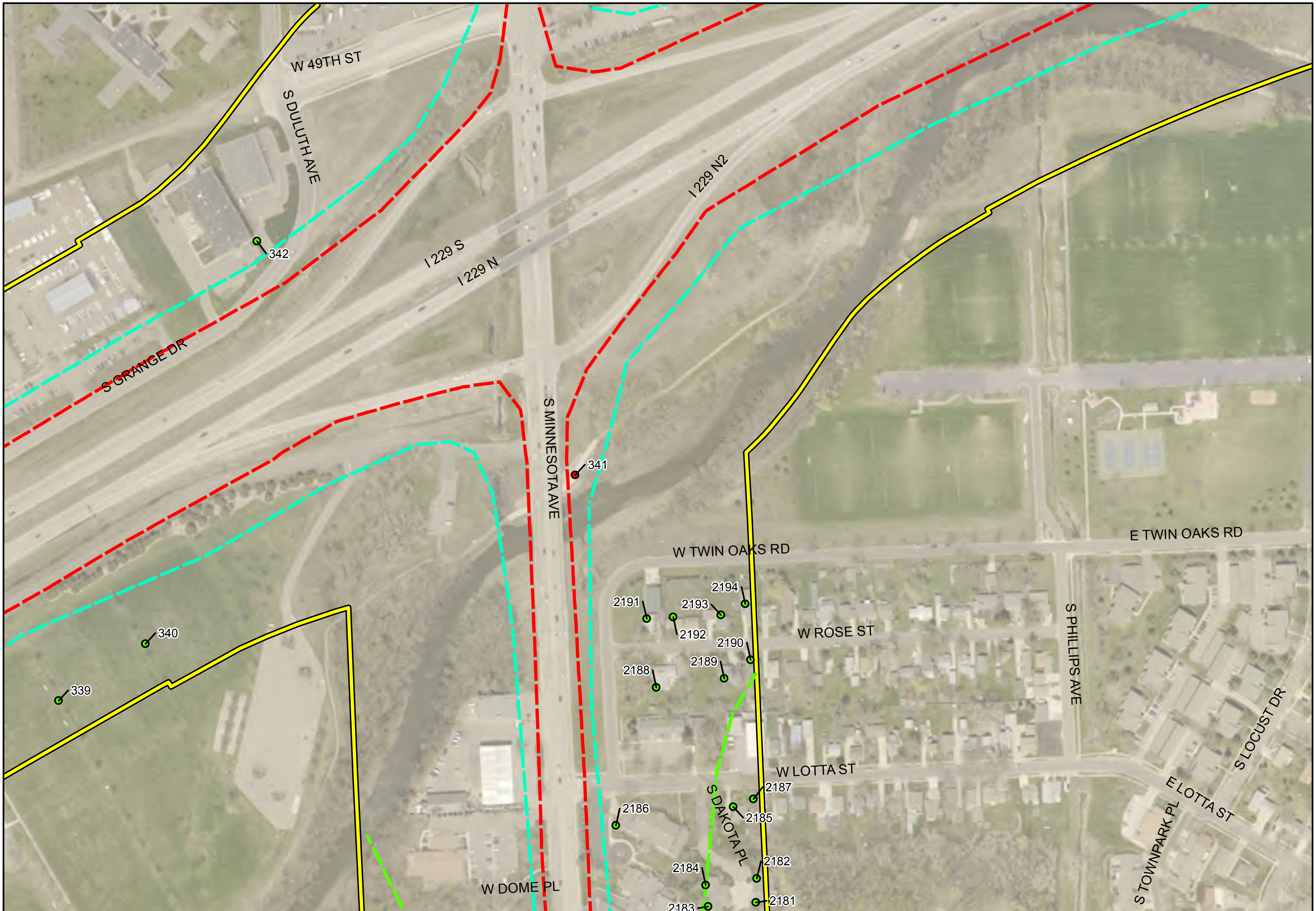


I-229 Major Investment Corridor Study

Sub-Study #1

Noise Contour Figures

Proposed Alternative Rice-1



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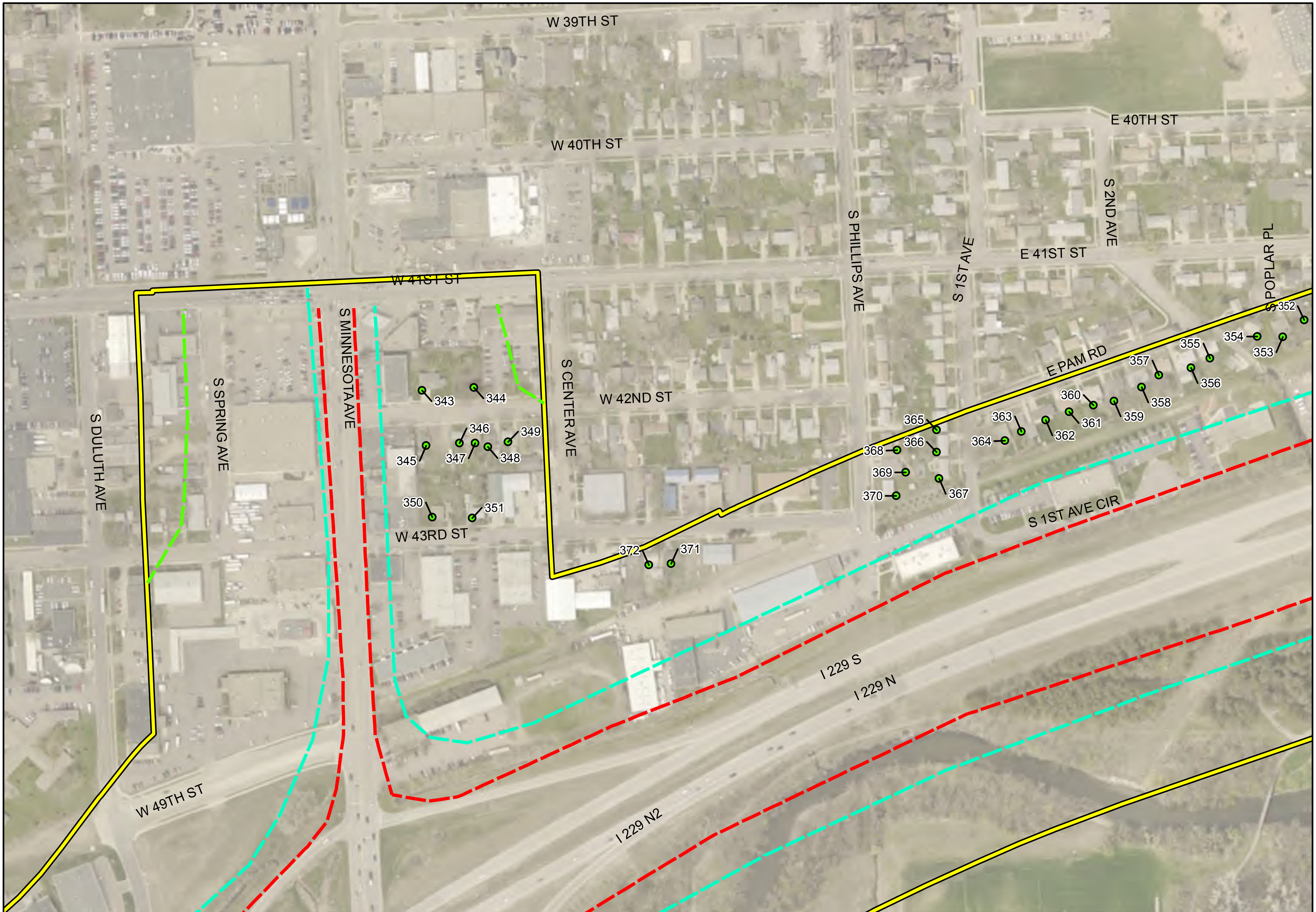

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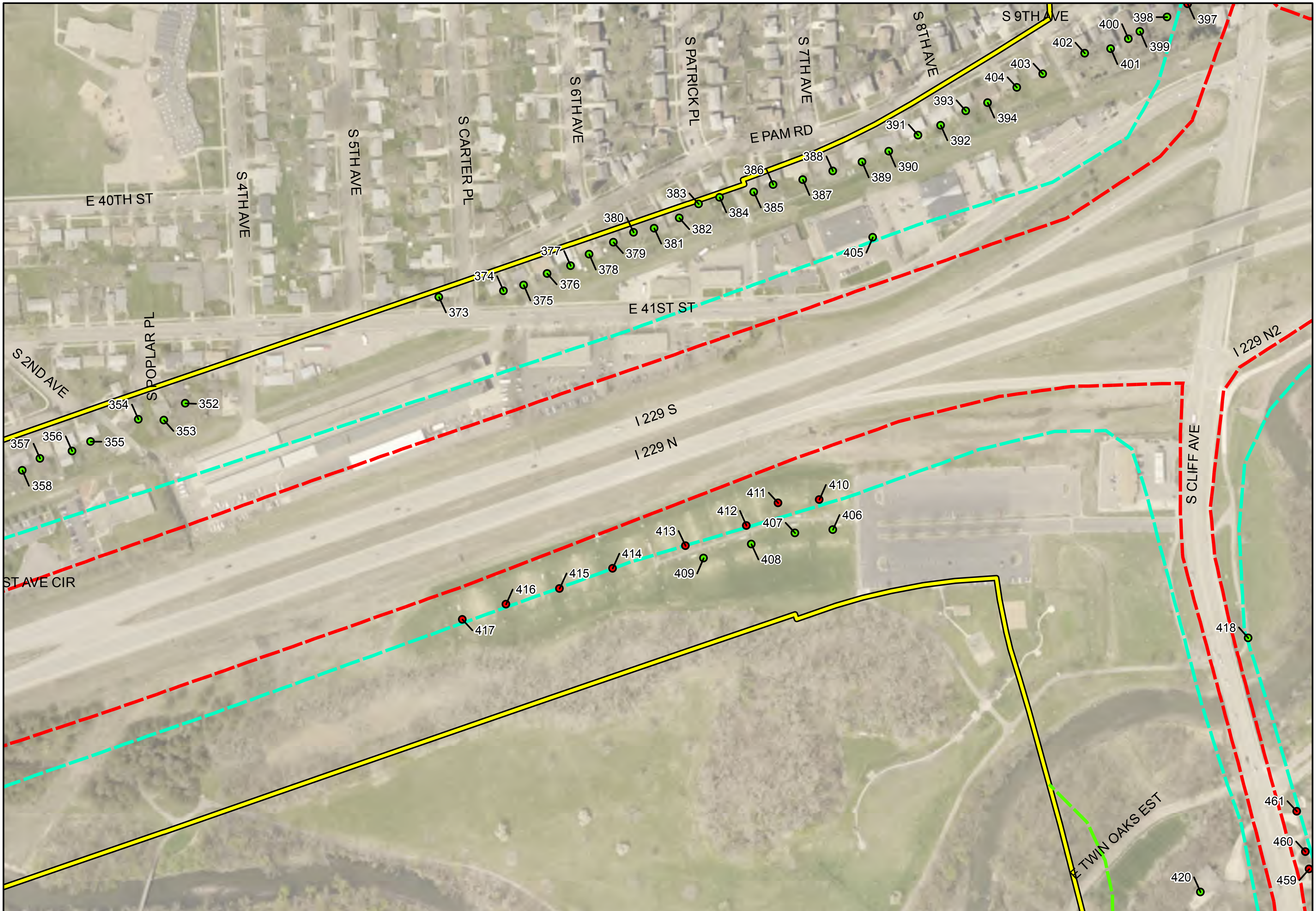

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I-229 Major Investment Corridor Study
Sub-Study #1
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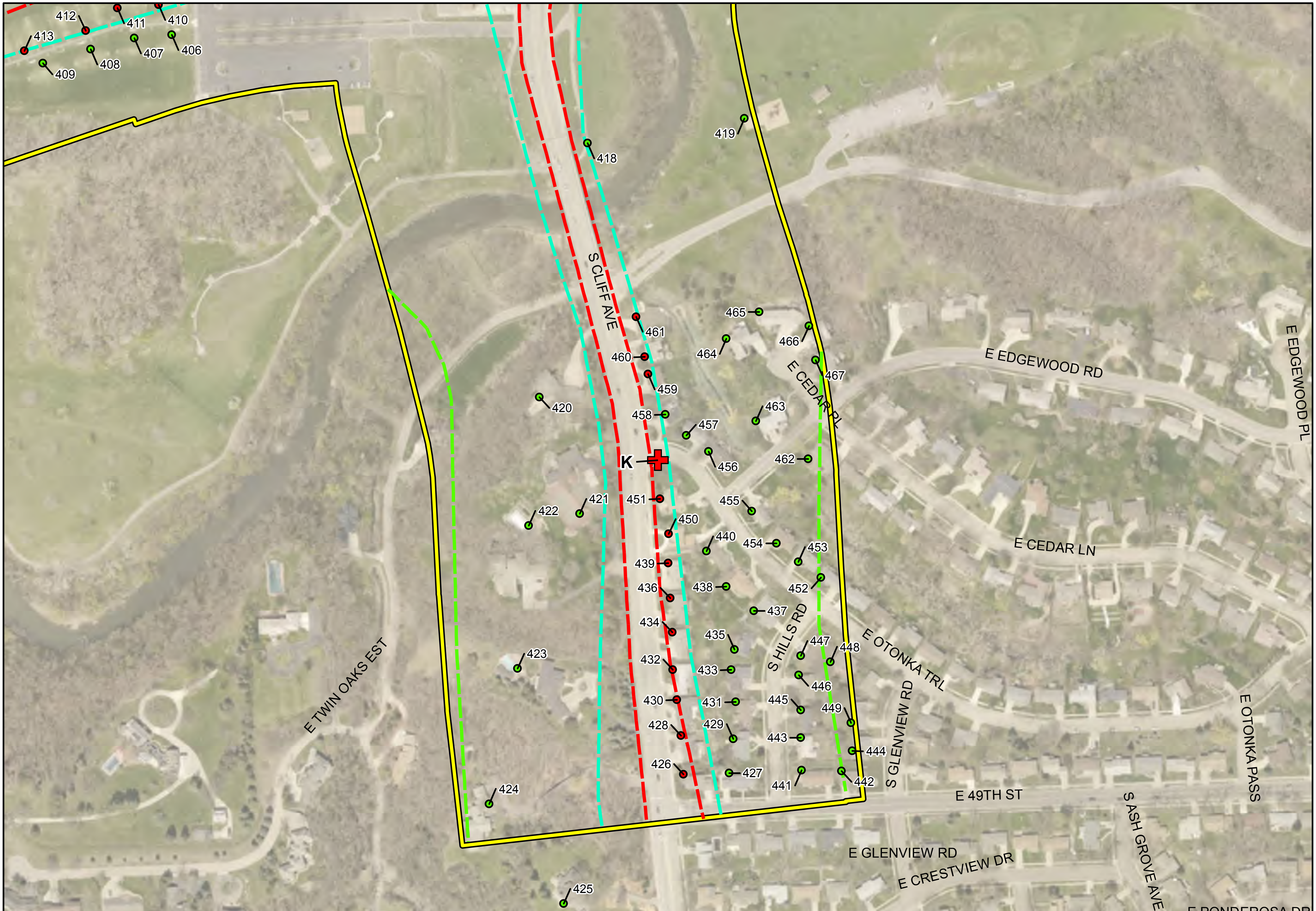

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I-229 Major Investment Corridor Study
Sub-Study #1
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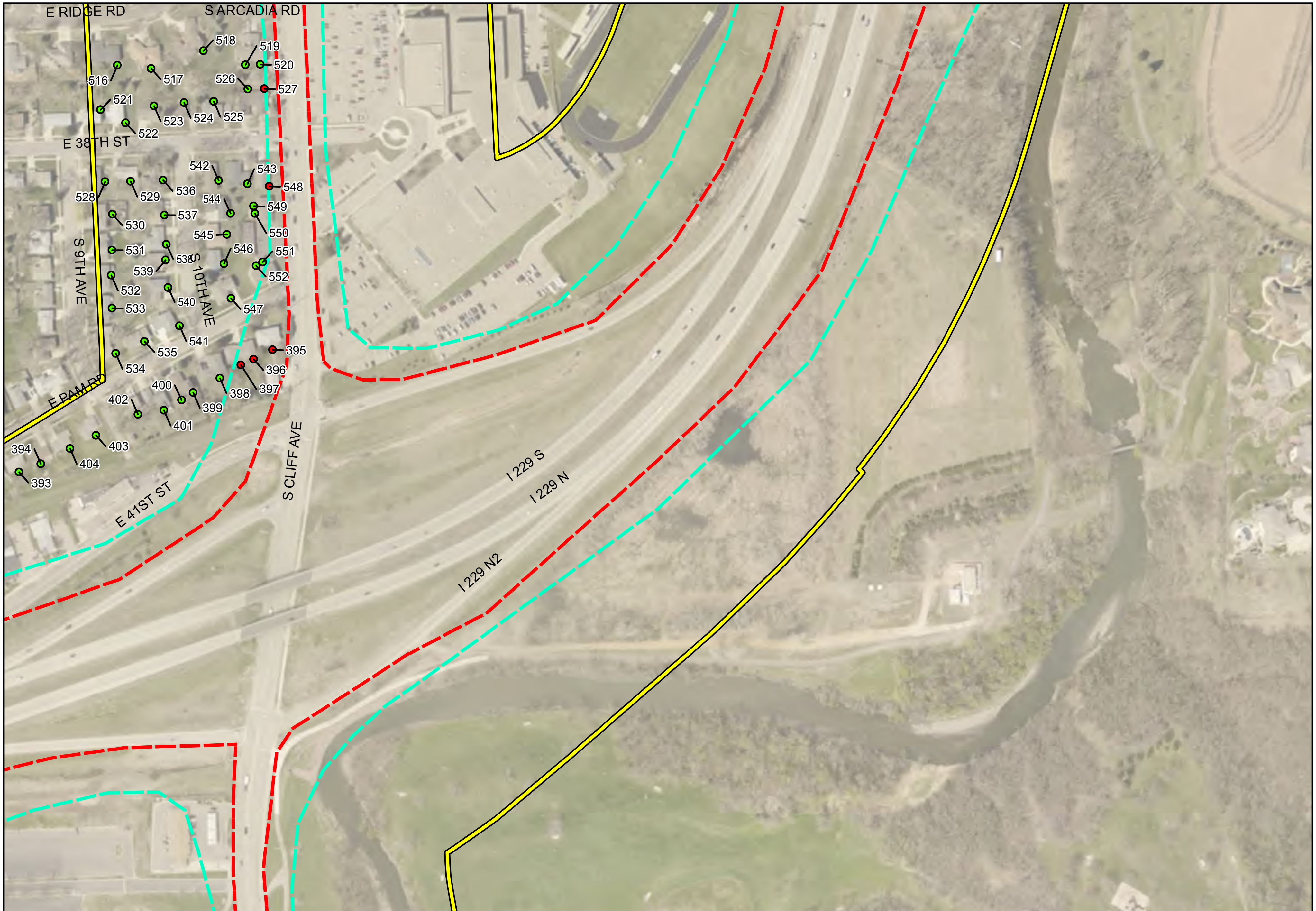

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I-229 Major Investment Corridor Study
Sub-Study #1
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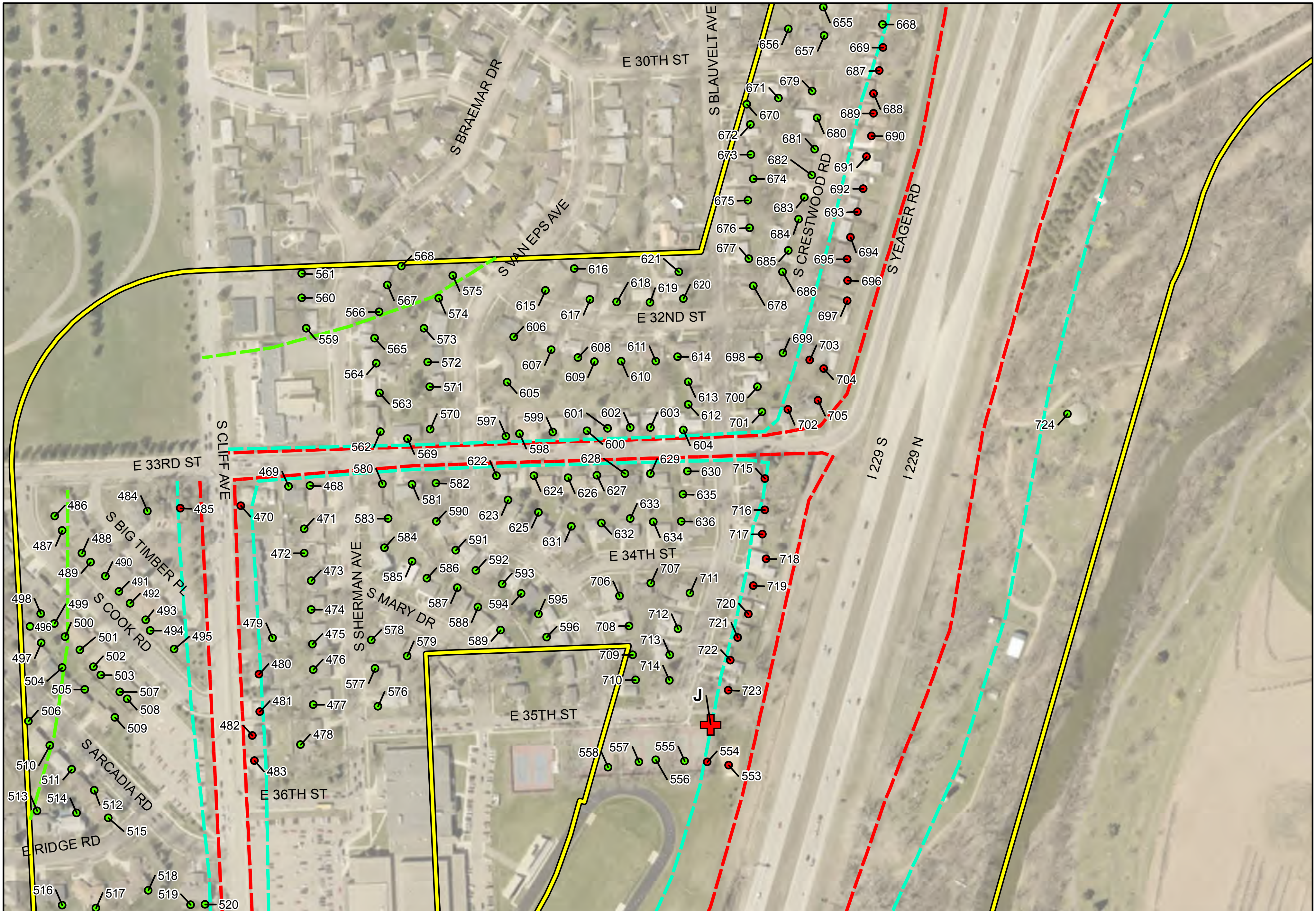

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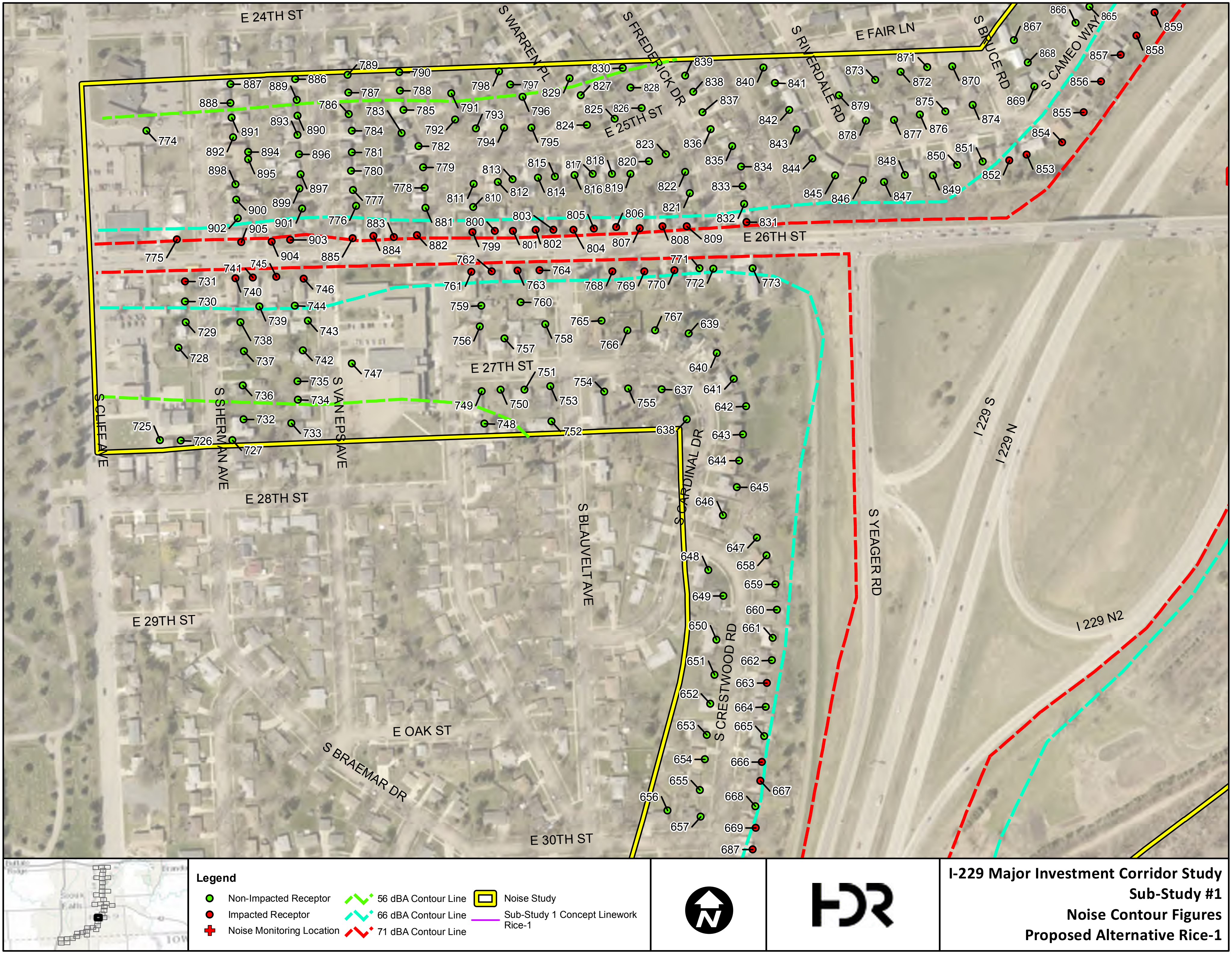

I-229 Major Investment Corridor Study
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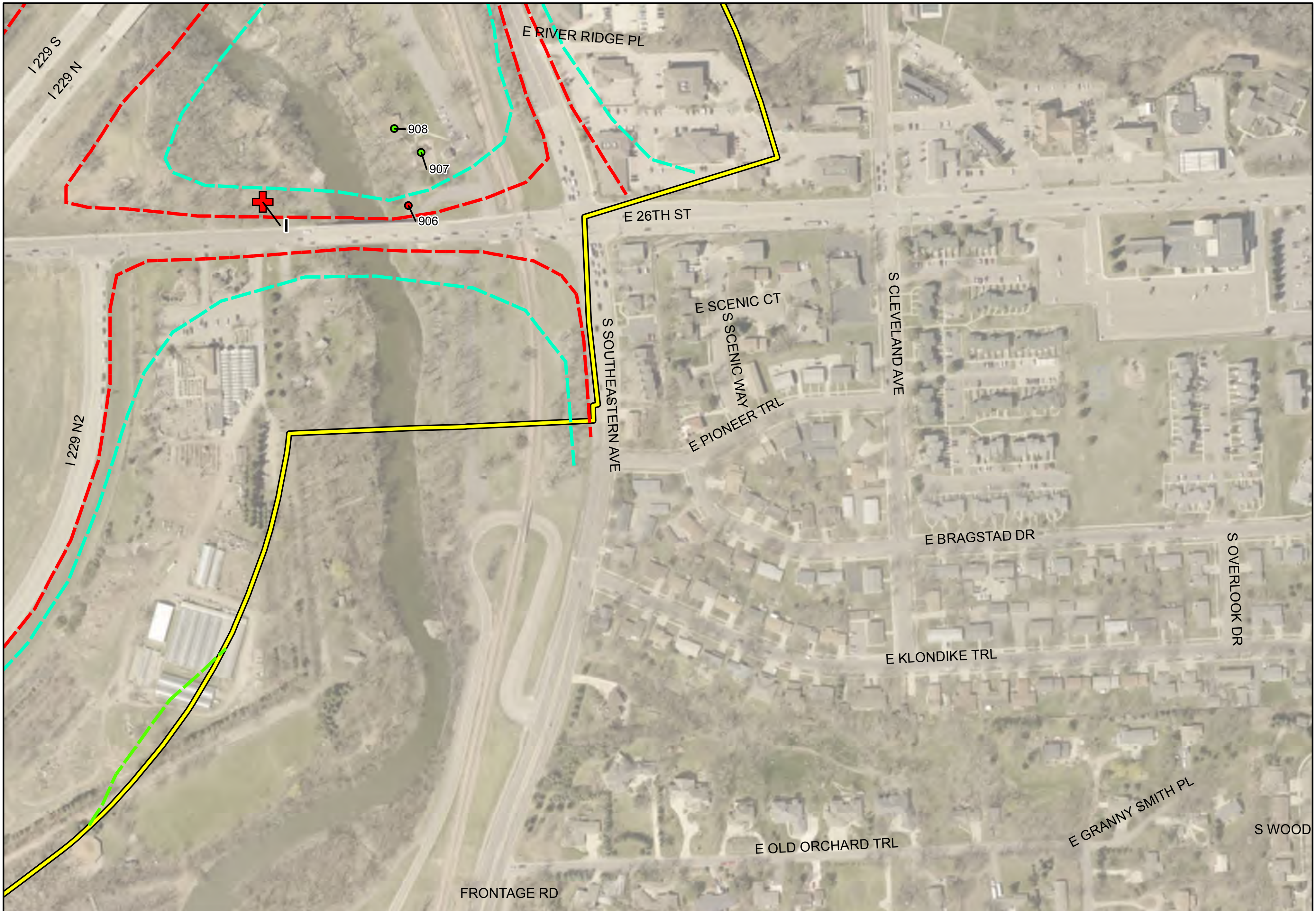

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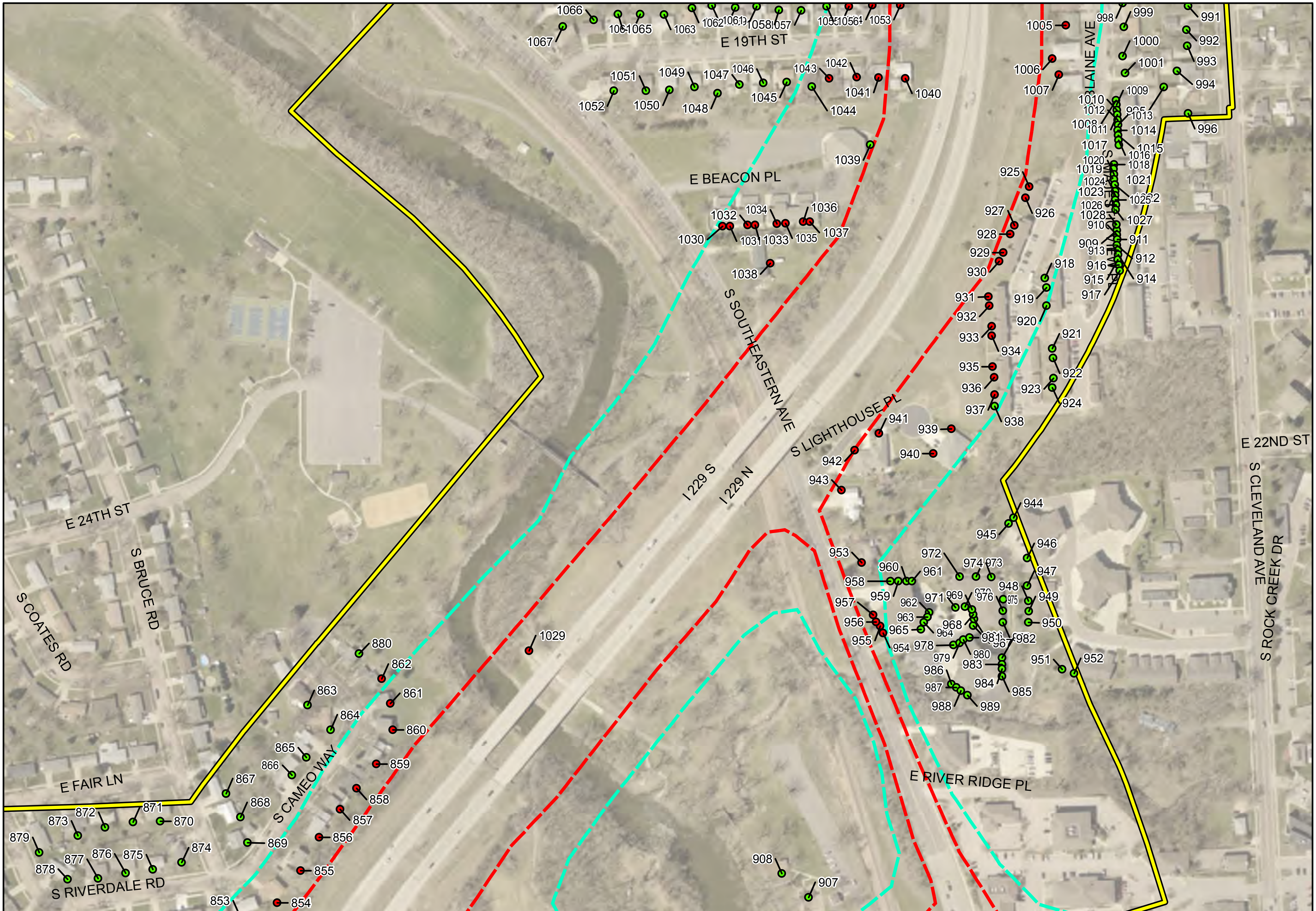

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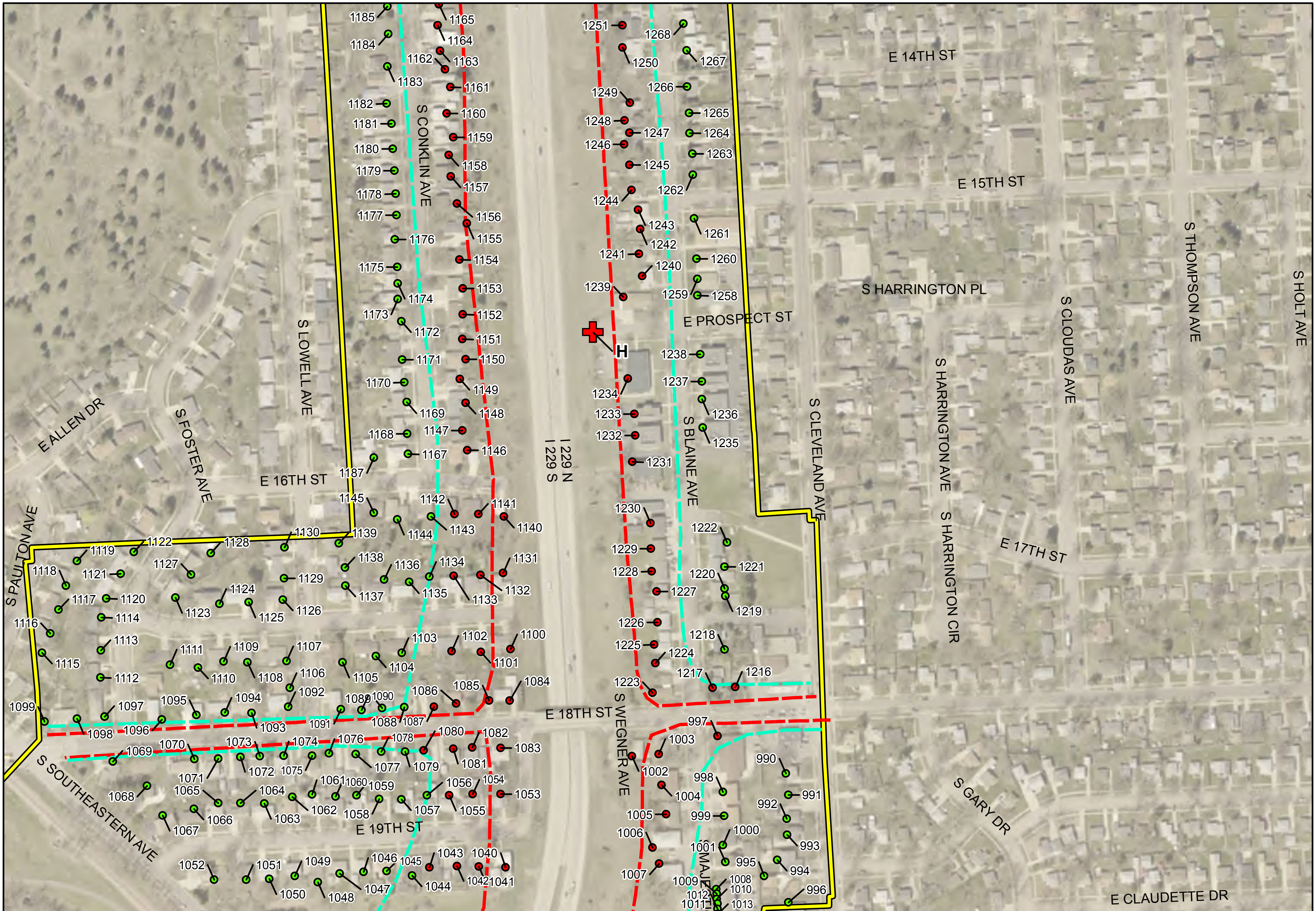

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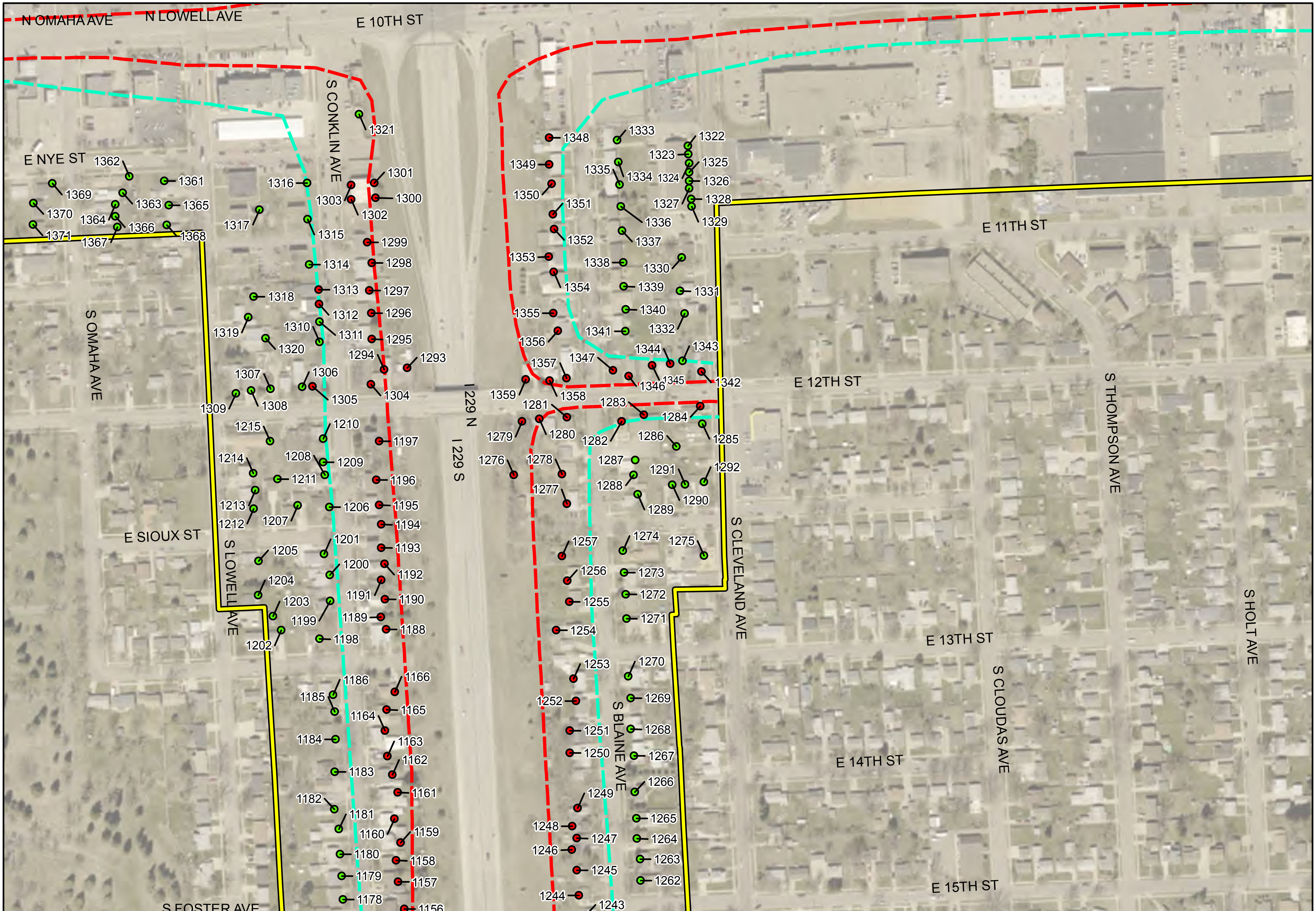

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I-229 Major Investment Corridor Study
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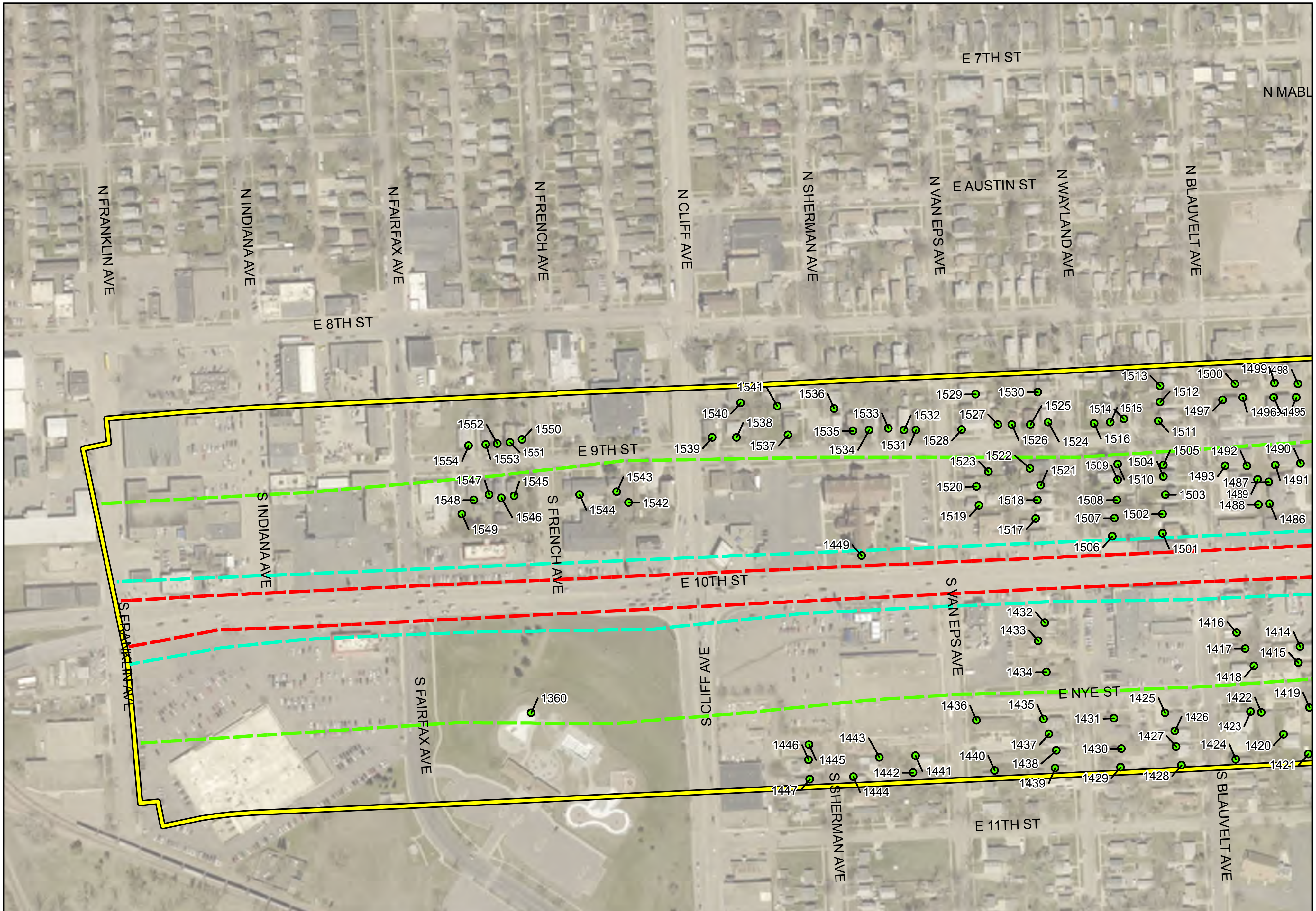

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I-229 Major Investment Corridor Study
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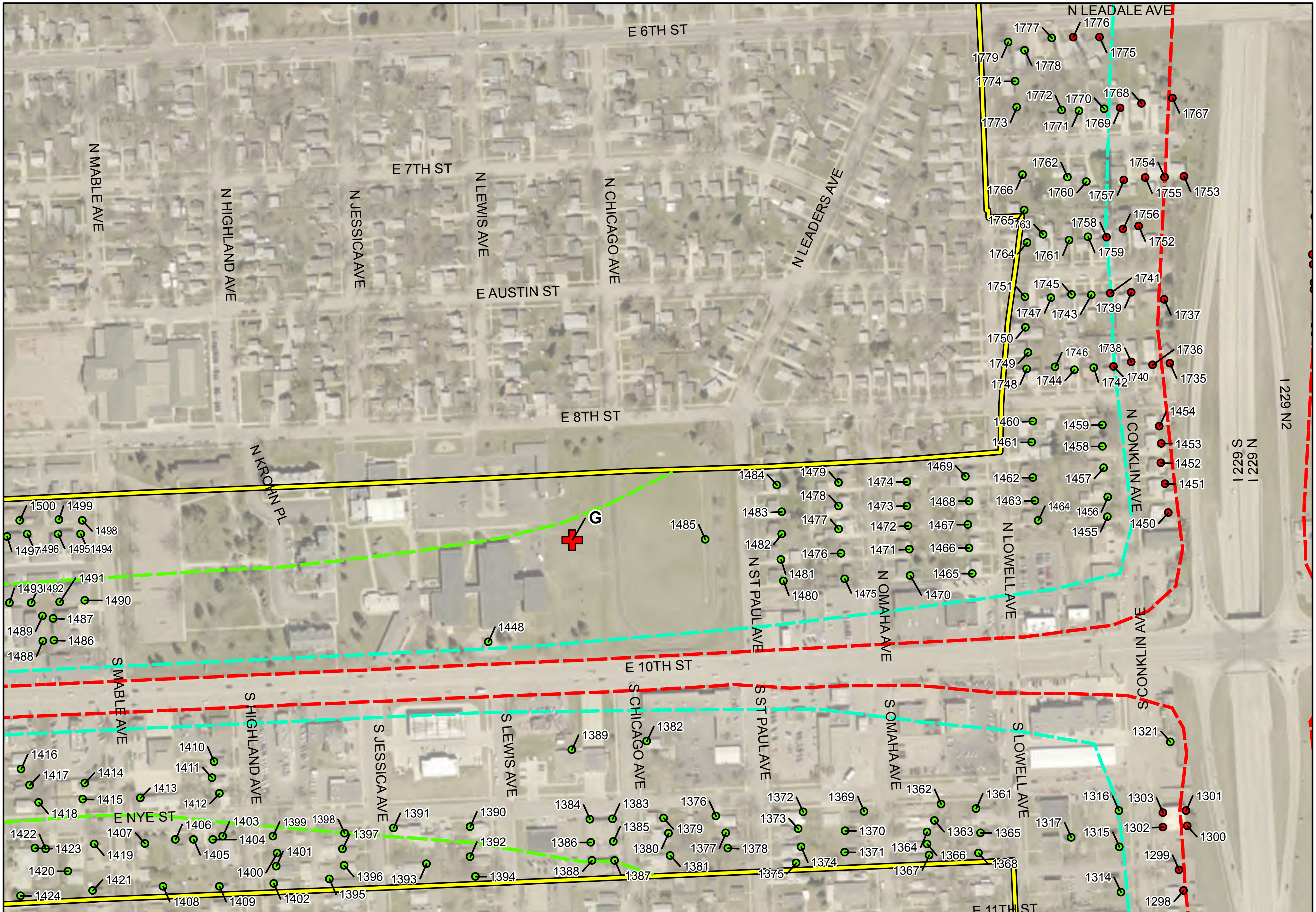

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I-229 Major Investment Corridor Study
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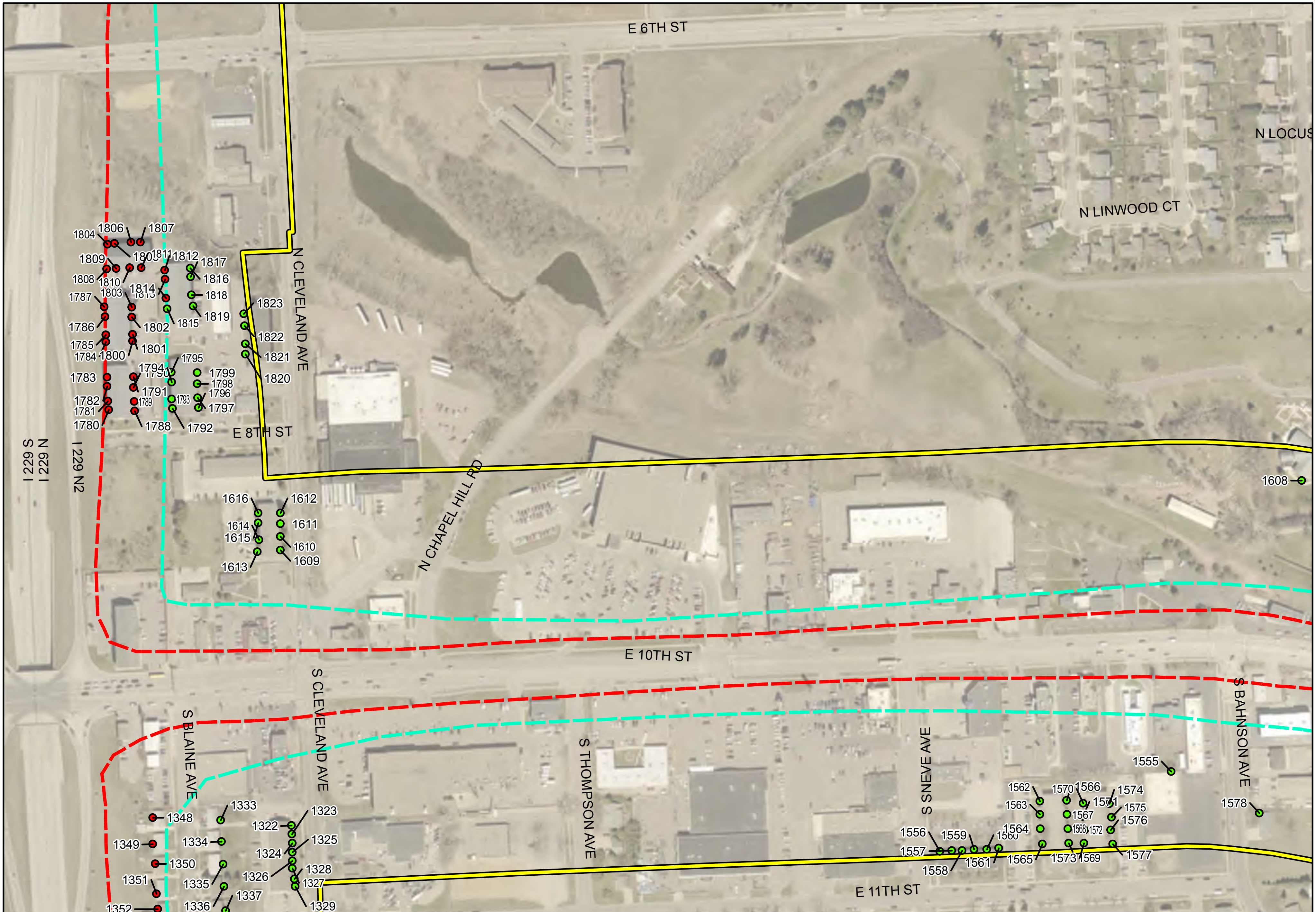

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I-229 Major Investment Corridor Study
Sub-Study #1
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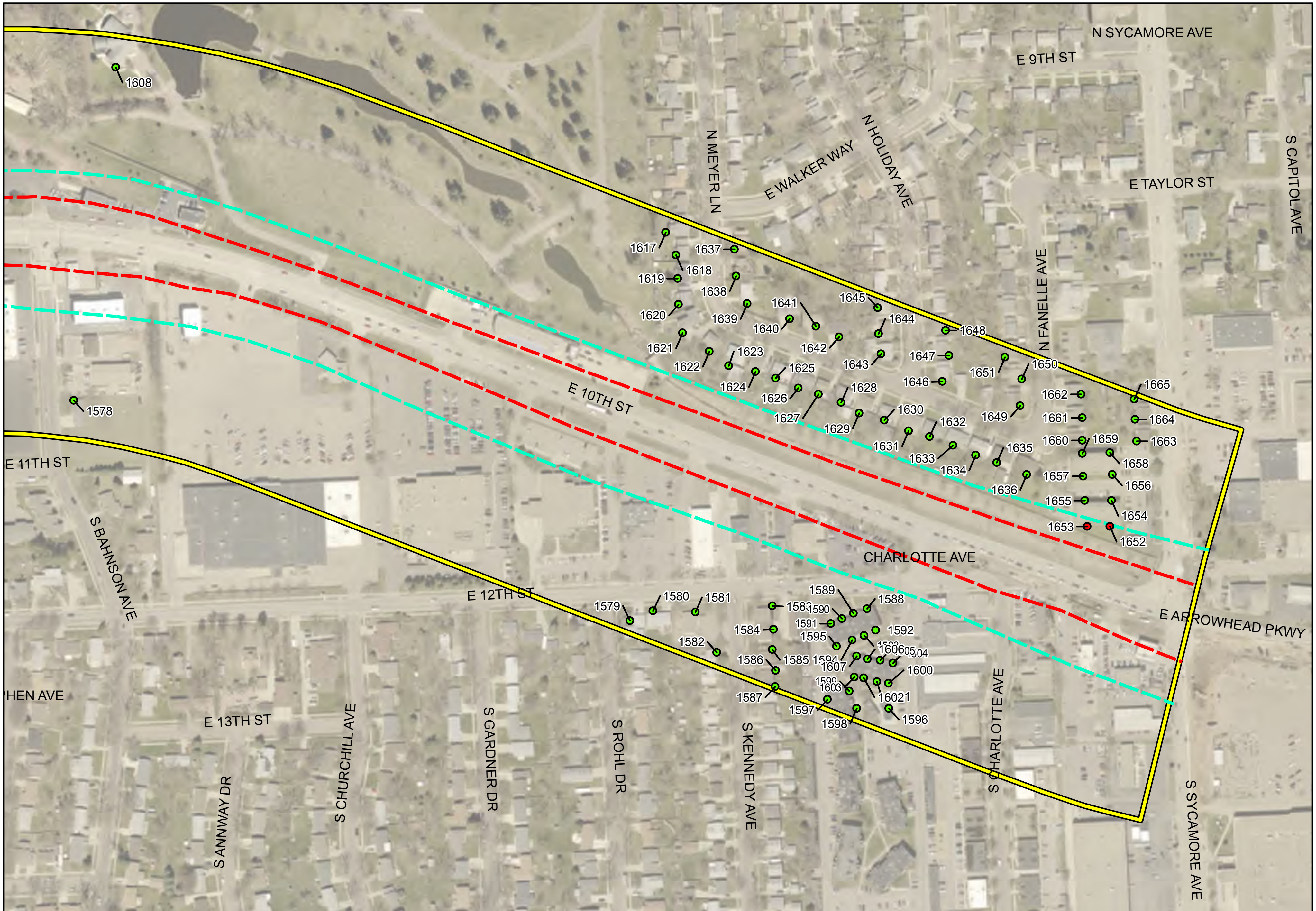

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I-229 Major Investment Corridor Study
Sub-Study #1
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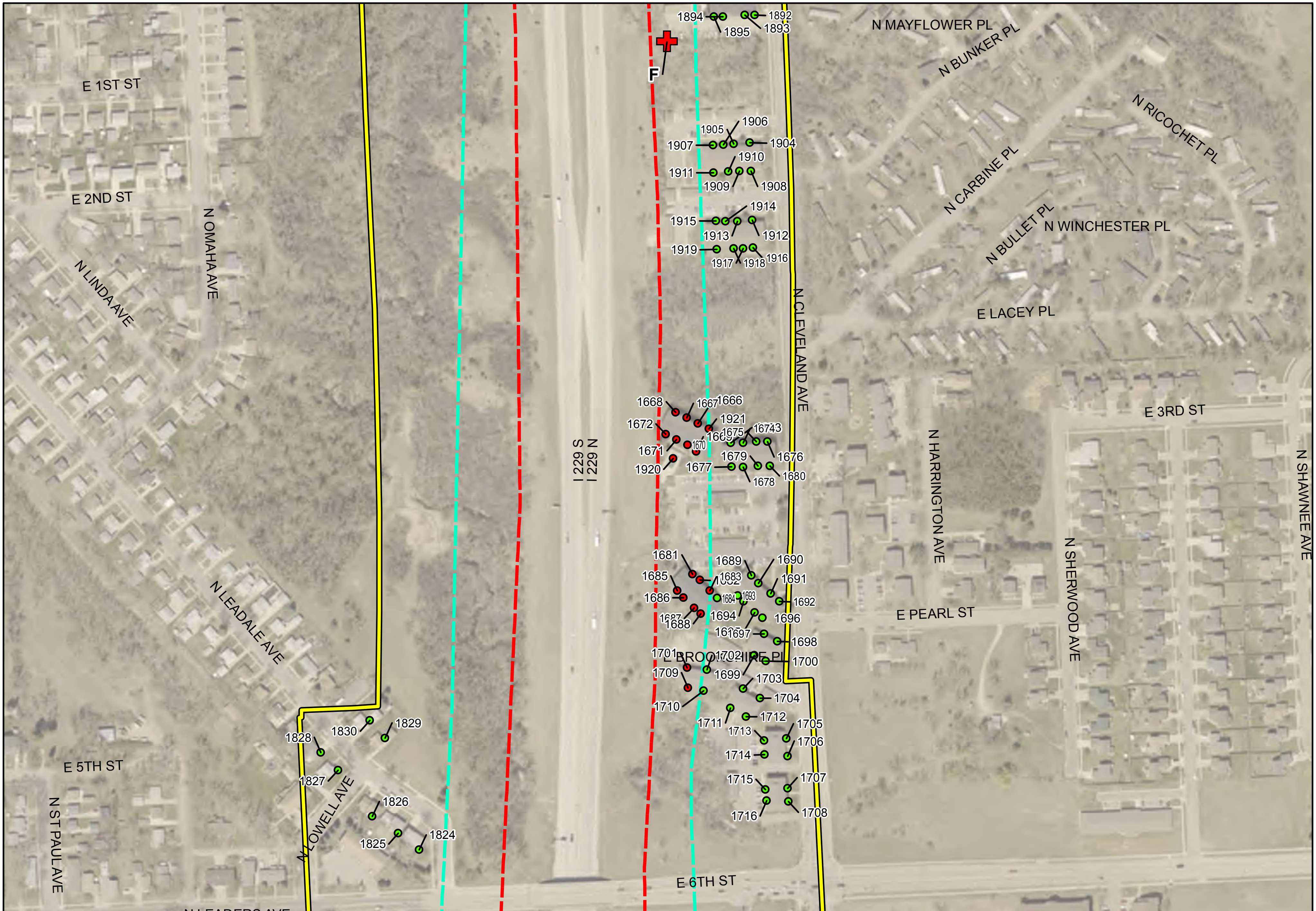

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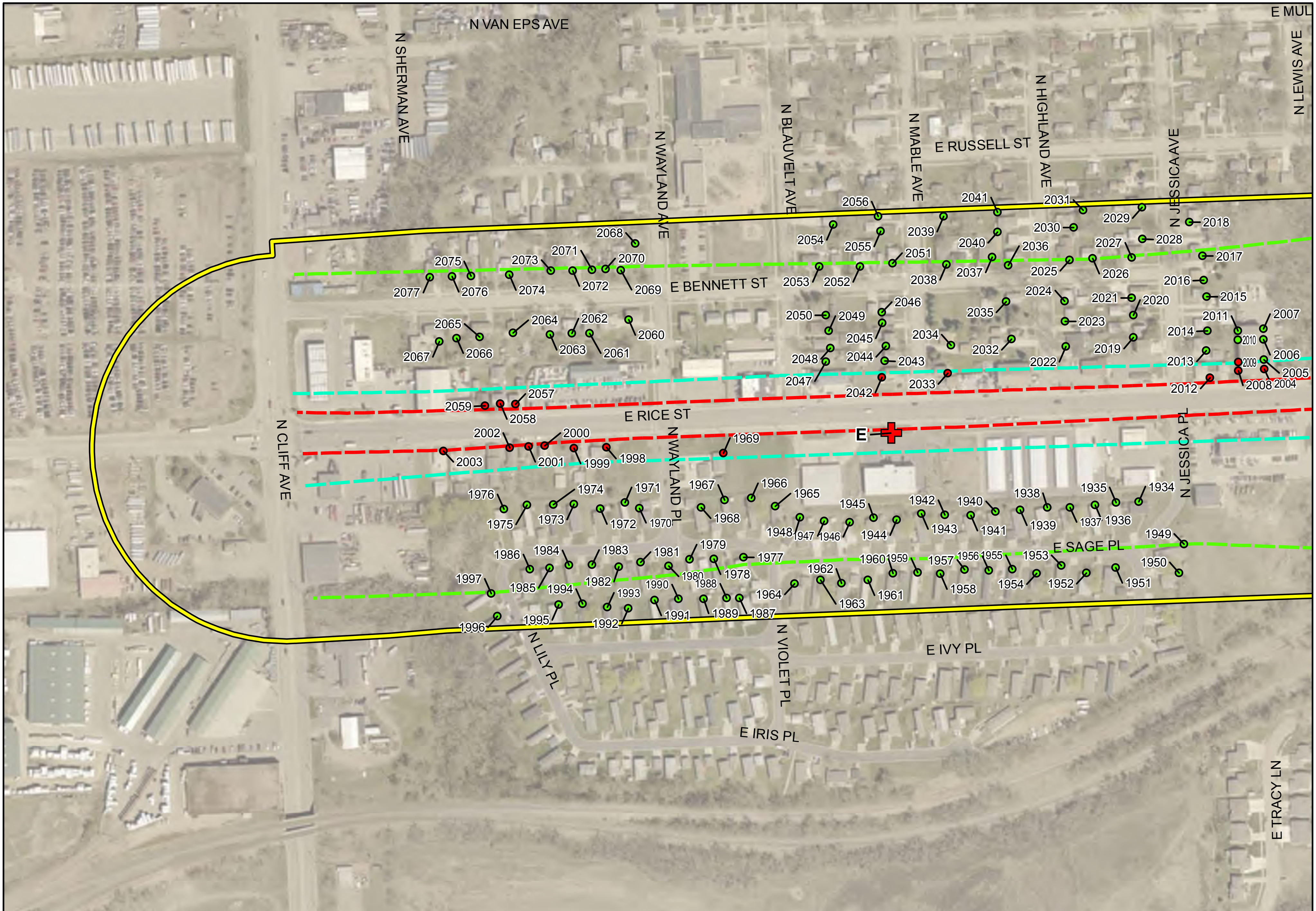

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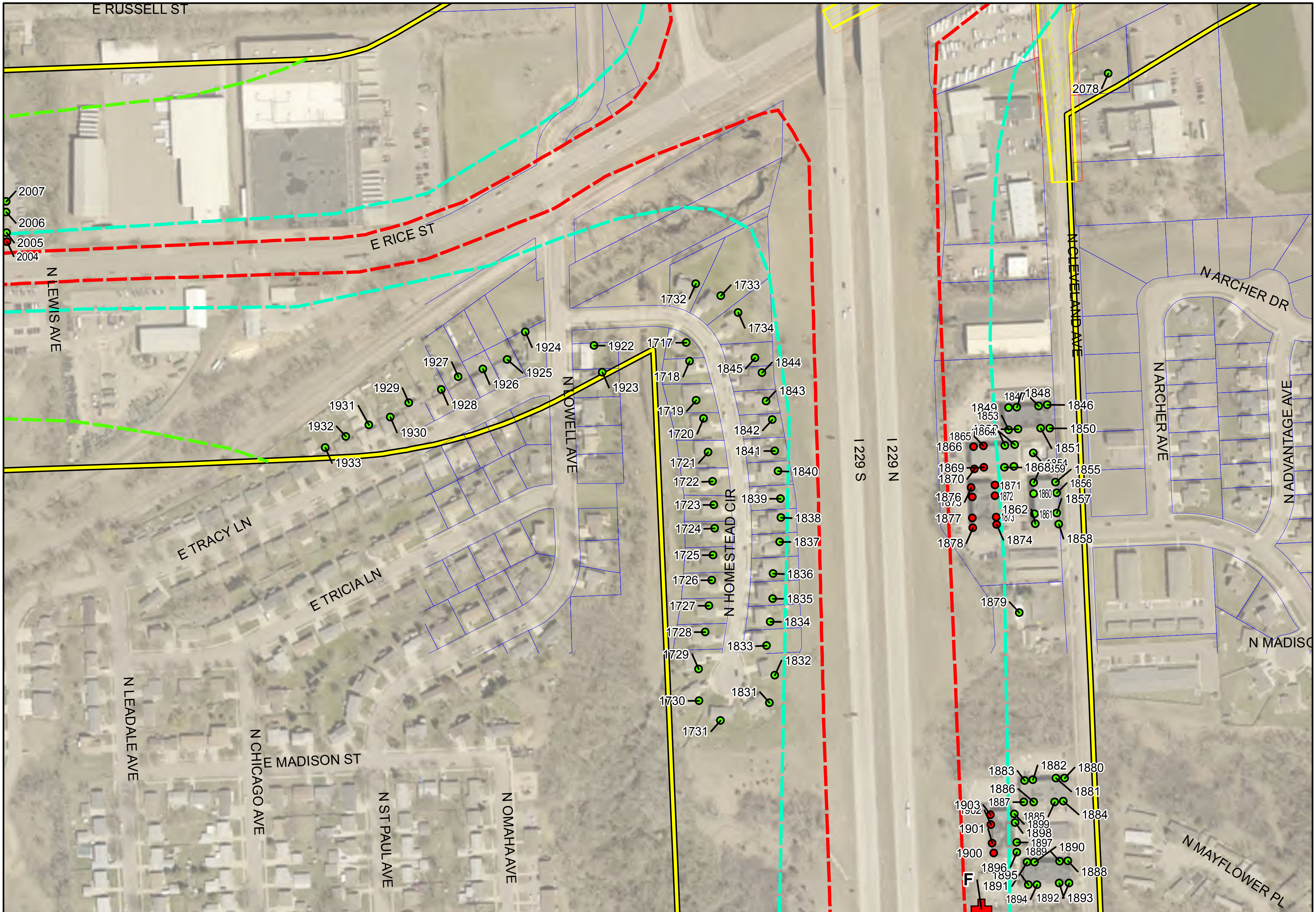

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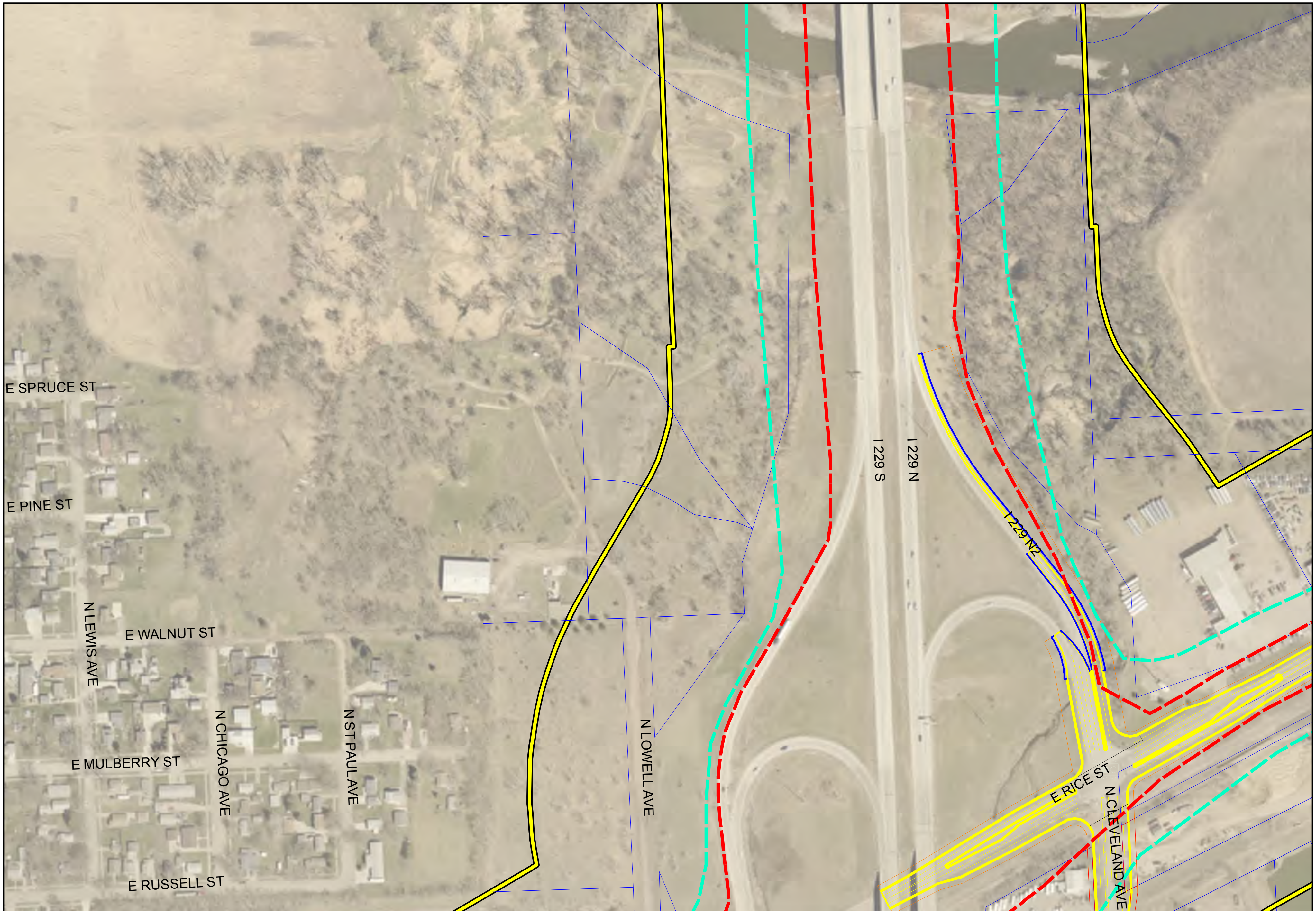

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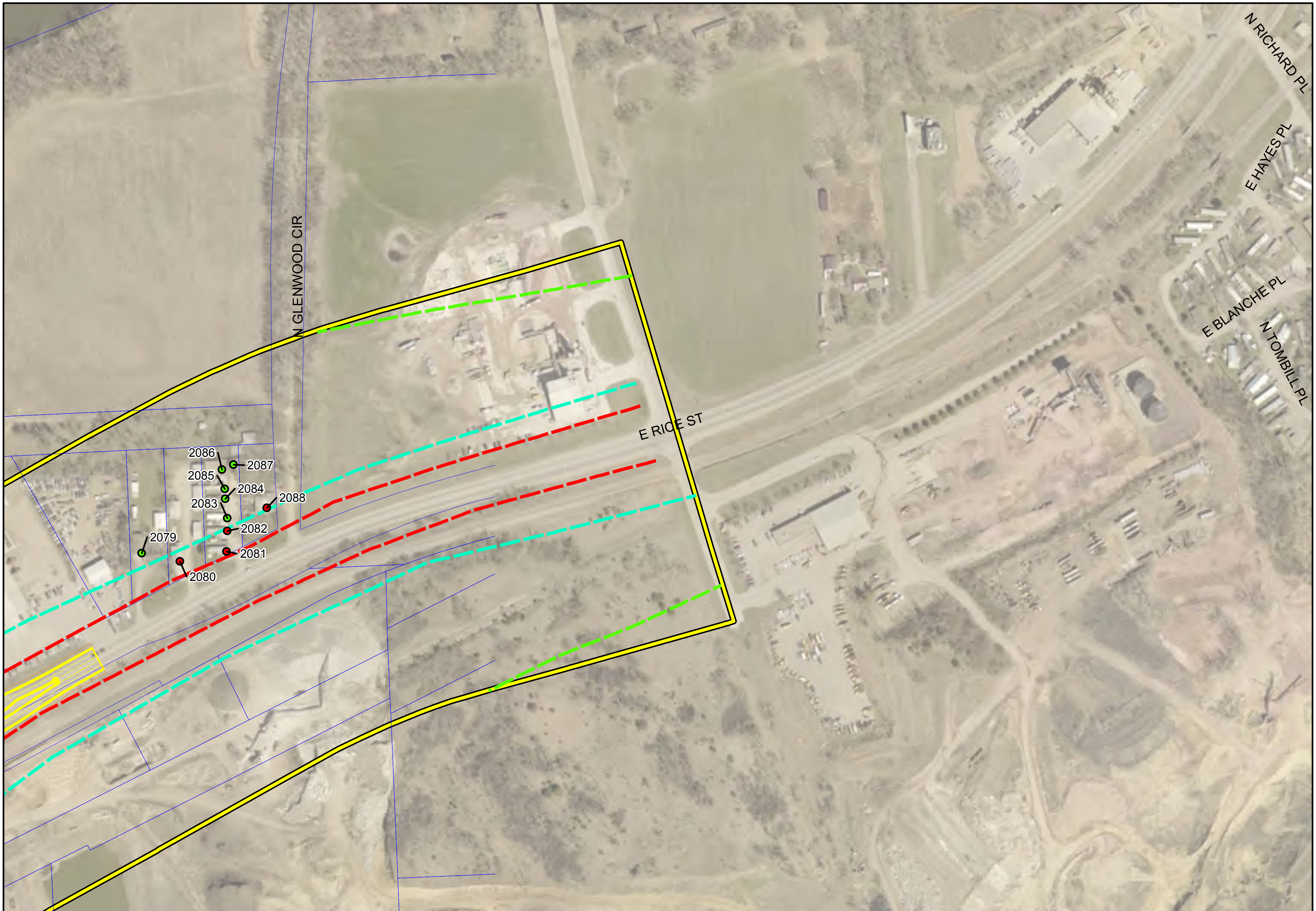

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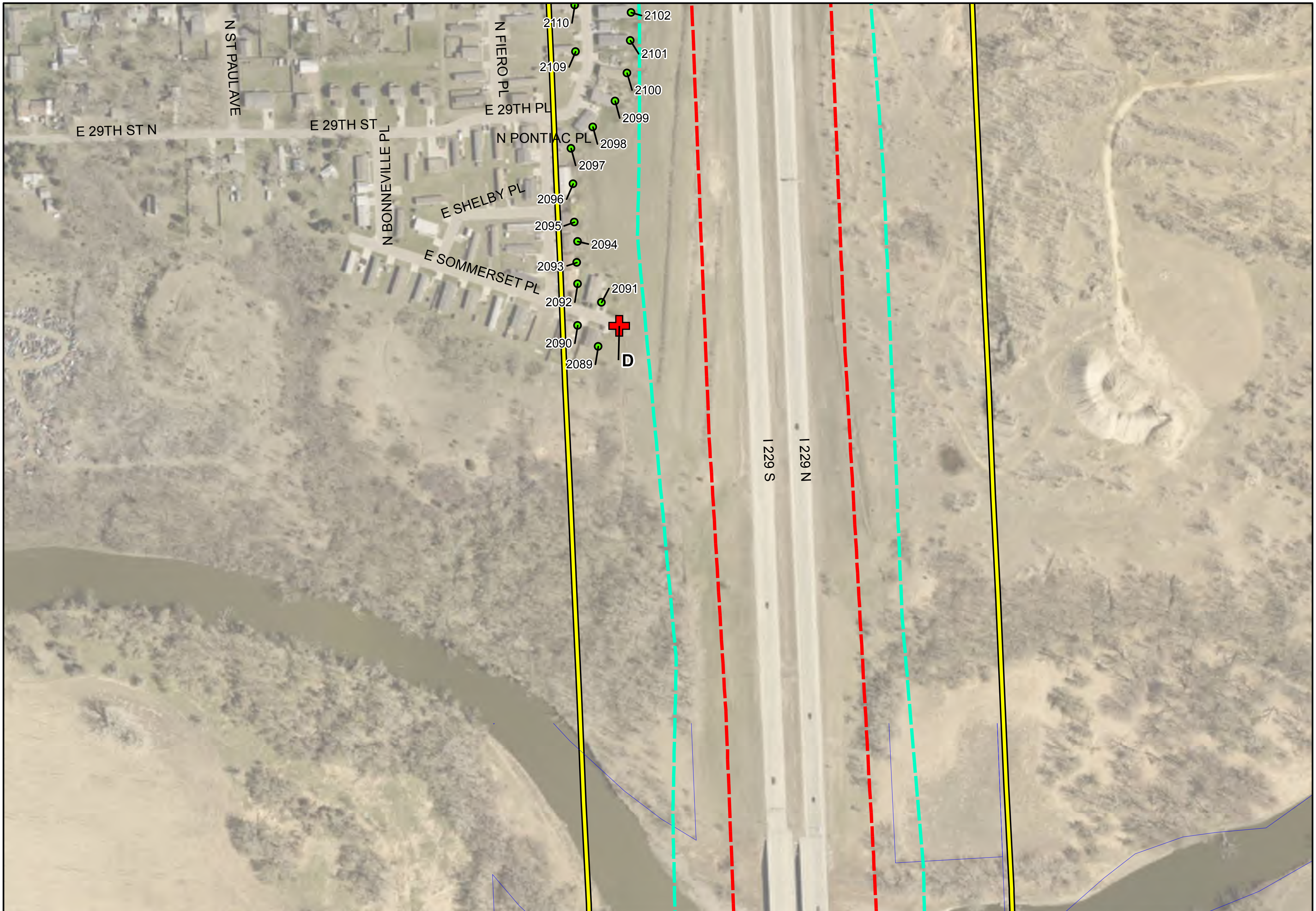

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I-229 Major Investment Corridor Study

Sub-Study #1

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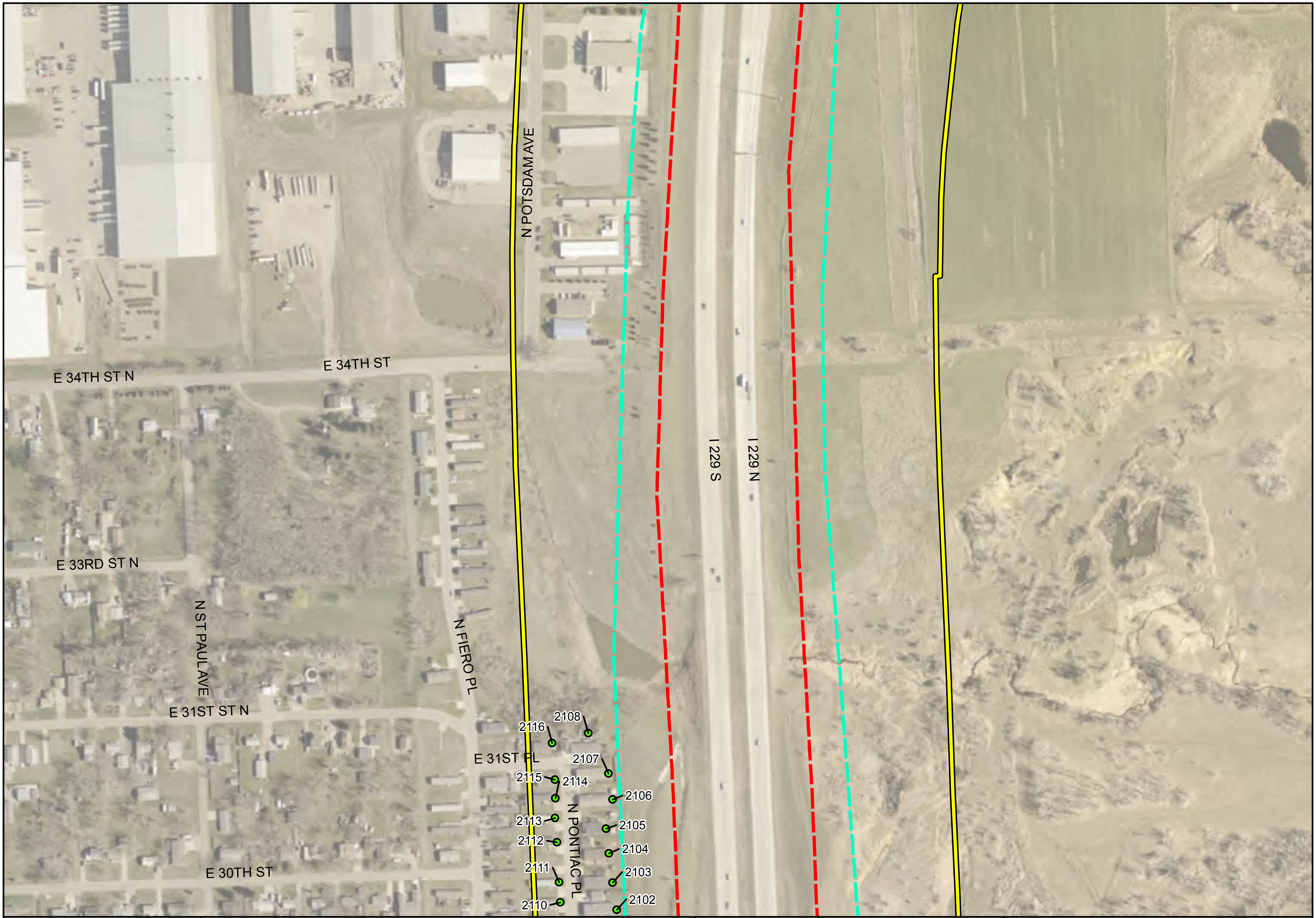

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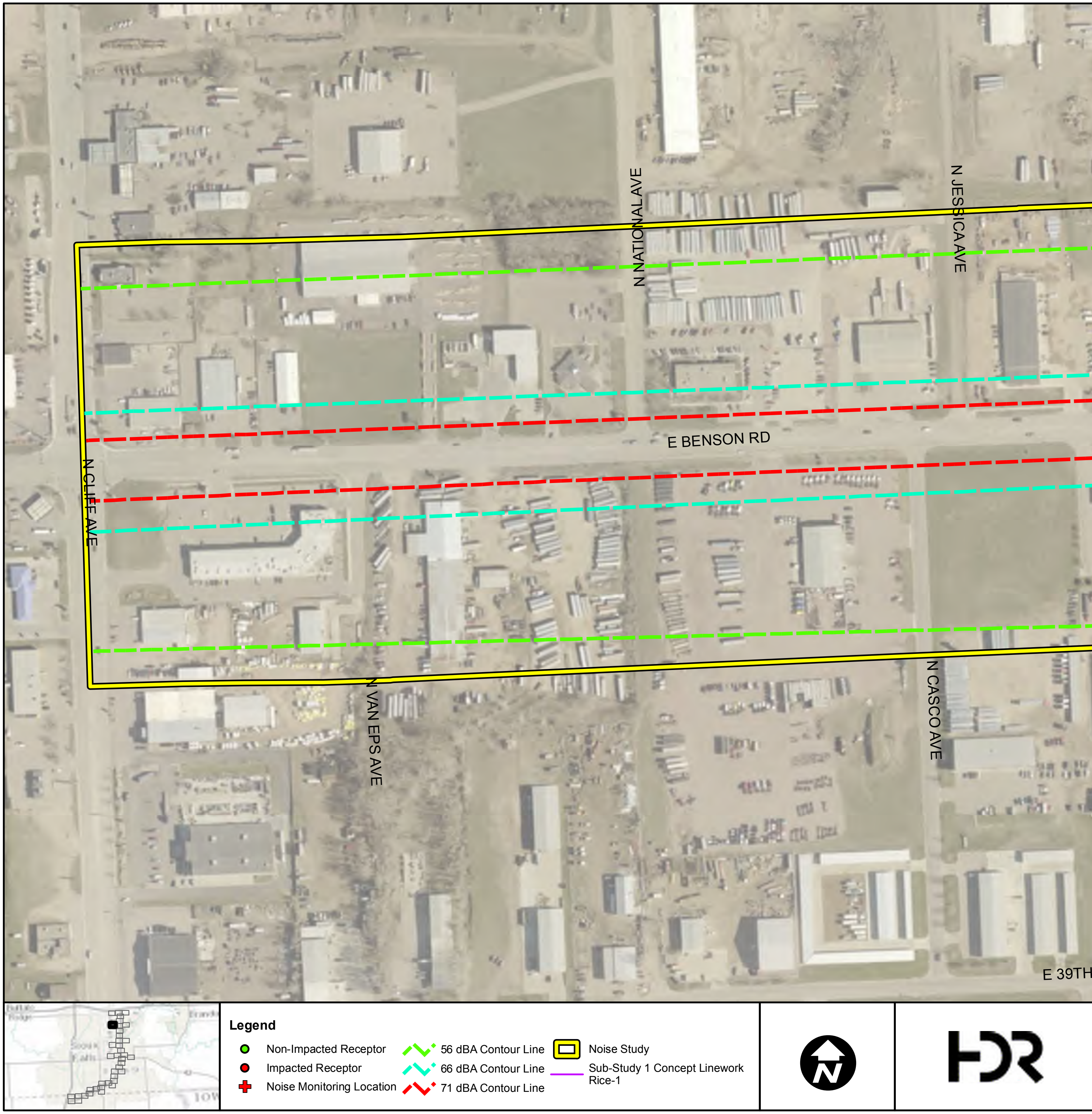

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Sub-Study #1
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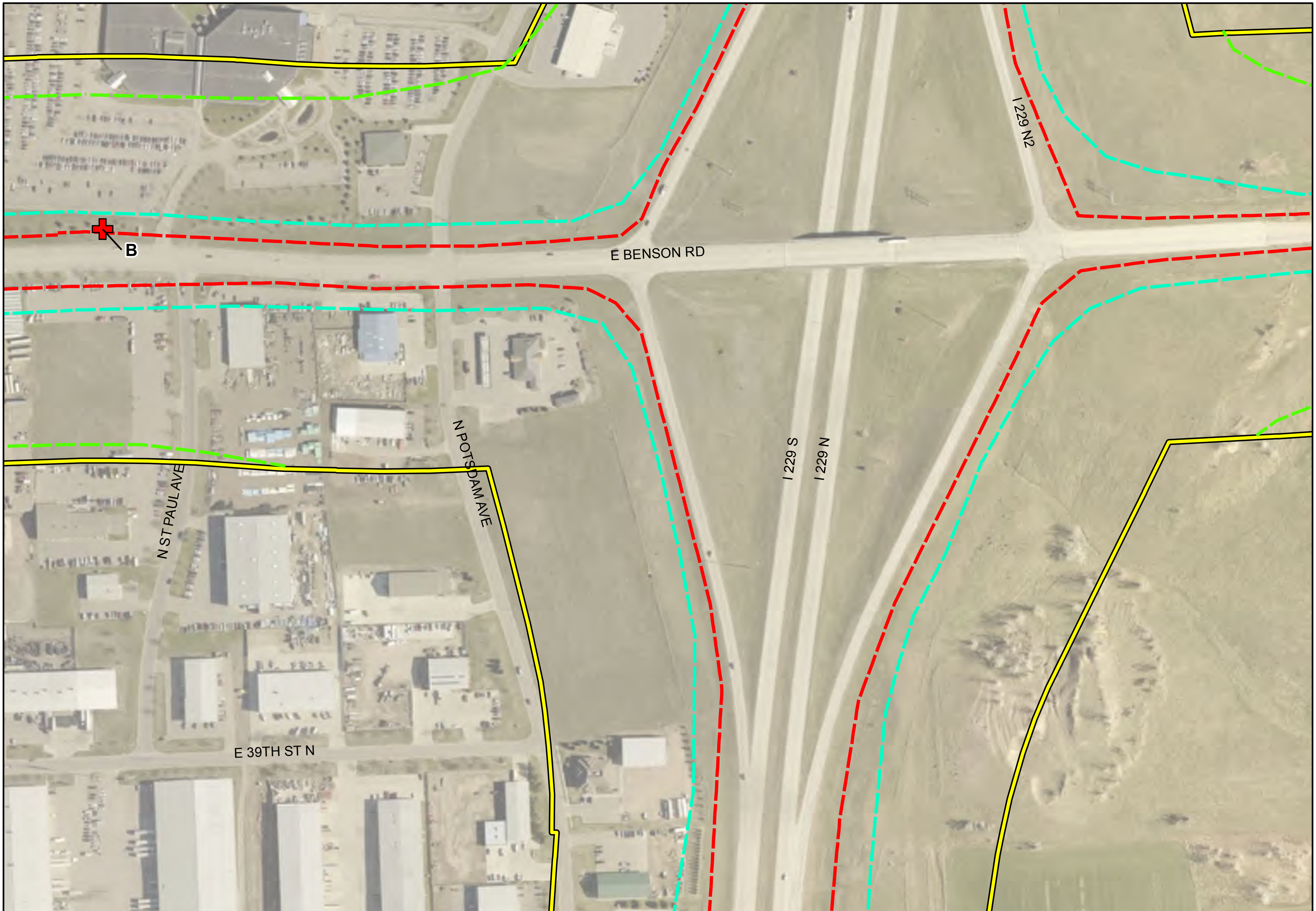

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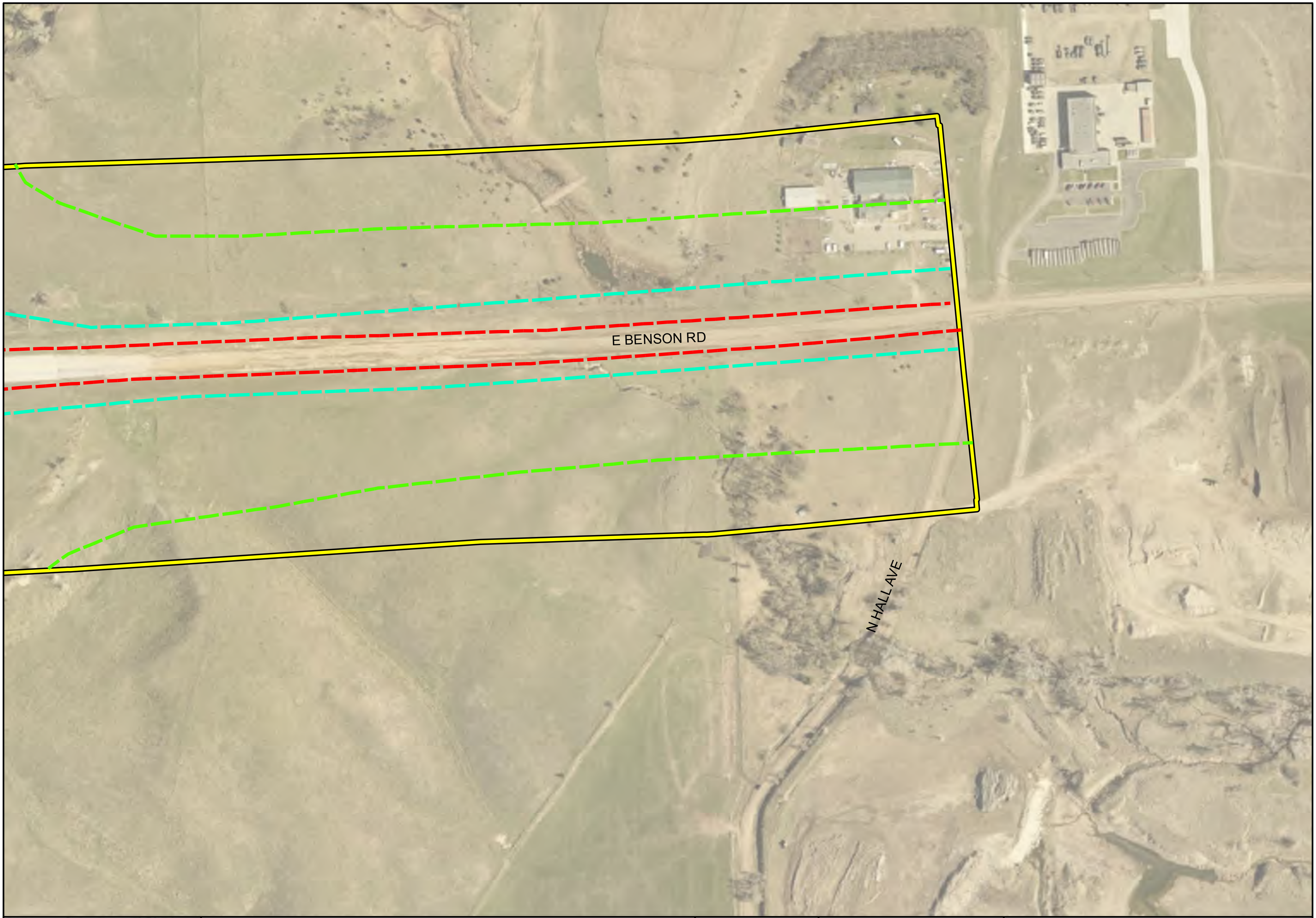

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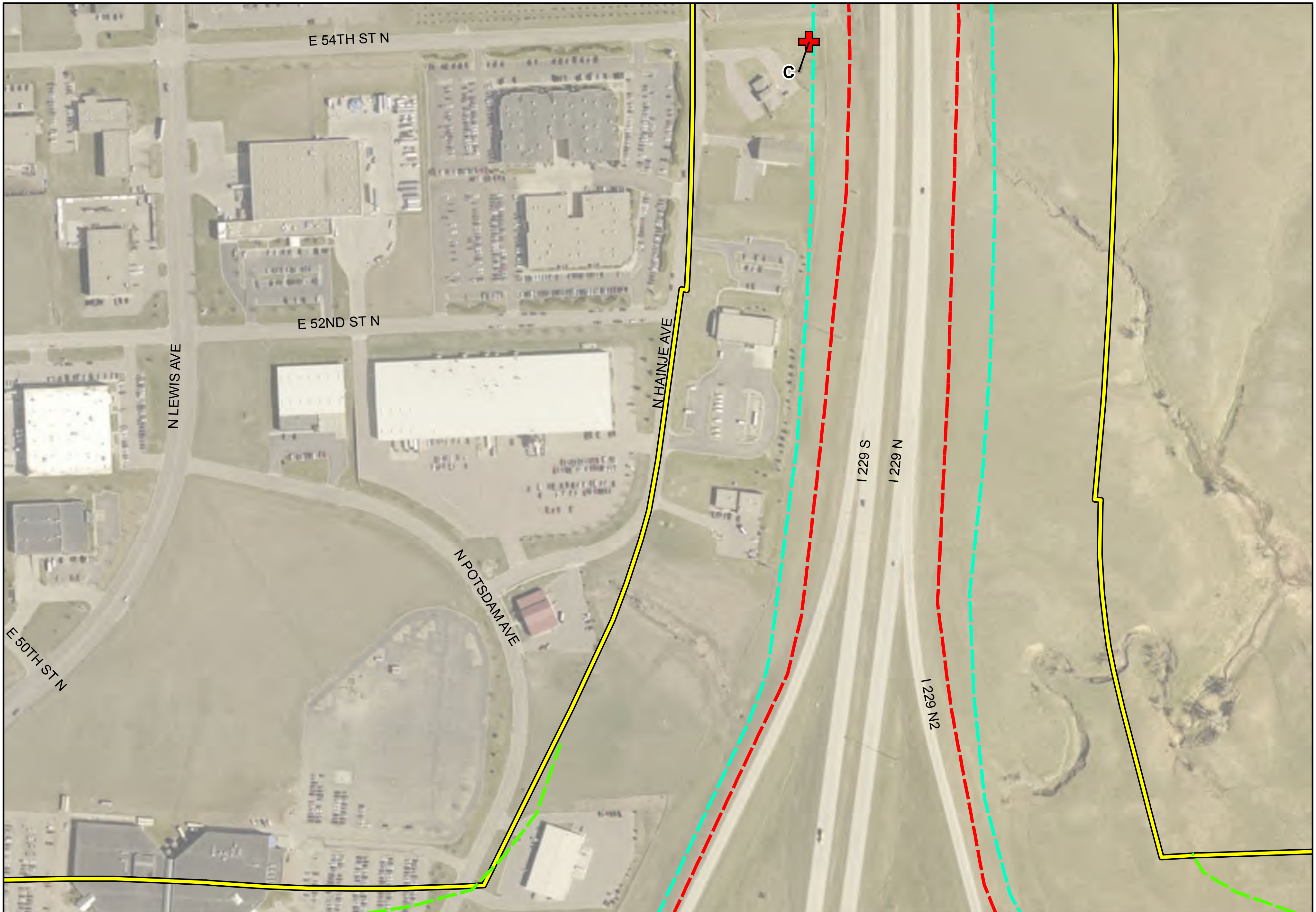

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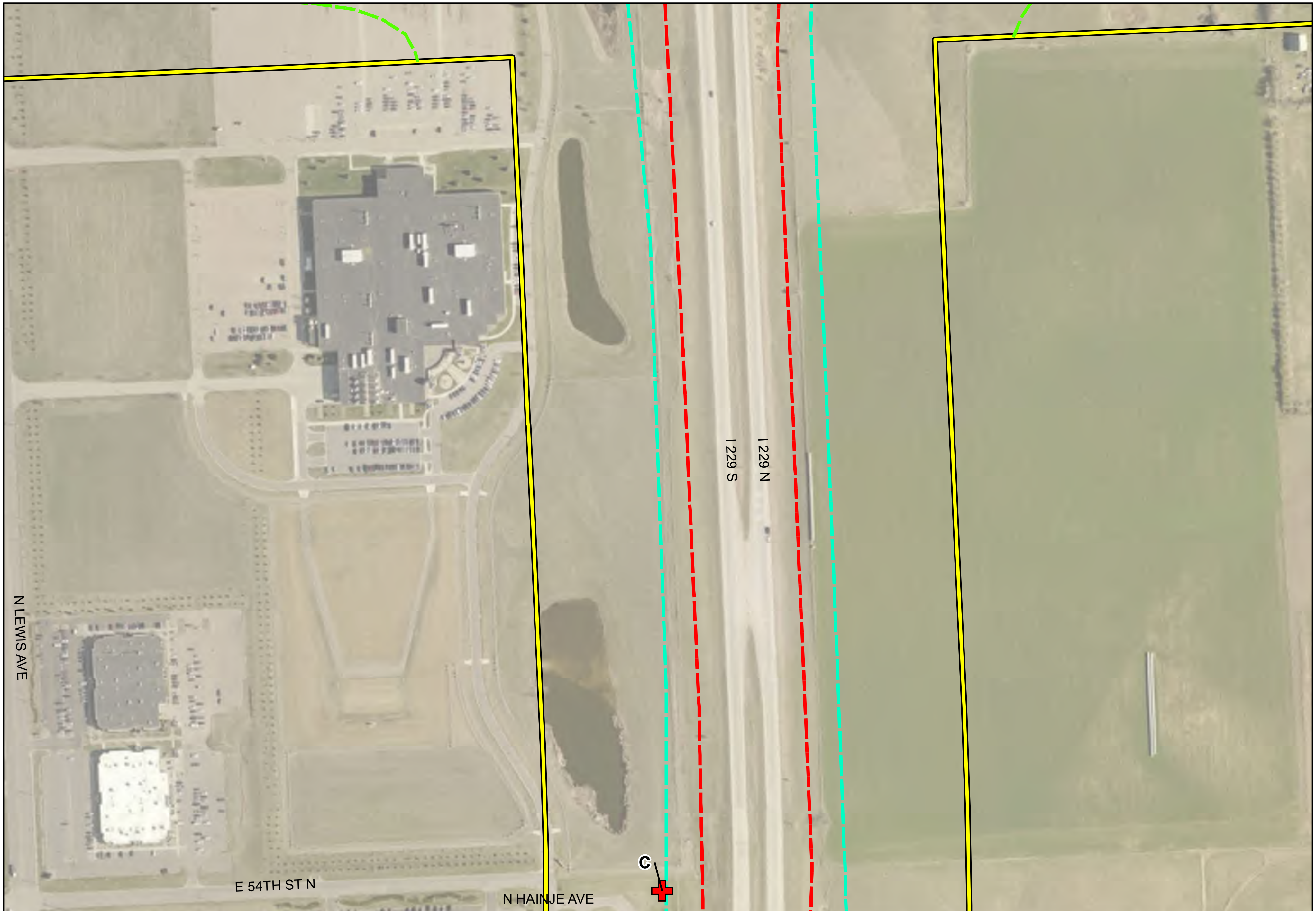
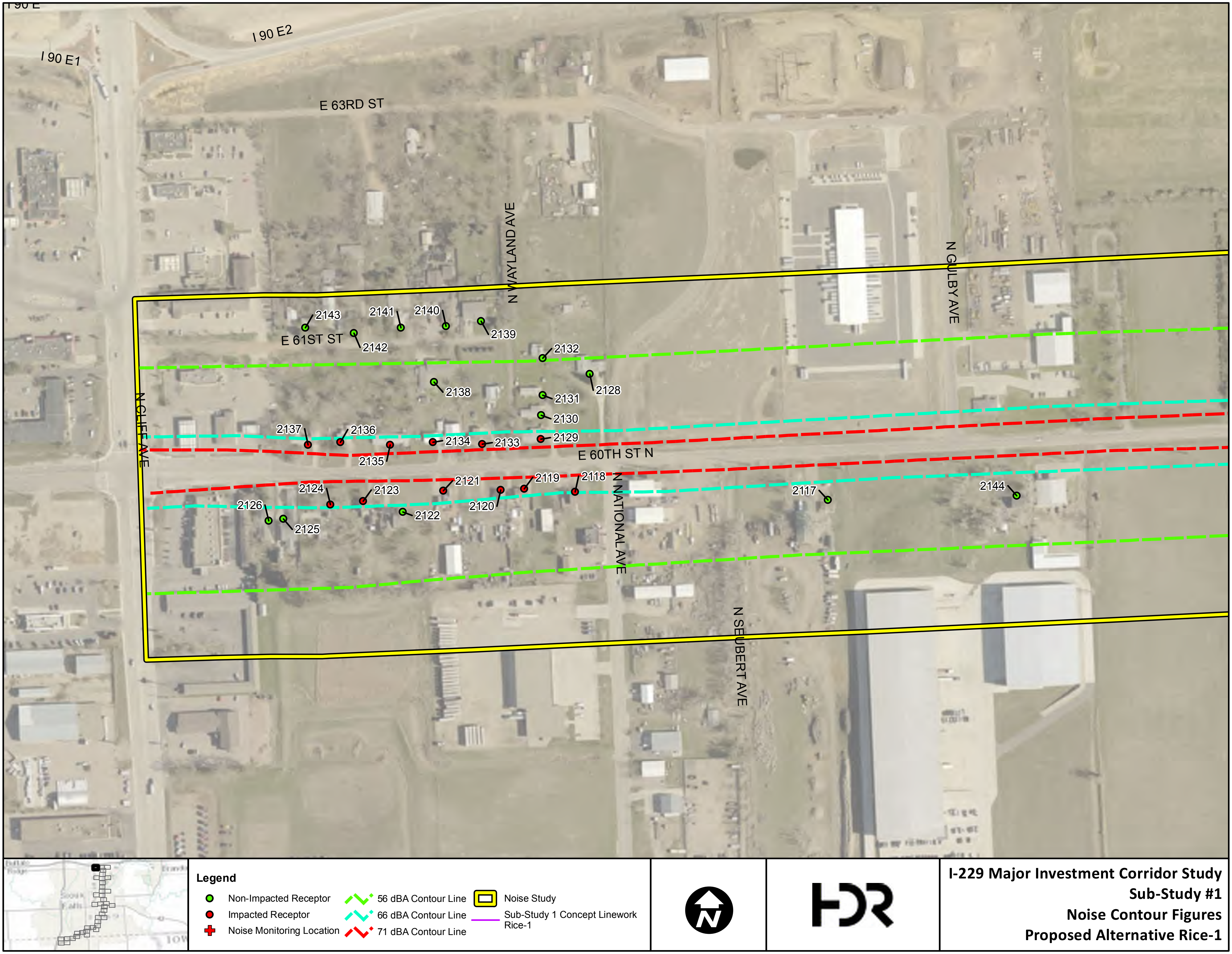
Noise Contour Figures
Proposed Alternative Rice-1



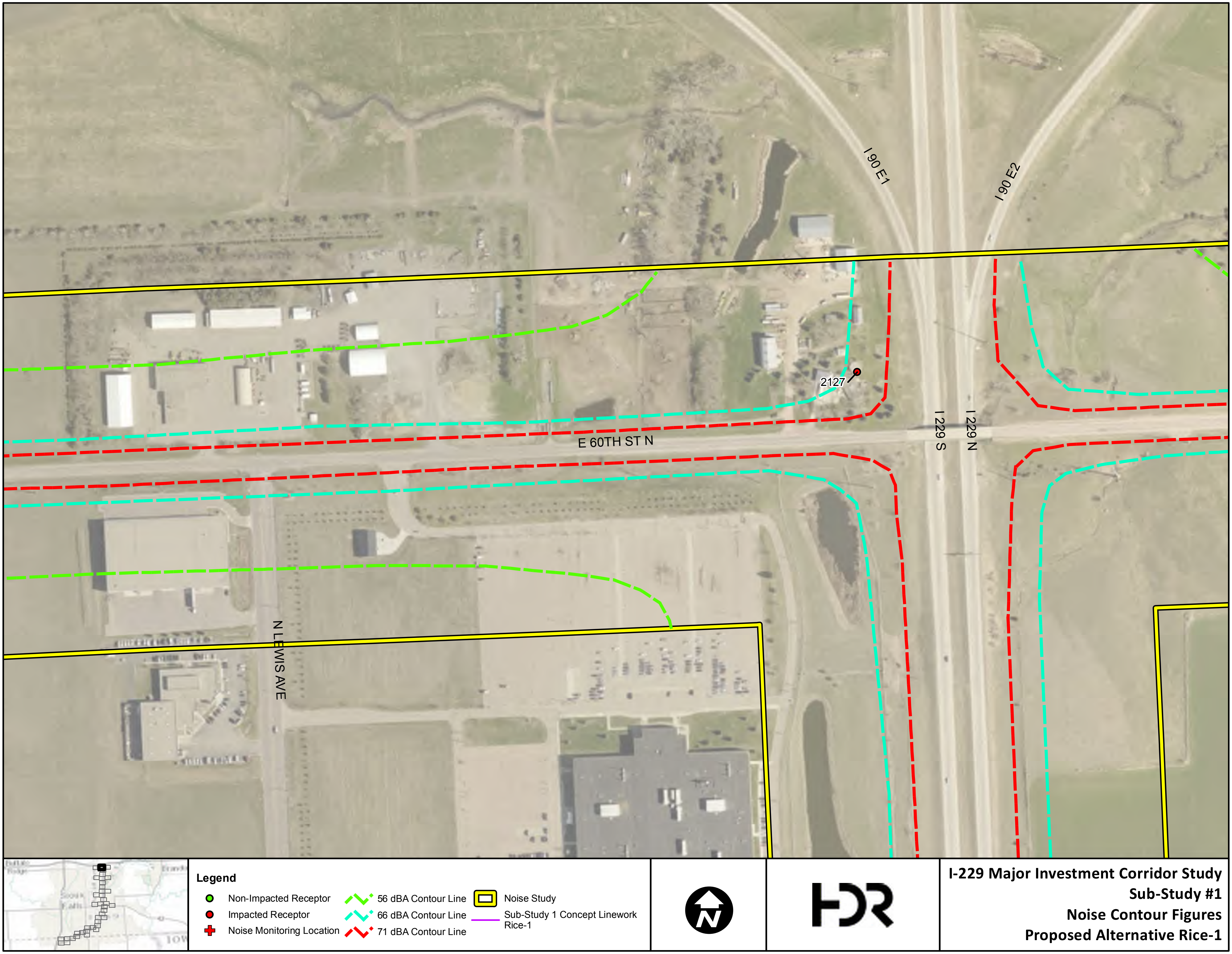
Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 1 Concept Linework Rice-1

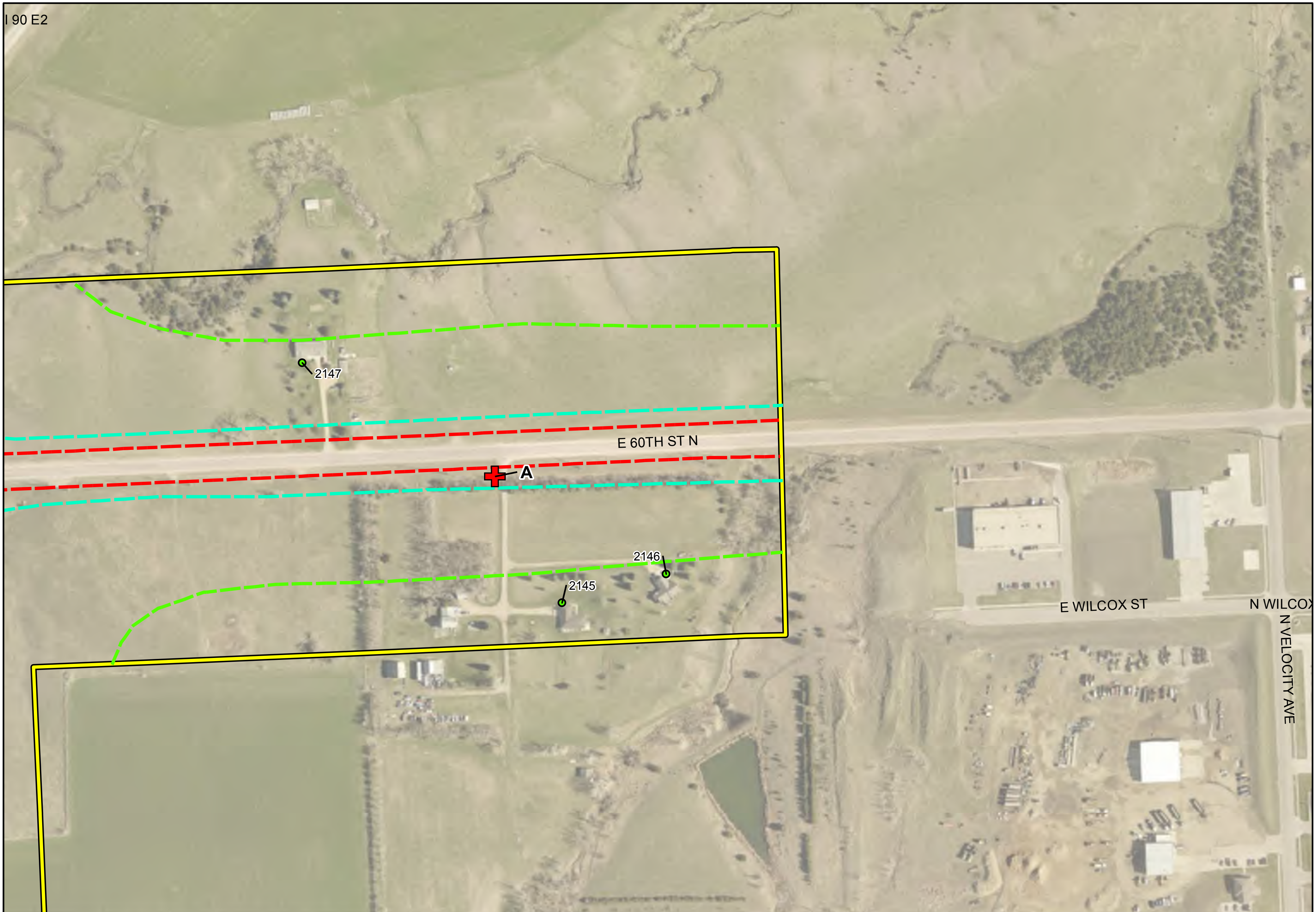
I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Rice-1

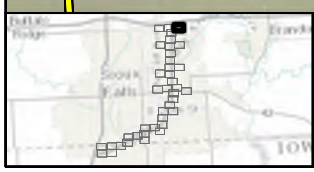


I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Rice-1



I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Rice-1





Legend

- Non-Impacted Receptor
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- Noise Study
- Sub-Study 1 Concept Linework Rice-1

I-229 Major Investment Corridor Study
Sub-Study #1
Noise Contour Figures
Proposed Alternative Rice-1

Appendix M. Public Involvement

The general public and public agencies were involved throughout the study process, with public meetings, landowner meetings, a website, and other techniques.

Public meetings

Public Meeting #1

The first Public Open House was held on October 30th, 2013. This meeting included an overview presentation describing the drivers of the I-229 Major Investment Corridor Study, types of findings the study will eventually result in, how to get/stay involved in the study, schedule, and next steps. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from this open house can be found in the ***APPENDIX***.

Public Meeting #2

The second Public Open House meetings were held on June 1st and 2nd, 2015. A presentation at the meeting provided a summary of study efforts to date, including the 2035 No-Build peak hour level of service results, conceptual ideas for I-229 mainline and interchange improvements and next steps in the study. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from this open house can be found in the ***APPENDIX***.

Cliff Avenue and Rice Street Public Meetings

The Cliff Avenue and Rice Street crossroad corridors were originally a part of the I-229 Corridor Study. During the development of the analysis of the potential concepts, it was determined to separate these corridors into their own sub-studies. The first Public Open House for these two corridors was held on June 22nd, 2016. A presentation at the meeting provided a summary of study efforts to date, including the 2035 No-Build peak hour level of service results, conceptual ideas for I-229 mainline and interchange improvements and next steps in the study. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from this open house can be found in the ***APPENDIX***.

Public Meeting #3

The third Public Open House (and second for the Cliff Avenue and Rice Street crossroad corridors) was held on December 6th, 2016. A presentation at the meeting provided a summary of study efforts to date, including the alternative scenario evaluation results, alternative scenarios recommended for further consideration. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from this open house can be found in the ***APPENDIX***.

Business/Landowner Group Meetings

Business/landowner group meetings were held on the following dates for the following sub-studies:

- I-229 Exit 3 (Minnesota Avenue) Crossroad Corridor Study
    - Stakeholder Meeting #1 – December 16th, 2014

  - Stakeholder Meeting #2 – December 6th, 2016
- I-229 Exit 4 (Cliff Avenue) Crossroad Corridor Study
  - Stakeholder Meeting #1 – June 22nd, 2016
  - Stakeholder Meeting #2 – December 5th, 2016
- I-229 Exit 6 (10th Street) Crossroad Corridor Study
  - Stakeholder Meeting #1 – December 16th, 2014
  - Stakeholder Meeting #2 – December 5th, 2016
- I-229 Exit 7 (Rice Street) Crossroad Corridor Study
  - Stakeholder Meeting #1 – June 22nd, 2016
  - Stakeholder Meeting #2 – December 6th, 2016
- I-229 Exit 9 (Benson Road) Crossroad Corridor Study
  - Stakeholder Meeting #1 – December 15th, 2014
  - Stakeholder Meeting #2 – December 5th, 2016

All of the meetings were designed to allow landowners within the study area to discuss specific issues regarding their properties with study staff. In addition, several meetings were held with individual landowners where specific improvement options, and the associated impacts of those options, were discussed. Meeting notes, sign-in sheets, public comments, and PowerPoint slides from all the meetings can be found in the **APPENDIX**.

Study Advisory Team

The Study Advisory Team, comprised of representatives of the Federal Highway Administration, South Dakota Department of Transportation, City of Sioux Falls, and the Sioux Falls Metropolitan Planning Organization, met periodically during the study to guide the study process and provide agency input. Members of the Study Advisory Team are shown in **TABLE 1**.

Table 1. Study Advisory Team Members

NAME	AGENCY
Shannon Ausen	City of Sioux Falls – Public Works
Mike Behm	SDDOT – Project Development
Christina Bennett	SDDOT – Operations Support
Jeff Brosz	SDDOT – Transportation Inventory Management
Andy Vandel	SDDOT – Project Development (Safety)
Joel Gengler	SDDOT – Right of Way
Amber Gibson	Sioux Falls MPO
Kevin Goeden	SDDOT – Bridge Design
Steve Gramm	SDDOT – Project Development (Planning)
Heath Hoftiezer	City of Sioux Falls – Public Works
Mark Hoines	FHWA

Dave Huft	SDDOT – Research
Bruce Hunt	FHWA
Scott Jansen	SDDOT – Mitchell Region
Captain Alan Welsh	South Dakota Highway Patrol
Ryan Kerkvliet	Sioux Falls MPO – Citizens Advisory Committee
Tom Lehmkuhl	SDDOT – Project Development (Environmental)
Pete Longman	SDDOT – Road Design
Ron McMahon	FHWA
Paul Nikolas	SDDOT – Road Design
Brad Remmich	SDDOT – Project Development (Planning)
Craig Smith	SDDOT – Mitchell Region

Website

A study provided easy access to information and documents prepared as part of the study. The website address was: WWW.I229STUDY.COM

The website provided project updates throughout the course of the study.

The "***Get Involved***" page provided opportunity for website visitors to submit a project comment or question.

The "***Resources***" page included links to relevant ongoing transportation studies in the area, as well as previously written documents referred to as part of the I-229 MIS.

MPO Meetings

The study team met with the Sioux Falls MPO in November 2013 and May 2015. The meetings on November 13th and 14th, 2013 followed Public Meeting #1, and the meetings on May 20th and 21st, 2015 followed Public Meeting #2. The formal presentations given at these MPO meetings were the same meeting materials as discussed at the public meetings.

APPENDIX -

PUBLIC MEETING #1 – OCTOBER 30TH, 2013

- **MEETING NOTES**
- **SIGN-IN SHEETS**
- **COMMENTS**
- **POWERPOINT SLIDES**

HDR | ONE COMPANY *Many Solutions*

Meeting Notes

Subject: I229 MIS Public Open House #1	
Client: SDDOT	
Project: I229 Corridor Study	Project No: 207030
Meeting Date: October 30th, 2013	Meeting Location: Sioux Falls Convention Center
Notes by: HDR	

Debrief Record: The following notes were provided by study participants to members of the study team during the meeting while reviewing the various open house displays.

1.) Many comments around providing better crossings for ped's and bike's along the I229 corridor. They find it very hard to get from one side to the other since most interchanges only have sidewalk on one side. Connections directly to the bike trail would be great.
2.) Several comments on how poor the 26th Street Interchange is and that the SB off/on ramp is so short it causes accidents and many people slide off of the road due to the tight SB on ramp curve.
3.) A few members heard a desire to finish the 49th Street extension as they believe it is long overdue.
4.) Interstate users believe that aux. lanes from 10th Street to 26th Street should be implemented soon.
5.) The interchange at 10th Street and the proximity of Cleveland Avenue is not good; this area doesn't work because one intersection backs up the other. Need to figure out something different at Cleveland.
6.) Many believe the I229 corridor needs to be 3 lanes in each direction to handle the traffic that we will see in the future.
7.) A few noted that placing a half interchange at 60th Street north would dramatically improve access to the industrial park and would reduce congestion at Benson Road.
8.) Folks from the SF Bike Club indicated that they would not use 10th Street as a bike route due to the driveway access. Rather have a route on 6th Street or 12th Street or both.
9.) Encourage the industrial park businesses to stagger shifts to reduce peaks in the traffic along the interstate.
10.) Maintain Access to businesses along Minnesota; don't place a median that will take away half of my traffic.
11.) Build the bridge over the BSR east of Hwy 11 on the 57th Street alignment so everyone doesn't have to enter the east side of the City on SD 42 which will reduce congestion on 10th Street.
12.) Lower the speed limit on I229 to 55 mph.
13.) Interested in the placement of variable speed limits on I229, have seen these in other locations and area easy to follow.
14.) SB on Ramp at 10th does not work well due to the structure in such close proximity.
15.) Summer mowing practices may need to be modified to insure grass is kept shorter to improve sight from ramp to interstate as vehicle merges with mainline from the on-ramp.
16.) Horizontal curves between 10th and 26th can be a problem during winter events.
17.) Conflicting comments heard regarding noise walls, some folks say they are needed and believe they need to be built soon and others felt that it would make their home "feel like a prison" to have a noise wall in their backyard and that the noise isn't that bad.
18.) An auxiliary lane is needed along SB I-229 between Louise Avenue and the I-29 NB ramp.
19.) On I-29, there needs to be a third lane / auxiliary lane between I-229 and 57th Street (Outside of Study Area).

20.) Need an interchange on I-29 @ 85th Street to allow for southern Sioux Falls to continue growing. (Outside of Study Area).
21.) Would like a crossing of I-229 for 33rd Street.
22.) Removing Yeager Road would be bad for 26th Street between I-229 and Cliff Avenue.
23.) There was concern over the elevation for the future 26th Street. There's also a "dip" in 26th Street at the old railroad bridge that they hope will be fixed with the new interchange.

6300 So Old Village Place
Suite 100
Sioux Falls, SD 57108

Phone (605) 977-7740
Fax (605) 977-7747
www.hdrinc.com

SIGN IN SHEET

Subject:	I-229 Major Investment Corridor Study – Public Open House #1		
Client:	City of Sioux Falls / South Dakota Department of Transportation		
Project:	PL 0100(87) 3616P, PCN 044K	Project No:	207030
Meeting Date:	Wednesday, Oct 30th, 2013 5:30 – 7:00 PM	Meeting Location:	Sioux Falls Convention Center

Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Chad Huwe / City of SF		367-8601	chuwe@siouxfalls.org
2	Manny Steele Dist 12		335-7036	bombmanny78@gmail.com
3	Nick mentele		770-8856	nickmentele@yahoo
4	Jim Entenman			
5	Stacy DuChene		221-2647	sduchene@mgreen.com
6	Trent Swanson	100 N Phillips #901 SF SD 57104-6725	335-4962	trents@cutlerlawfirm.com
7	Stephanie Logue	6300 S. Old Village Pl SF	997-8104	Stephanie.logue@hdrinc.com
8	Allen Bindert	47120 85th SF	605-368-2114	
9	Jack Mallek	4705 Yellowstone	335-5596	
10	Gail Brown	6500 Tallgrass	357 4780	
11	Craig Lloyd	6904 S Westfield Tr	376-5834	Craig@LloydCompanies.com
12	Marv Schlechter	809 Day Ave	336-6874	
13	Mike Kuno	724 W Cascade St	413.5874	
14	Rodney McClure	1800 W 22nd St	332-7290	
15				
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18				
19				

SIGN IN SHEET

CITY OF SIOUX FALLS PUBLIC WORKS — Providing a Better Quality of Life for You!

Subject:	I-229 Major Investment Corridor Study – Public Open House #1
Client:	City of Sioux Falls / South Dakota Department of Transportation
Project:	PL 0100(87) 3616P, PCN 044K — Project No: 207030
Meeting Date:	Wednesday, Oct 30th, 2013 5:30 – 7:00 PM — Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Rich Schwanke VFW	3601 S Minnesota St.		Imbliss688@aol.com
2	Butch Haugen VFW	3601 S. Minn. SFSD	605-553-5518	bhaugen@gmail.com
3	Mike Behm SDDOT	700 E Broadway Pierre SD	605 773 4423	Michael.Behm@state.sd.us
4	Brad Remmich SDDot	" "	605-773-3093	bradley.remmich@state.sd.us
5	Thomas Hein	6100 E Hein Place SF	605-361-8400	
6	Christina Bennett	Pierre, SD 700 E Broadway Ave	605-773-4759	christina.bennett@state.sd.us
7	Ross Harris	5525 Merle Hay Rd STE 200	515-278-2913	rharris@hrgreen.com
8	Steve Hoff	6300 S. Old Village Sioux Falls, SD	605-977-7740	steve.hoff@hdrinc.com
9	Kent Scribner	1505 S. Kiwanis, # 244 SF, SD 57105	605-338-0966	akscrib@yahoo.com
10	Brad Hicks	604 S. Conklin SF SD 57103		
11	Bill + Carol Kollis	3217 W. Zephyr Pl S.F. SD.		
12	Larry Karsten	2504 E. 19th	338-4760	
13	Chris Parsley	7001 W 66th	319-389-1507	cmparsley@gmail.com
14	Brent Hamilton	1301 S. Majestic View	605-553-3868	
15	Jerry + Jackie Nash	2105 Tricia Lane	605-338-1970	
16	Julie Christiansen	1705 S Riverdale	605-338-3260	bigkahuna@sconidco.net
17	Robert Leonhardt	2001 S. Cardinal Dr	605-331-5074	
18	Mike Miller	3905 S Jolly SF 57103		
19	Mark Hoines	116 E. Dakota		

SIGN IN SHEET

Subject:	I-229 Major Investment Corridor Study – Public Open House #1
Client:	City of Sioux Falls / South Dakota Department of Transportation
Project:	PL 0100(87) 3616P, PCN 044K — Project No: 207030
Meeting Date:	Wednesday, Oct 30th, 2013 5:30 – 7:00 PM — Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Steve Gramm	700 E Broadway Ave Pierre	605-773-6641	steve.gramm@state.sd.us
2	Jim Stalzer	5909 W Bristol Dr	605-366-5874	rep.stalzer@state.sd.us
3	Ruth Smith Gordon Smith	3500 E 60th St N 57104	605-940-4943	——
4	Amber Gibson SECOG	500 N Western Ave. Ste 100 SF SD 57104	605-367-5390	amber@secog.org
5	Mike Holm	1309 E NorthStar		mholm@cibinc.net
6	Joan Storer	3900 W Avera Dr	605 322-4373	joan.storer@avera.org
7	Dennis Waldrayer	5510 ShadowWood PL.	605-351 0219	dwaldrayer@lincolncounty sd.org
8	Josh Larson	2208 S Sheffield	605-205-0016	joshadc@hotmail.com
9	George Hahn	647 S. Main	360-6639	SF SD 57104
10	Arnie Wulf	1600 S Gray Goose	335-1897	AMWULF@SVTV.com
11	Glenda Breed	944 S. Holt Ave	940-6380	cribstein@sio.midco.net
12	Phil Gundvaldson	1800 E. Arrowhead Pass	929-8190	philg@infrastructuredg.com
13	Bob Bohm	3600 S Duluth Ave	334 4220	robert.bohm@dakotability.org
14	Mike Murphy / SF YMCA	2411 S. Carter Pl.	360-7414	camp@siouxfallsymca.org
15	Duane A.			duane@hss.com
16	Brian Ray	8404 Indian Hills Drive Omaha NE	402 399 1000	brian.ray@hdrinc.com
17				
18				
19				

CITY OF SIOUX FALLS PUBLIC WORKS
Providing a Better Quality of Life for You!

SIGN IN SHEET

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Client:	City of Sioux Falls / South Dakota Department of Transportation		
Project:	PL 0100(87) 3616P, PCN 044K	Project No.	207030
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Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Joel WGangler SDDOT	700 E Broadway Ave. Pierre SD	605-773-3746	—
2	Pete Longman SDDOT	700 E Broadway Ave Pierre	605-773-6488	-
3	Vicki Melrose	[illegible] S. [illegible] Ave. SF SD 5[illegible]		
4	Rex Rolfing	SFSD		
5	Gerald Teunissen	SF, SD		
6	James Unruh	HDR SF, SD		
7	Sam Trebilcock	City of SF	367-8890	
8	Heath Hoftiezer	City of SF		
9	Jon Wiegand	HR Green		
10	Bill Moran	HR Green		
11	Cheryl Rath	SFSD		
12	Clint Kolda	7605 W. Regina SF SF		dakotacyclist@gmail.com
13	Steven [illegible]	5000 [illegible] Cir SF		
14	Rick Kiley	1108 N. West Ave Sioux Falls	605-361-7785	kiley@southdakotasafety.org
15	Ernie Otten	46787 273rd St.		
16	Tom Sweetman	PO Box 2320 SFSD 57101	605 366 5746	thomasrsweetman@gmail.com
17	Greg Boris	5915 E Westwind	321-5514	
18	[illegible]	616 E. Winwell Pl.	376.4056	
19	Marshall Lavin	1710 S. Southeastern Ave	334-7979	glavins@sio.midco.net

SIGN IN SHEET

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Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1	Mary : Jack Mortenson	2116 S. Crestwood Rd	605.321-0509	mary@sparklight.org
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I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before Nov 8th, 2013 to:

Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Very informational when asked questions while looking at the boards. Excited to See the progress take place

(optional)
Name: ______________ Address: ______________

Phone: ______________ Email: ______________

I-229 Major Investment Corridor Study

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6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

(optional)
Name: Jim Stalzer

Address: 5909 W Bristol Dr 57106

Phone: 605-366-5874

Email: jim.stalzer@gmail.com

I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

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Fax: *605-977-7747*

Very informational when asked questions while looking at the boards. Excited to See the progress take place

(optional)
Name:
Address:
Phone:
Email:

Kjenstad, Jason

From: BlueMail@bluehost.com
Sent: Wednesday, October 16, 2013 3:05 PM
To: email@i229study.com
Subject: Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Chris Parsley
Org	Falls Area Bicyclists, President
Address2	7001 W 66th St
CSZ	Sioux Falls, SD 57106
Phone2	319-389-1507
Email2	cmparsley@gmail.com
Study2	I-229 Corridor Study
Comments	According to item 2, consider that bicycles operate as vehicles and make sure that the I229 crossings are safe for bicyclists. I would also ask that a pedestrian crossing be considered from South Phillips over I229 and connecting to the multi use path on the other side.
redirect2	http://www.i229study.com/thank-you.html

Kjenstad, Jason

From: Chris Parsley <cmparsley@gmail.com>
Sent: Wednesday, October 30, 2013 5:33 PM
To: Kjenstad, Jason
Subject: I229 MIS

Some of my concerns involve getting pedestrians and bicyclists over I229 safely. I have not seen anything in the plan that addresses this issue.

Kjenstad, Jason

From: BlueMail@bluehost.com
Sent: Sunday, October 27, 2013 7:23 PM
To: email@i229study.com
Subject: Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Jonathan Keill
Org	N/A
Address2	1515 S Glendale Ave
CSZ	Sioux Falls, SD 57105-1417
Phone2	(605) 321-2517
Email2	jjkeill@hotmail.com
Study2	I-229 Corridor Study
Comments	I've lived in Sioux Falls my whole life and am planning in the near future to relocate to the Twin Cities to attend a graduate program at the University of Minnesota in urban planning and design. After reviewing this study (as well as having seen the city and its traffic grow by leaps and bounds in the 25 years I've lived here), I have several ideas as to how we can possibly create new or reconfigure existing exits along the I-229 corridor. A few of these would require "hybrid" exits so-to-speak...but seeing how well the freeway systems work in the Twin Cities, I believe we would be able to maximize efficiency in traffic flow along the corridor for decades to come (not to mention a couple of ideas for the stretch of I-29 from I-229 to 41st St). These would provide increased access to the Empire/Empire East and the Interstate Crossing Business Park. I don't have professional software or anything with which I can already provide detailed plans...however, I would enjoy being able to meet with or talk to someone about my ideas and see if there is a plausibility aspect to them. Granted, I also am not very privy to things like costs or right-of-way, but having an analytical and mathematical mind, I feel I am able to see how things could be improved in a number of ways. I'd love to hear back from someone just to offer some proposals. Thank you for your time!
redirect2	http://www.i229study.com/thank-you.html

- Jason met w/ Jon Keill - Shared ideas for on/off ramps to 57th near I229 Underpass
- wants a connection for 69th to I29
- nothing really new between Western and Rice
- Interested in Benson - 60th - I229/I90 Junction

Kjenstad, Jason

From: Thomas Hein <theinmail@gmail.com>
Sent: Monday, November 04, 2013 9:38 AM
To: Kjenstad, Jason
Cc: Jeff R. Mindt; Shally Rogen; Brian Sather (gdentltd@hotmail.com); Eric & Mary Stormo (estormo@uswest.net)
Subject: I-229 Major Investment Corridor Study

Jason,
This email is in regards to your meeting on October 30th, 2013.
Please be advised that I own, with four other partners, the property call Minnesota Crossing located on the corner of 43rd and Minnesota Ave.
I am extremely concerned that you and your planning group are going to attempt to take our accesses away from the building located at 3508 S Minnesota Ave., just north of the Taylor Oil building.

I am hoping, with advance notice, your engineering team can design an appropriate exit on I-229 and Minnesota Ave so that you will be able to keep and maintain the integrity of my real estate access points. This real estate truly enhances its value because of the customers traveling south and approaching my strip mall as well as those customers coming from the South traveling North.
Lets make sure that we work toward the common goal of keeping both those access directions open from both north and south and not try to consider a median in the middle of the road way to eliminate 1/2 of our customer base.

Please be sure to forward all design concepts that you are discussing or considering so that we may include our input to find a win win solution.
I will watch for your reply and acknowledgement that you will provide me with all concept drawings that you are considering.

Thanks for your help in advance.
Tom Hein

Kjenstad, Jason

From:	BlueMail@bluehost.com
Sent:	Wednesday, November 06, 2013 5:06 PM
To:	email@i229study.com
Subject:	Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Robin Solberg-Versluys
Org	
Address2	1205 S Gordon Dr
CSZ	Sioux Falls SD 57110
Phone2	605-331-5015
Email2	robin.versluys@gmail.com
Study2	I-229 Exit 9 (Benson Rd) Study
Comments	I work in the Industrial Park area and have noticed how bad the traffic is on East Benson getting on I229 South. I take E54th St N to Lewis Avenue then south to Benson. There are two lanes that turn left (east) on to Benson Rd off Lewis. However, there is approximately 1/2 mile for everyone from the two lanes to merge together into one lane to get onto I229 south. If someone is nice enough to let you in to the lane, you need to be very careful as the people in front of you are usually stopping for others that need to be let in. I can only imagine how many accidents or close calls there have been in this area. The second part of the problem is there is a street closer to the exit (Potsdam Ave) in which you have other people trying to get onto Benson. I think it would be more beneficial if there were two lanes to turn south onto I229 and merge prior to entering I229 (similar to the exit on the Benson and I29, and 12th and I29), and possibly a stop light on Potsdam to help those travelers get onto Benson. There are two lanes getting off of I229 onto Benson and i think the traffic would flow a lot better if the other side (south bound exit) would have two lanes also. Thank you, Robin Solberg-Versluys
redirect2	http://www.i229study.com/thank-you.html

Kjenstad, Jason

From: Mark Miller <mark.miller@sio.midco.net>
Sent: Sunday, November 17, 2013 9:56 AM
To: Kjenstad, Jason
Subject: I-229 Corridor Study

I live in south Sioux Falls and work by Sanford Research in northern Sioux Falls. I know the traffic well on 229. Traffic is solid during peak commute times. People are becoming more impatient and careless with their driving habits. I notice cars weaving between traffic, cutting off other drivers while jockeying for a better position for the Benson Road exit. That exit is overwhelmed during rush hours. Last week there was a accident on the ramp, causing traffic to backup in the 2 outside lanes of 229 all the way down to the Rice Street exit. The other problem is traffic merging on Benson to go south on 229. Again, impatient drivers and dangerous driving decisions.

Here are my suggestions:
- put in a half-diamond interchange at 229 and 60th Street N. This will alleviate the load on Benson tremendously. Without question this would be my first choice. It would be the most cost effective development to address the traffic congestion at Benson.
- widen 229 to four lanes. The reality is that traffic is bad now and is going to get worse as the north industrial parks continue to develop. Completing Hwy 100 is a long ways out and will not provide relief in time.

Kjenstad, Jason

From: BlueMail@bluehost.com
Sent: Sunday, December 01, 2013 7:52 PM
To: email@i229study.com
Subject: Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Michael Christensen
Org	
Address2	1813 S Purdue Ave
CSZ	Sioux Falls, SD, 57106
Phone2	605-929-8923
Email2	mytzpyk@gmail.com
Study2	I-229 Corridor Study
Comments	Please include Cliff Ave in the study: because the Cliff Ave interchange is so similar to the Minnesota Ave interchange I am surprised that it is not being included in this study. I understand there may be vehicular factors that logically cause its exclusion, however the issues faced by pedestrians and bicyclists are the same as Minnesota Ave interchange. Consider bike & pedestrian crash data in your analysis, please. Minnesota Ave & Cliff Ave proximity to bike trail: please recognize and plan to include better movement or access from north of I-229 to the bike trail south of I-229. I-229 blocks a major path of desire for non-motorized access to the city's best and more frequently used park feature. Fix it. Add width to the outside lanes on Minnesota Ave. Add better sidewalk visibility and controls. Bridges: add pedestrian bridges over I-229 south from West Ave, south from Phillips Ave, and east from 35th St. Itâ€™s hard for me to believe justification exists for the pedestrian bridge west from Teem Drive over I-29 that doesnâ€™t exists for any of these three possibilities.
redirect2	http://www.i229study.com/thank-you.html

Kjenstad, Jason

From:	BlueMail@bluehost.com
Sent:	Monday, December 02, 2013 8:08 PM
To:	email@i229study.com
Subject:	Message from BlueMail

Your BlueMail form has been completed, following are the results:

Field	**Value**
Name	Art Holden
Org	
Address2	705 W Victory Ln
CSZ	Sioux Falls
Phone2	6053713928
Email2	art@thundergeeks.com
Study2	I-229 Corridor Study
Comments	Please take active transportation options seriously in this study. Investments in pedestrian and cycling infrastructure have been proven to increase property values, spur economic growth, and enhance public health. I think a pedestrian bridge on South Phillips toward Tomar park would connect a large portion of central Sioux Falls to the trail and park system. I believe this would be heavily used and very valuable to the citizens of Sioux Falls. Thank you for the opportunity to voice my opinions.
redirect2	http://www.i229study.com/thank-you.html

I-229 Major Investment Corridor Study
Public Open House
October 30th, 2013 – 5:30 pm to 7:00 pm

Study Advisory Partners

Advisory Agencies

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Consultant Team

HDR Engineering, Inc.

HR Green, Inc.

CITILABS

airsage

The power of where and when

Primary Contacts

SDDOT Project Manager
Steve Gramm, PE
Project Development, Data Analysis Engineer
Steve.gramm@state.sd.us
Phone: 605-773-6641

City of Sioux Falls Project Manager
Shannon Ausen, PE
Traffic Engineering Division
sausen@siouxfalls.org
Phone: 605-367-8607

CONSULTANT - Public Involvement Lead
Jason Kjenstad, PE
HDR Engineering, Sioux Falls
Jason.Kjenstad@hdrinc.com
Phone: 605-977-7740

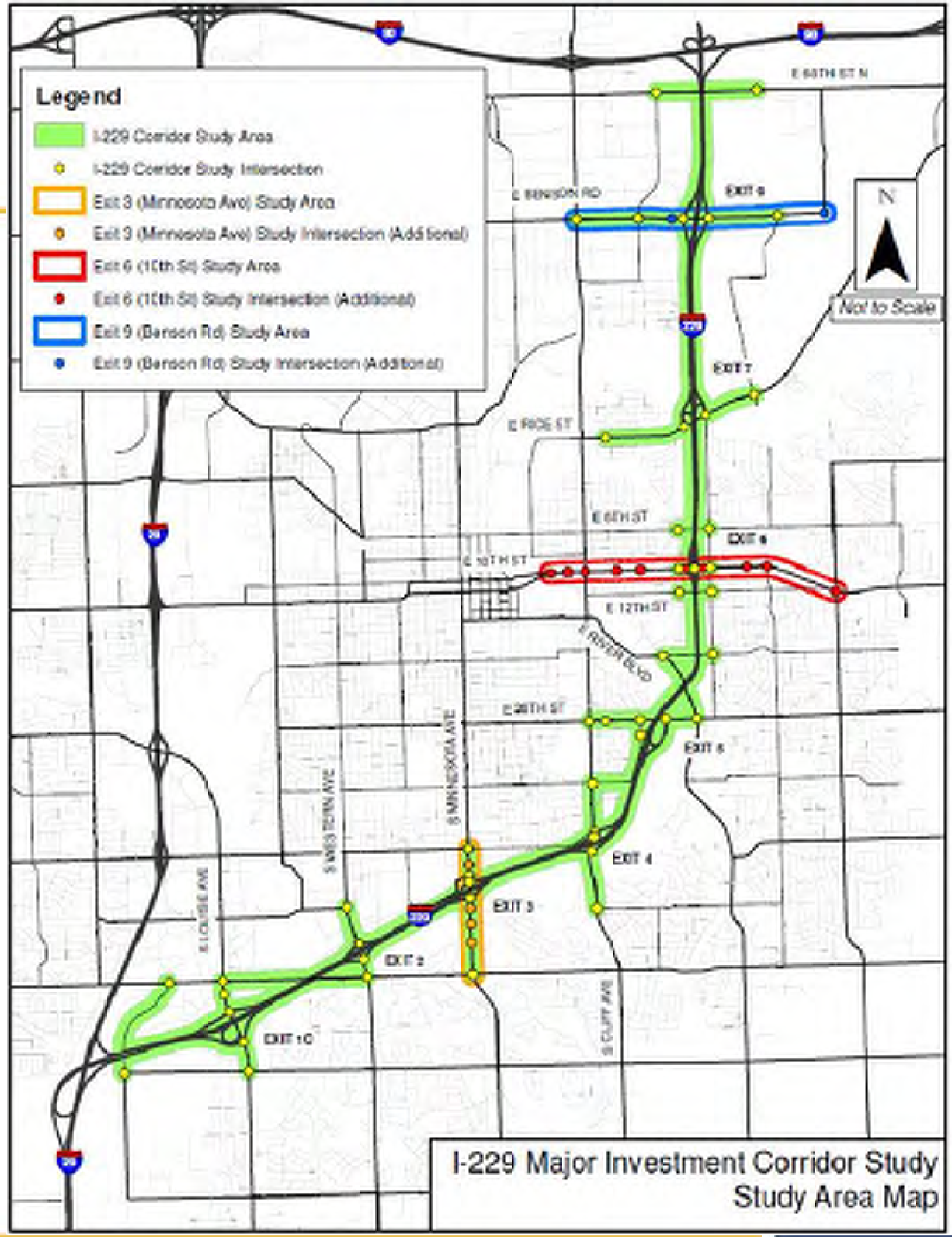
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass

to

60th Street N. Overpass



Additional Studies

Exit 3 – Minnesota Ave

Exit 6 – 10th Street

Exit 9 – Benson Road

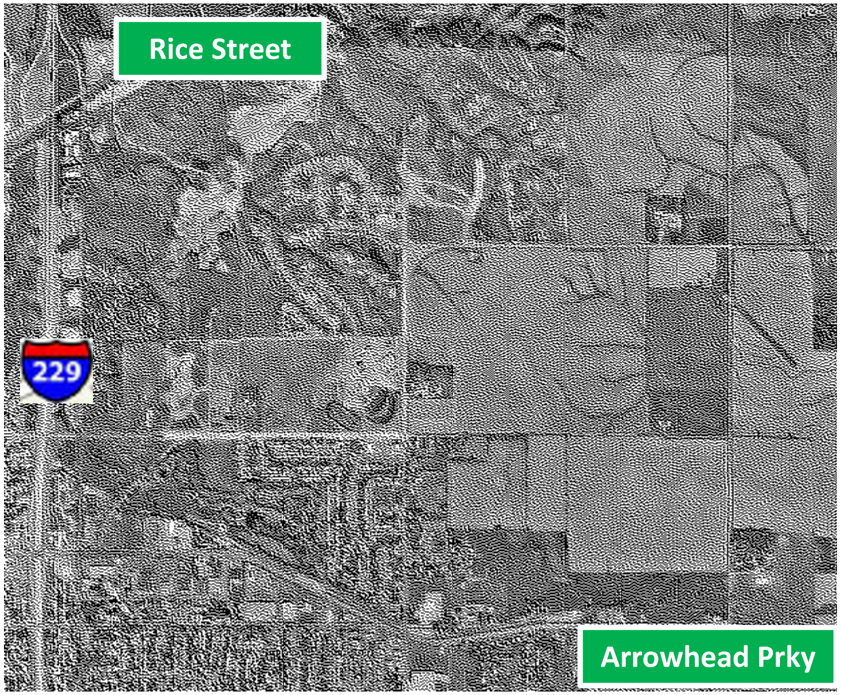
What is Driving this Study?

Louise Avenue Area – 1990's

Louise Avenue Area – 2010's

What is Driving this Study?

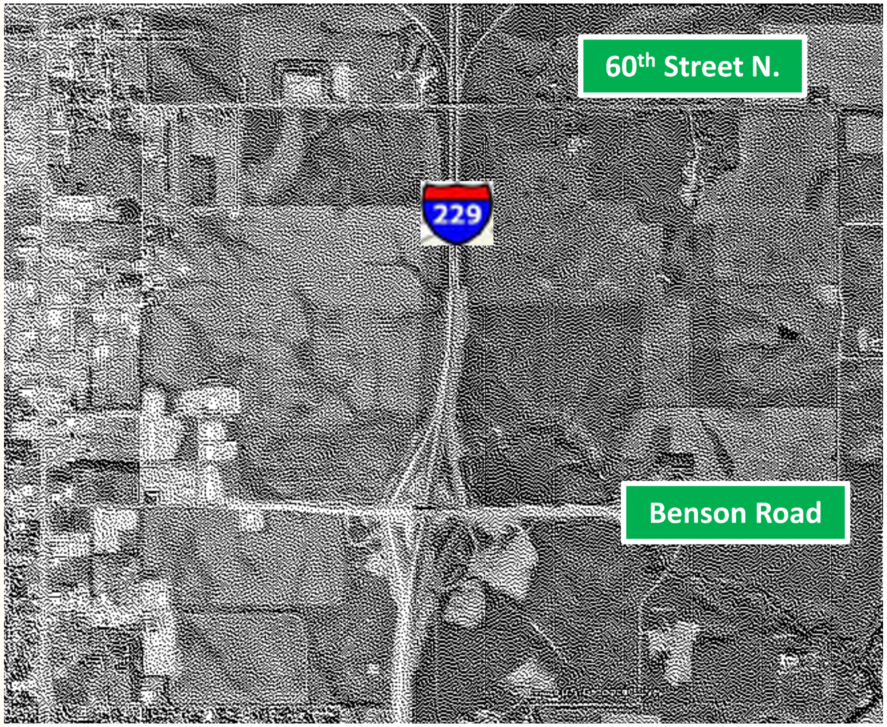
10th Street Area – 1990's



10th Street Area – 2010's

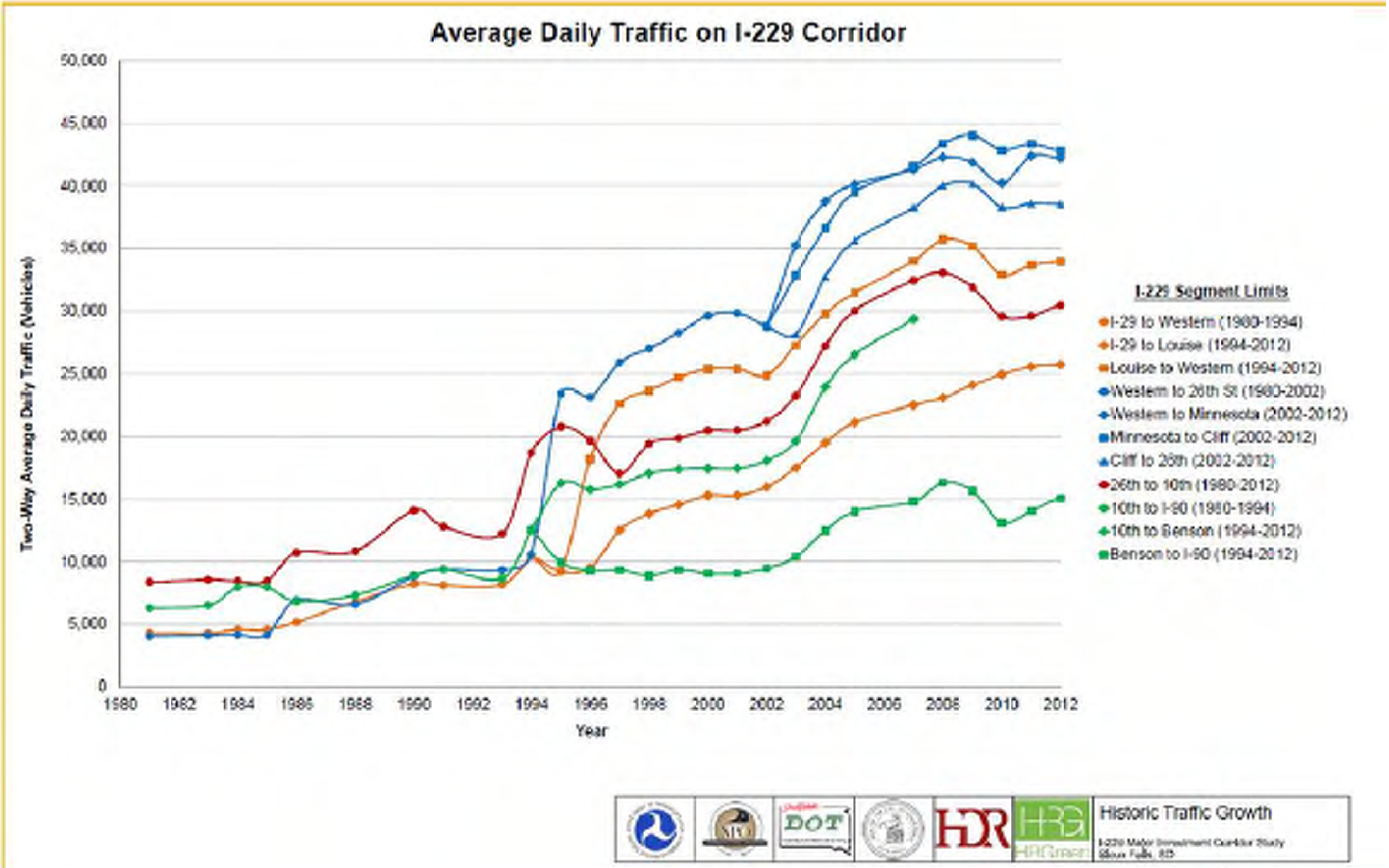
What is Driving this Study?

Benson Rd Street Area – 1990's



Benson Rd Street Area – 2010's

What is Driving this Study?



What Should the Study Tell Us?

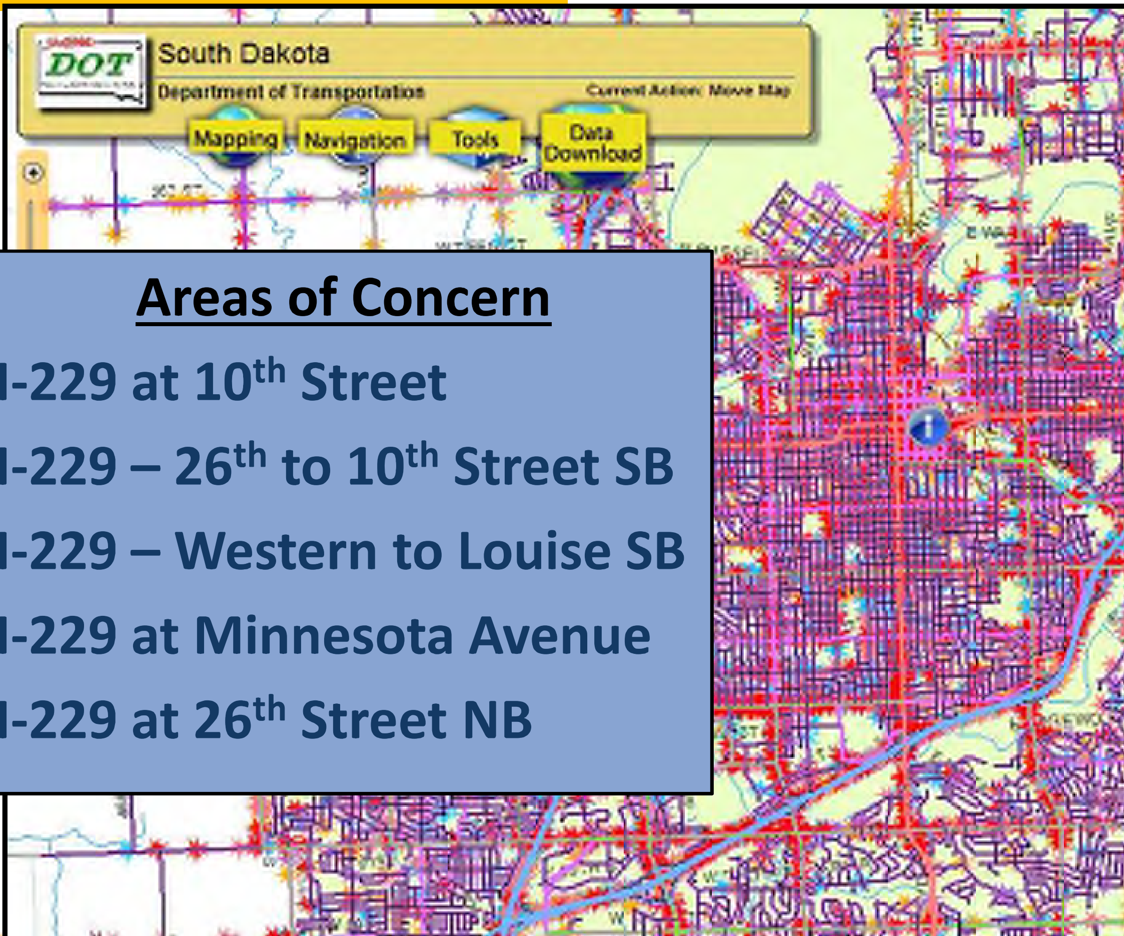
- **Traffic Capacity**

<u>Traffic Analysis Locations</u>

- I-229 Mainline
- I-229 Ramps
- Interchange Intersections
- Crossroad Intersections

What Should the Study Tell Us?

- Traffic Capacity
- **Traffic Safety**



Areas of Concern

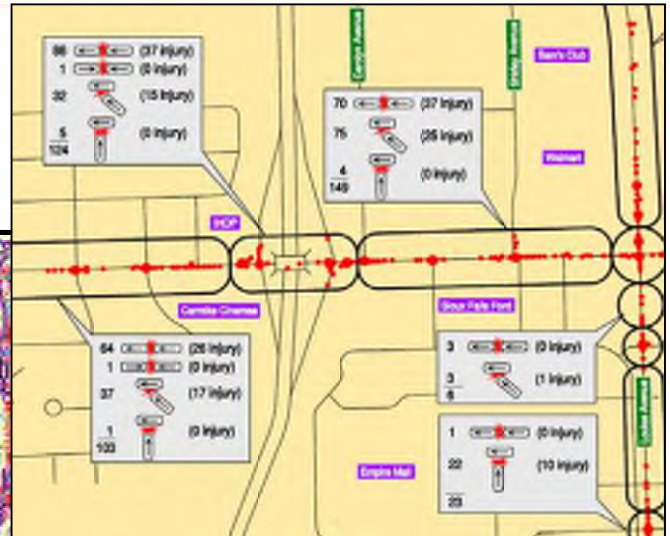
I-229 at 10th Street

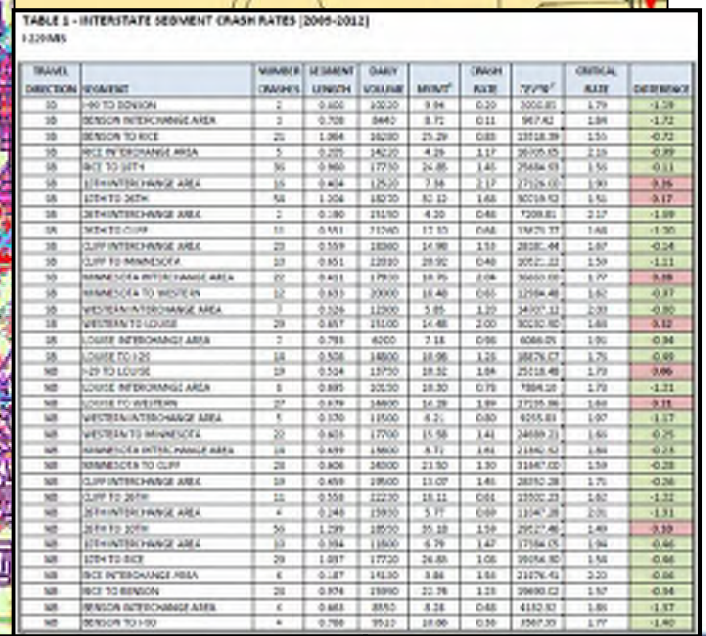
I-229 – 26th to 10th Street SB

I-229 – Western to Louise SB

I-229 at Minnesota Avenue

I-229 at 26th Street NB

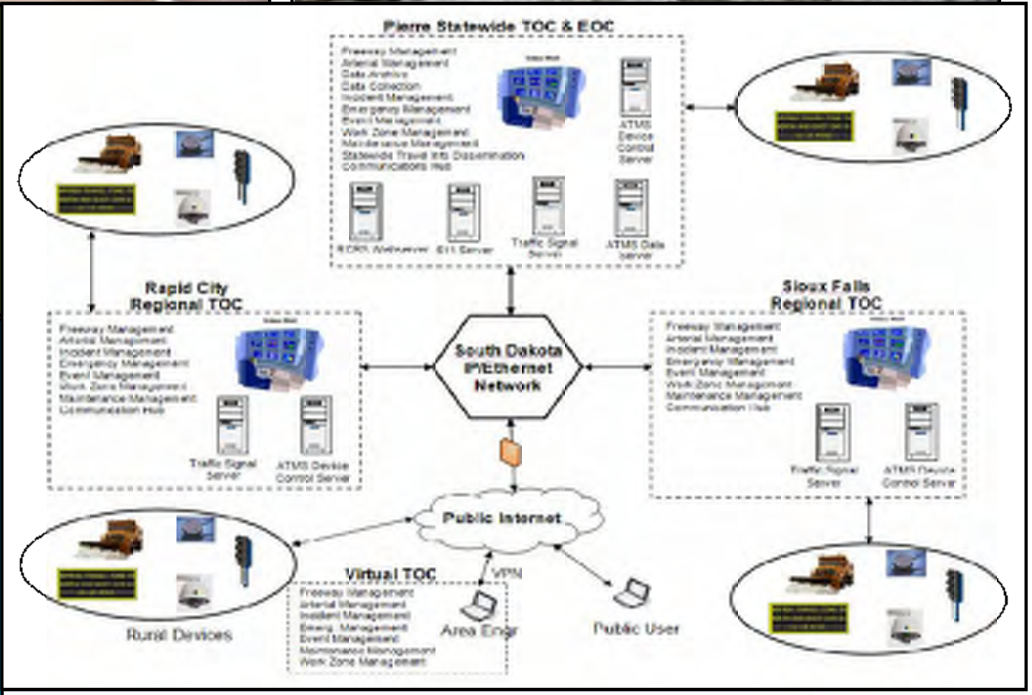




What Should the Study Tell Us?

- Traffic Capacity
- Traffic Safety
- **Incident Management**

<u>Incident Management Study Goals</u>
- Development of Base Mapping for Detours along I-229
- Begin discussions on Communication Activities



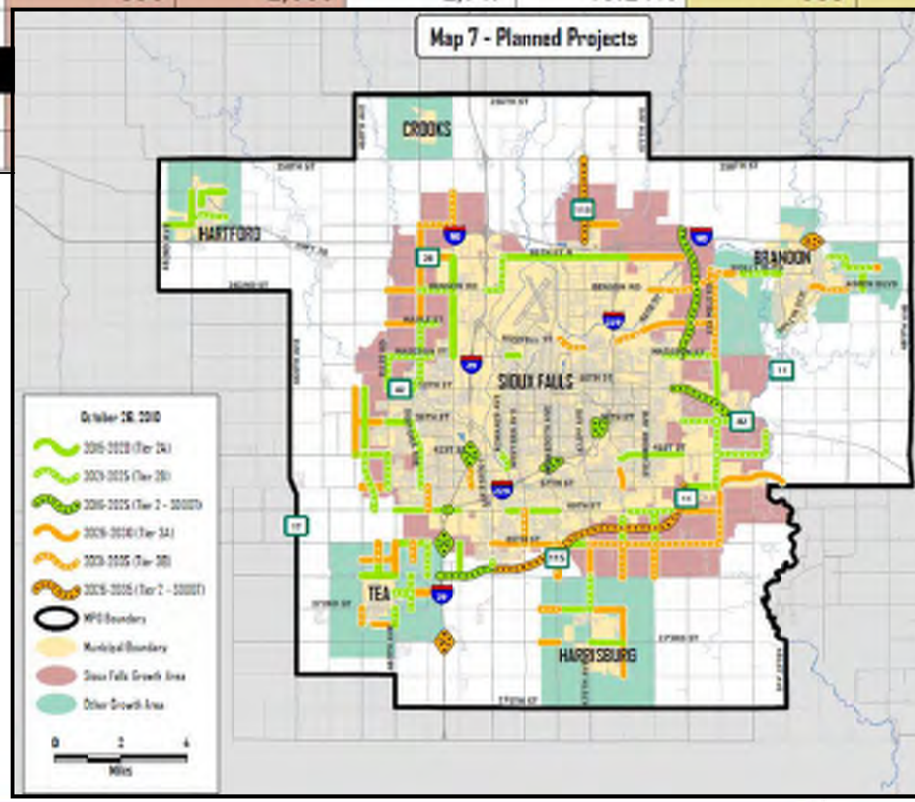
<u>Traffic Incident Management Partners</u>
- Law Enforcement
- Fire and Rescue
- Medical Services
- Public Safety Communications
- Traffic Information Media
- SDDOT, City of Sioux Falls, and others

What Should the Study Tell Us?

- Traffic Capacity
- Traffic Safety
- Incident Management
- **Short & Long Term Planning**

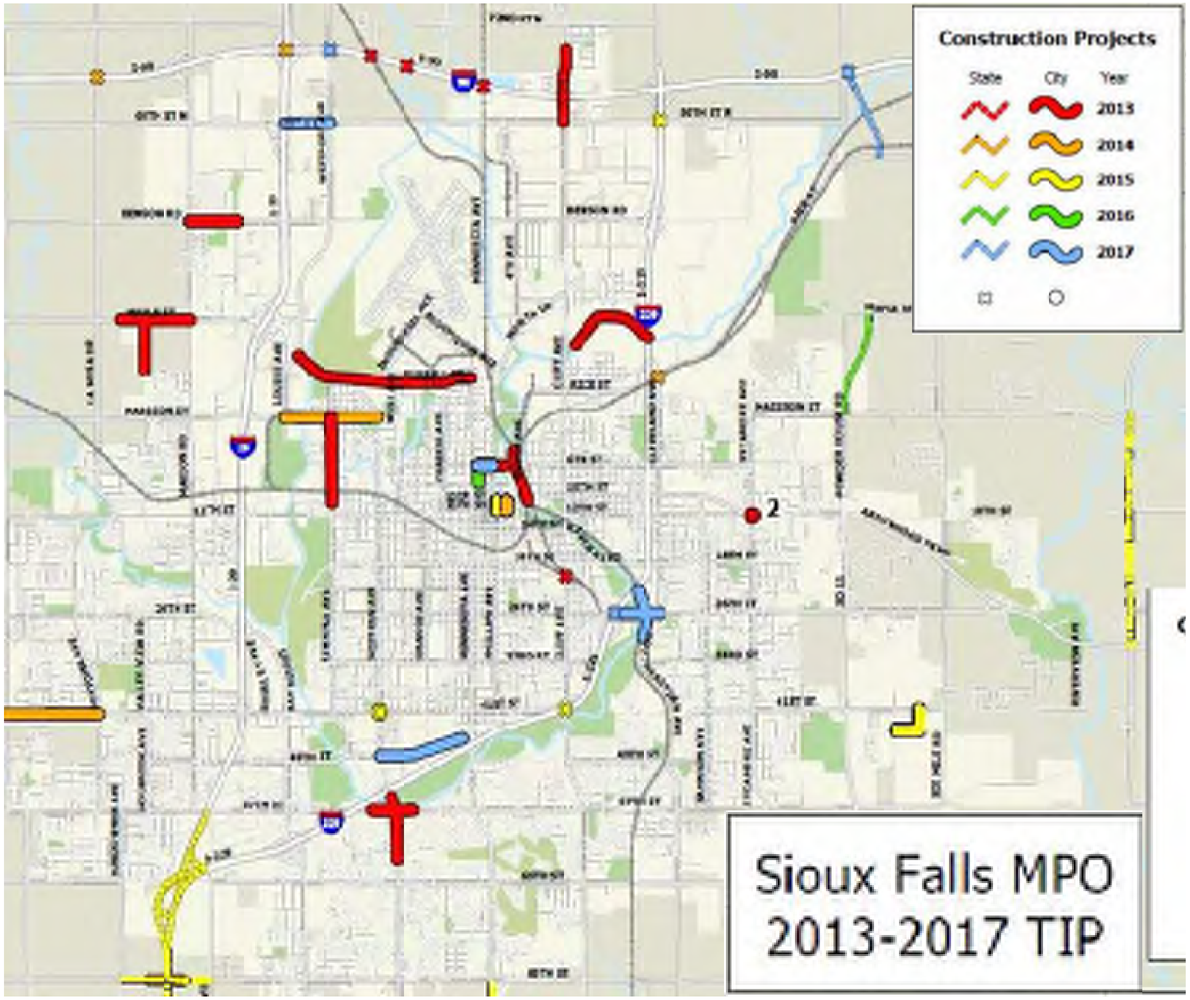
Chart 5-P: MPO Community 2035 Growth Projections

Minnehaha County Population and Employment						
City	No. of Employees 2008	Population 2008	Population 2010	Population-to-Employee Ration	No. of Employees 2035	Population 2035
Brandon	2,058	9,000	9,500	24.36%	4,889	19,500
Crooks	127	1,263	1,272	10.30%	285	2,800
Hartford	558	2,680	2,717	18.24%	935	5,000
Sioux Falls	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	270,000
Tea	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]200
Harrisburg	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]800



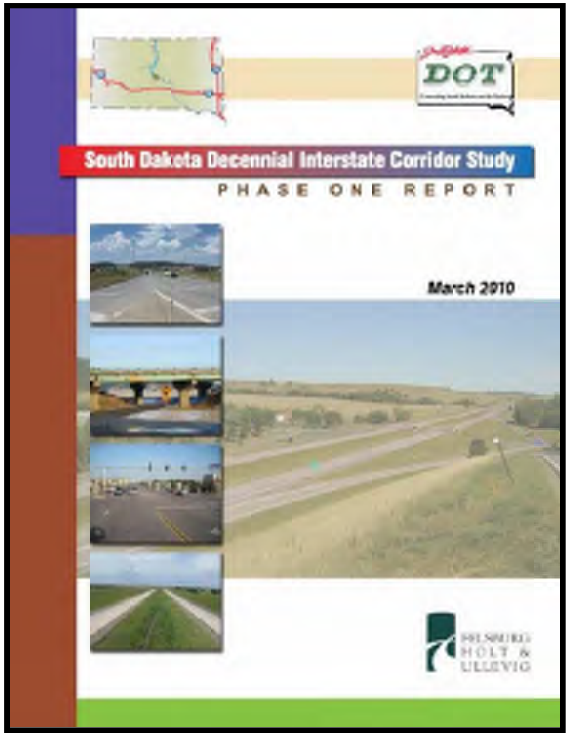
What Should the Study Tell Us?

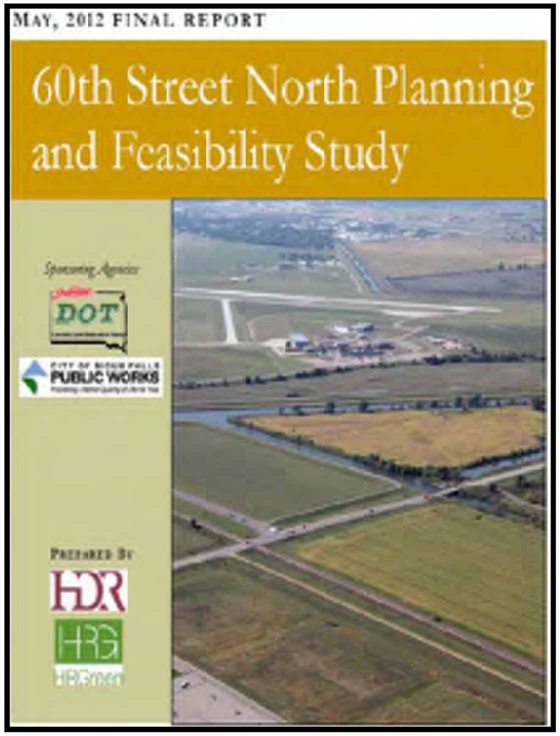
- Traffic Capacity
- Traffic Safety
- Incident Management
- Short & Long Term Planning
- **Coordinated Implementation**

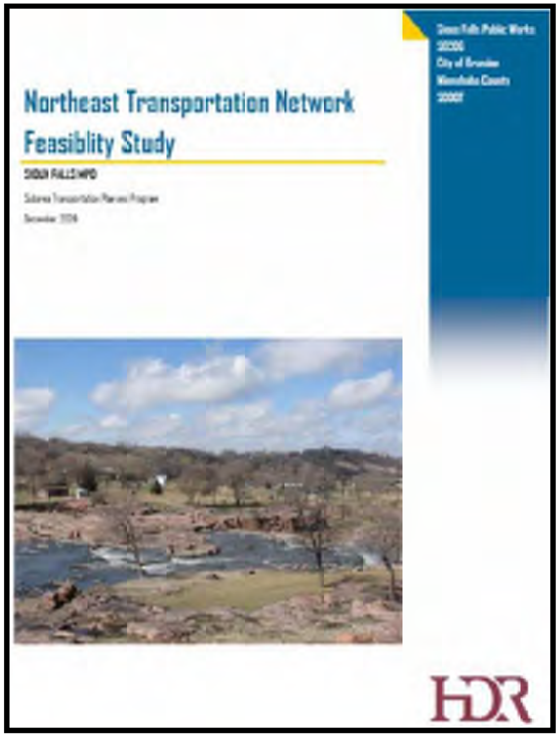


Why Additional Studies?

- Previous Planning Studies have indicated that Exit 3 (Minnesota Avenue), Exit 6 (10th Street), and Exit 9 (Benson Road) will need improvements along with possible crossroad corridor improvements.



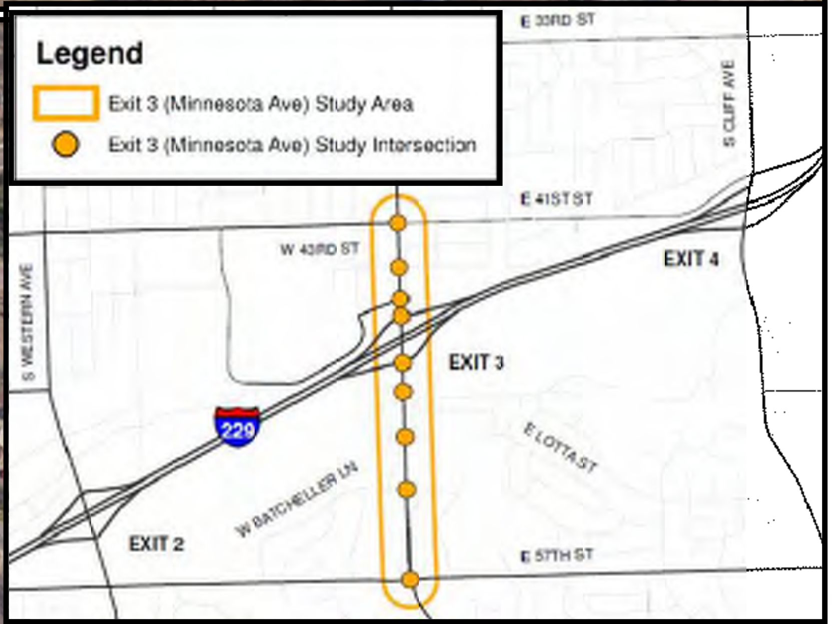




Exit 3 (Minnesota Avenue)

Crossroad Study Goals

- Reduce traffic congestion
- Evaluate interchange options
- Integrate plans for the 49th Street Extension with the interchange options developed
- Improve pedestrian and bike access to the Big Sioux River Pathway
- Improve safety for corridor users
- Improve vehicle safety to Yankton Trail Park



Exit 6 (10th Street)

Crossroad Study Goals

- Reduce traffic congestion
- Develop Corridor Growth Plan to meet traffic demands but minimizing impacts to developed properties
- Improve pedestrian mobility
- Improve safety for corridor users
- Identify improvements to the interchange as well as the 10th Street and Cleveland Ave intersection

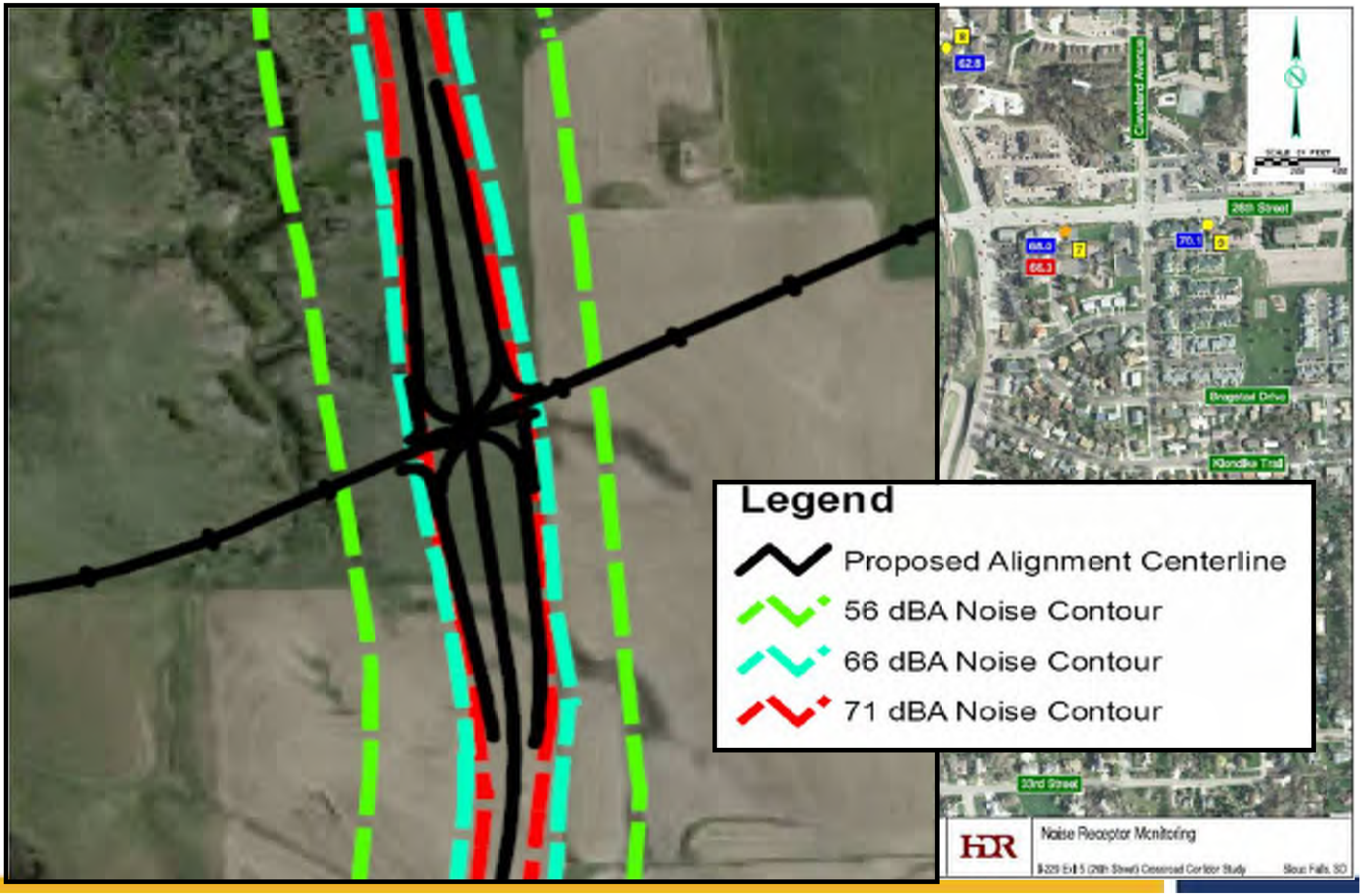
Exit 9 (Benson Road)

Crossroad Study Goals

- Reduce traffic congestion at NB on/off interchange ramp terminal
- Develop Corridor Growth Plan to meet traffic demands from development taking place east of I-229
- Improve pedestrian mobility
- Make recommendations to improve corridor intersections
- Develop interchange alternatives to meet future traffic demands

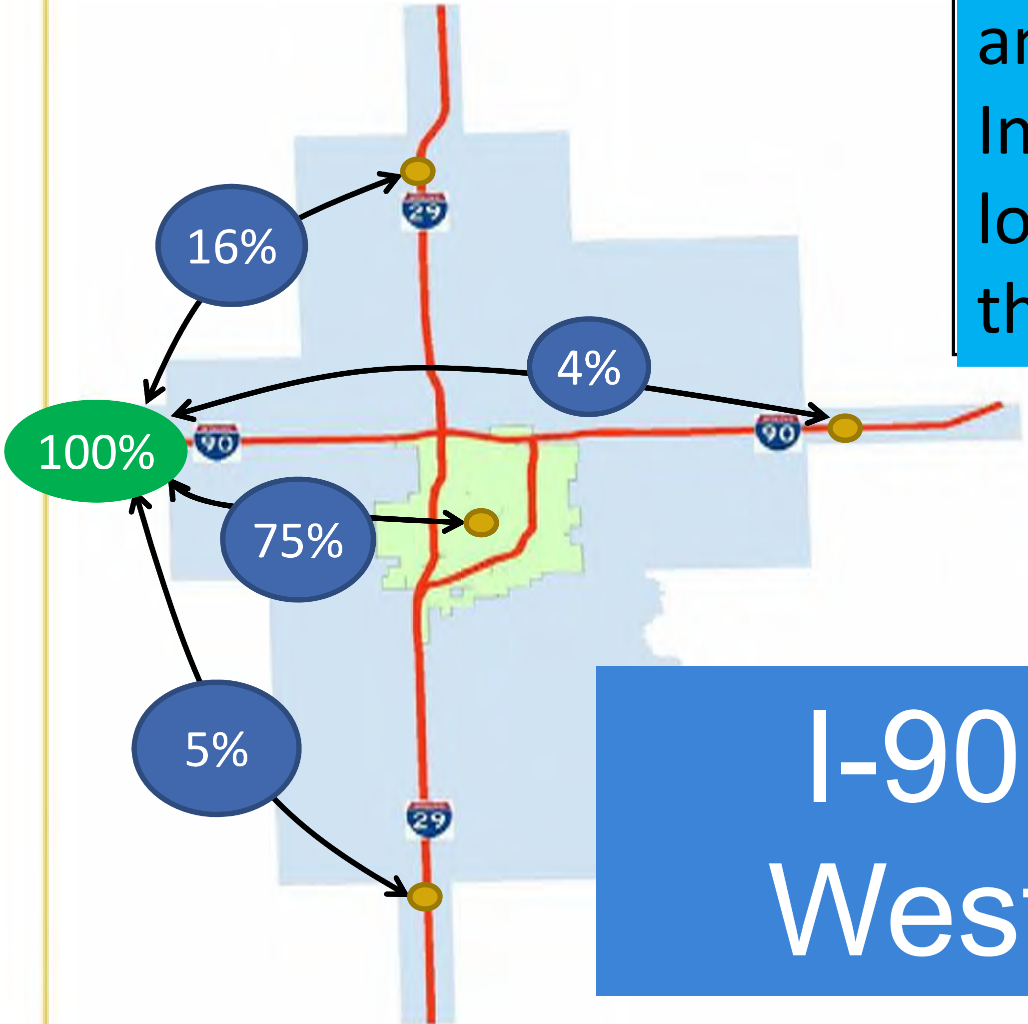
Other Study Activities?

- **Noise Data Collection**



Other Study Activities?

- **Origin-Destination Study**



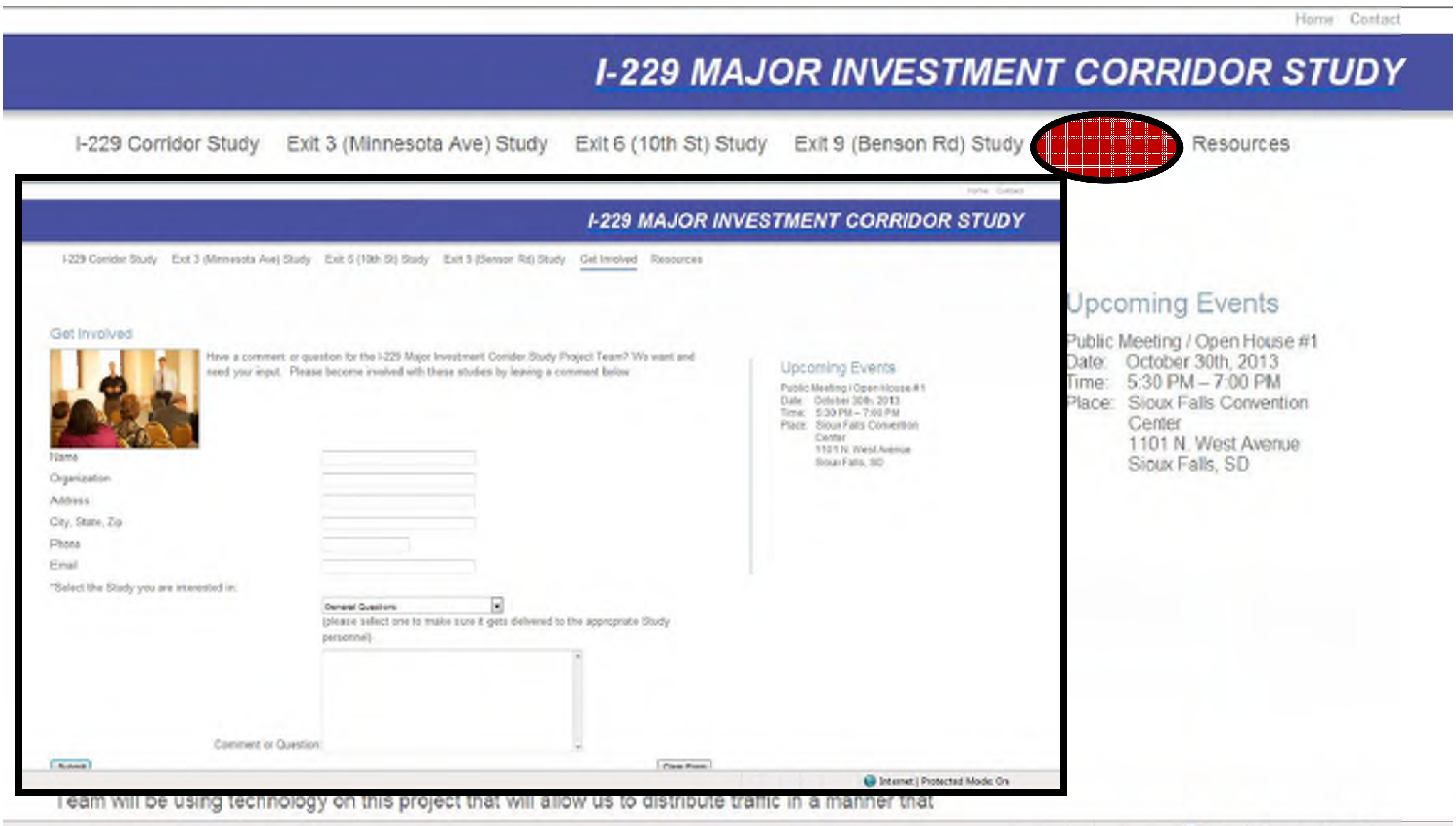
What is the amount of state and regional traffic on the Interstate system versus local traffic in and around the study area?

I-90 West

Methodology:
1.) Airsage collects signaling data from cell phone towers as your smartphone constantly communicates.
2.) This cell phone technology can locate a phone spatially at a given time of day.
3.) This data is being recorded 24 hours a day – 7 days a week.
4.) This “Technology” allows for anonymous and aggregated data meaning it only that knows that it is a phone, nothing more.
5.) Data sets are provided indicating time and location for us to determine travel demand *(keep in mind this is only a sample size of the overall population but allows us to estimate travel patterns better)*

Project Website

[WWW.I229STUDY.COM](http://www.i229study.com)



Project Schedule

TIMELINE OF EVENTS

YEAR 2013

April 2013 – Study Began

May / October 2013 – Data Collection & Traffic Model Building

October 30th, 2013 – *Public Open House #1*

November 2013 / March 2014 – Complete Traffic Assessment and Develop Alternatives for Improvements

YEAR 2014

March / April 2014 - *Public / Stakeholder Meetings*

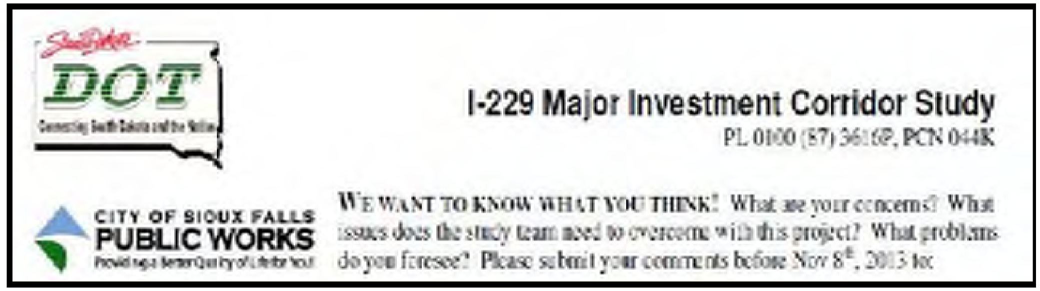
April / July 2014 – Refine Alternatives & Produce Draft Reports

August 2014 – *Public Meeting (Final)*

October 2014 – Complete Study

Next Steps

(1.) Take public comments on concerns you have regarding I-229 Study Areas



DOT

CITY OF SIOUX FALLS PUBLIC WORKS

I-229 Major Investment Corridor Study

PL 0100 (57) 3616P, PCN 044K

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before Nov 8th, 2013 to:

(2.) Complete Traffic Assessment and begin to develop base alternatives to mitigate the capacity issues identified

(3.) Begin noise monitoring along corridor this fall

Before You Leave Please…

SIGN IN SHEET

Subject	I-229 Major Investment Corridor Study – Public Open House #1
Client	City of Sioux Falls / South Dakota Department of Transportation
Project	PL 0100(87) 3616P, PCN 044K — Project No: 207030
Meeting Date	Wednesday, Oct 30th, 2013 5:30 – 7:00 PM — Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	NAME/REPRESENTING	ADDRESS	BEST CONTACT PHONE	E-MAIL
1				
2				
3				
4				
5				
6				

Please Sign In!

I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before Nov 8th, 2013 to:

Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

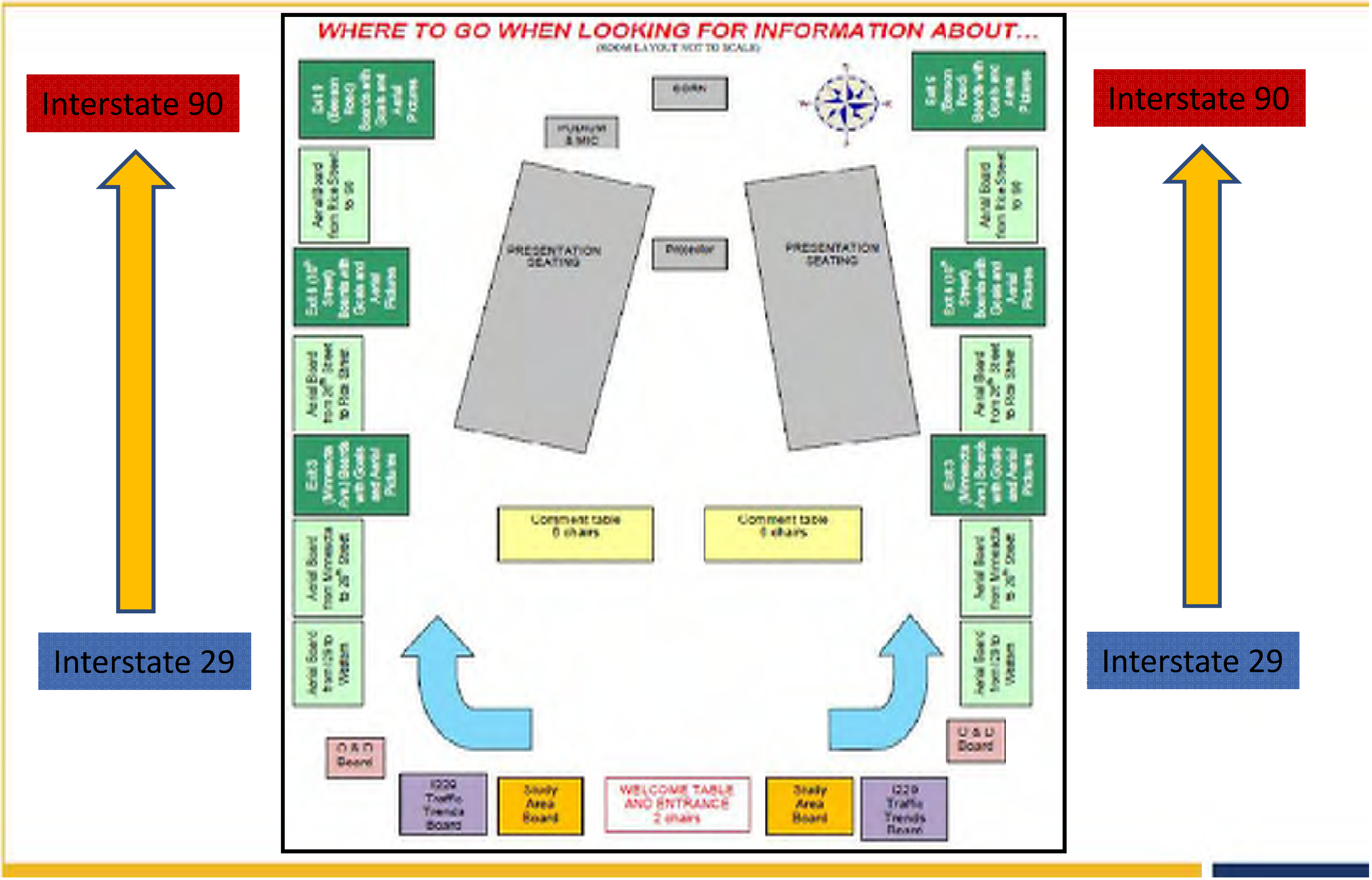
E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

(optional)
Name: ______ Address: ______
Phone: ______ Email: ______

Leave a Comment or Suggestion!!!!

Room Layout


Interstate 90
Interstate 29
WHERE TO GO WHEN LOOKING FOR INFORMATION ABOUT...
PRESENTATION SEATING
PRESENTATION SEATING
Comment table
Comment table
Study Area Board
WELCOME TABLE AND ENTRANCE
Study Area Board
Interstate 90
Interstate 29

Thanks for Attending!

WWW.I229STUDY.COM

APPENDIX -

PUBLIC MEETINGS #2 – JUNE 1ST & 2ND, 2015

MINNESOTA AVENUE

JUNE 1ST, 2015

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE END OF PUBLIC MEETINGS #2 APPENDIX)
- COMMENTS (SEE END OF PUBLIC MEETINGS #2 APPENDIX)

Note: actual attendance count was 53 people (including 15 women)

Sign In Sheet

Subject	I-229 Major Investment Corridor Study – Informational Meeting for Minnesota Avenue Sub-Study
Client	City of Sioux Falls/South Dakota Department of Transportation
Project	PL 0100(87) 3516P, PCN 044K — Project No.: 207030
Meeting Date	Monday, June 14, 2015 5:00 PM — Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Ray Kirlin	3209 S. Lincoln	334-2411	kirlin.r@[illegible]
2	Pam + Stan [illegible]	3000 S. Sunnymede	332-6509	
3	Ron McMahon	116 E Dakota Ave, Pierre	776-1009	ron.mcmahon@dot.gov
4	John Shelso	2800 W 23rd St. SF. SD	605-951-2970	jhshelso@earthlink.net
5	[illegible]	1501 W [illegible]		
6	Art Holden	705 W Victoryln SF 57108	605-371-3028	artholden67@gmail.com
7	Bruce Danielson	[illegible] SF 57[illegible]		
8	[illegible]	3600 S Duluth	334-4220	robert.[illegible]@dakotabilities.org
9	[illegible]	5415 S. Westwood	321-5514	g.boris@aol.com
10	David Heinold	205 S. Menlo Ave.	219-363-5768	d-heinold@gmail.com
11	Kevin Nyberg	330 W. 41st, 57105	605 3314088	knyberg@nybergsace.com
12	Susan [illegible]	600 E 21st St	332 5319	sah @ [illegible].net
13	Gerald Teunissen	808 Jane Lane SF- SD	366-1979	gerald@benders.com
14	Kurt Greff	605 E 21st 57105	3326035	KJG324@yahoo.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 8518P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 14, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Brad Remmich	SDDOT		
2	Craig Smith	SDDOT	995-3300	craig.smith@state.sd.us
3	Steve Gramm	SDDOT	773-6641	steve.gramm@state.sd.us
4	[illegible]		605-521-9231	[illegible]@[illegible]
5	Dave Rose	Empire Bldg Ctr	321-9823	DaveinSiouxFalls@[illegible].com
6	Sara Bertsch	Argus Leader	605-321-0831	
7	Jon Wiegand	HR Green		jwiegand@hrgreen.com
8	Amber Gibson	SECOG	367-5390	amber@secog.org
9	Kevin Kroeze	Boen & Associates	336-0425	KevinK@BoenAssociates.com
10	James Unruh	HDR	373-7766	james.unruh@hdrinc.com
11	Trevor Pierson	5700 S Chuckwagon [illegible]		Trevorhockey@[illegible].net
12	Greg Johnson	6801 E. Split Rock Cir	332-8166	grjohnson@sio.midco.net
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3615P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 1st, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Jo Wahle			
2	Stan + Donna Schmidt	2214 W Zephyr Pl. #1		Stan@goingbeyondwords.com
3	Kay Gollesch	LifeScape		kay.gollesch@lifescapesd.org
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CITY OF SIOUX FALLS PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project IM 0100(87) 381SP, PCN 044K **Project No.:** 207060

Meeting Date Monday, June 15, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SDDOT	773-6485	pete.longman@state.sd.us
2	Jason Kjenstad	HDR	605-977-7755	jason.kjenstad@hdrinc.com
3	Christina Bennett	SDDOT	(605)773-4759	Christina.Bennett@state.sd.us
4	Paul Nikolas	SDDOT	60-367-5680	paul.nikolas@state.sd.us
5	Al Schoeneman	1801 W 50th St SF 57105	605 376 1189	al.schoeneman@schoenemans.com
6	Thomas Hein	6100 E Hein Place SF SD 57110	605-361-8910	Theinmail@gMail.com
7	Travis Dressen	SDDOT - SF Area	605-367-5680	travis.dressen@state.sd.us
8	Ross Harris	HR Green 5525 Merle Hay Rd. Johnston, IA 50131	515-657-5263	rharris@hrgreen.com
9	Michael Gerdes...	1813 S Prairie Ave	605 929 8923	...@gmail.com
10	Audrey James	27002 Split Creek Ct	605-929-7591	audreyjames@bordestates.net
11	Joe James	27002 Split Creek Ct S-Falls	605-366-5328	jamesd@borderstates.net
12	Chris Pressler	7001 W 66th St SF SD	319-389-1507	CPressler@Gmail.com
13	Lori Bischene	3100 S Southeastern Ave #A Sioux Falls SD	5073605554	bischene@midco.net
14	West Valley Dale Froehlich	6 So. Le Chateau SF, SD 57105	605-201-9810	dalefroehlich@gmail.com
15	Nancy Preston	5700 S. Chuck Drive		
16	Alex County	1510 W 57th St	331-7620	alex.county@siouxfalls...gmail.com
17	Kathy & Jerry Phillips	5100 S. Swift Park Dr	940-2448	kphilli2@yahoo.com
18				
19				
20				

Interstate 229 Major Investment Study
Exit 3 – Minnesota Avenue Sub-study

Informational Meeting
June 1st, 2015
5:00 pm to 7:00 pm

HDR

HRGreen

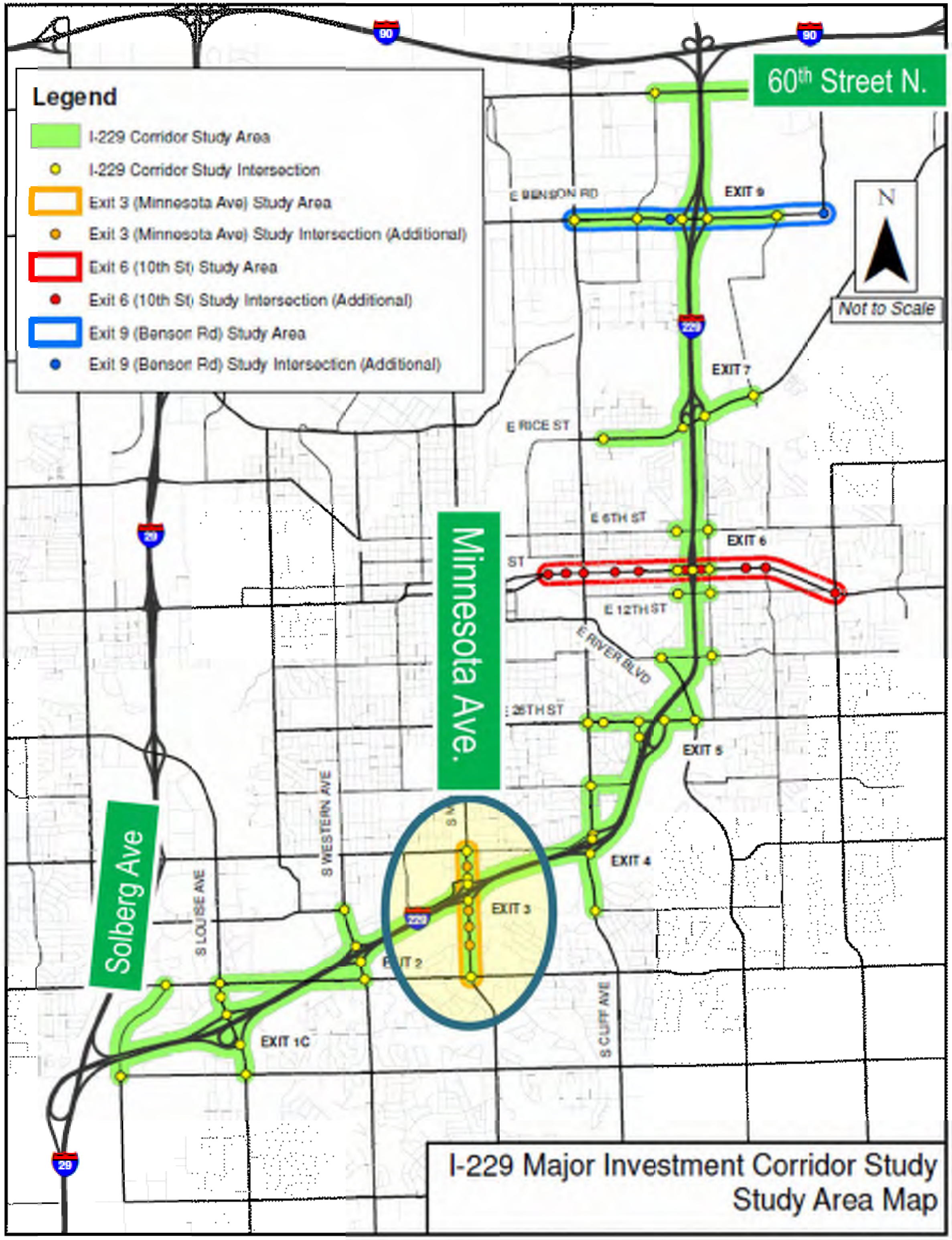
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Meeting will focus on:

Exit 3 – Minnesota Ave



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

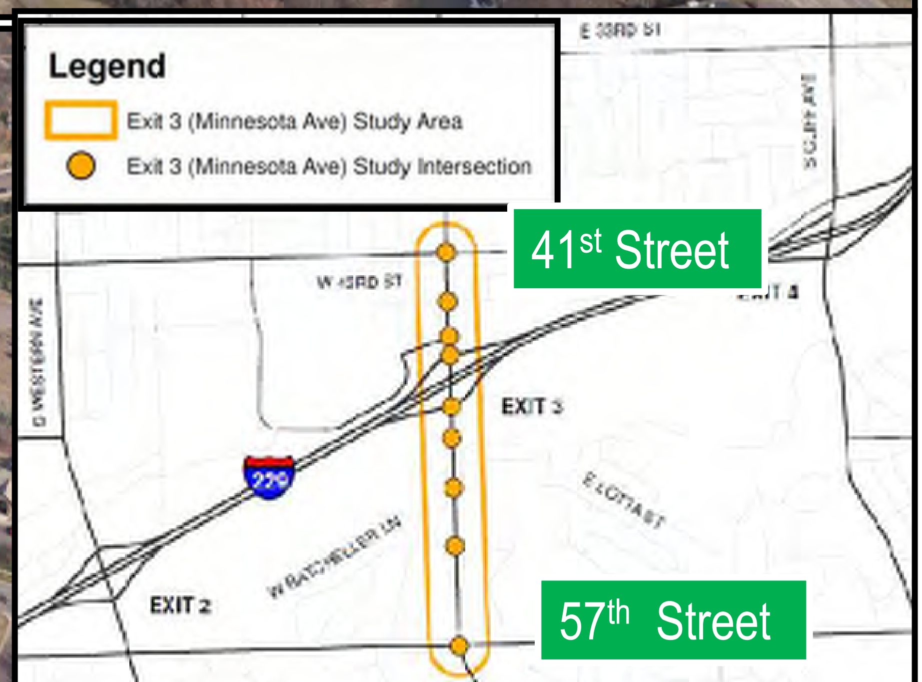
City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

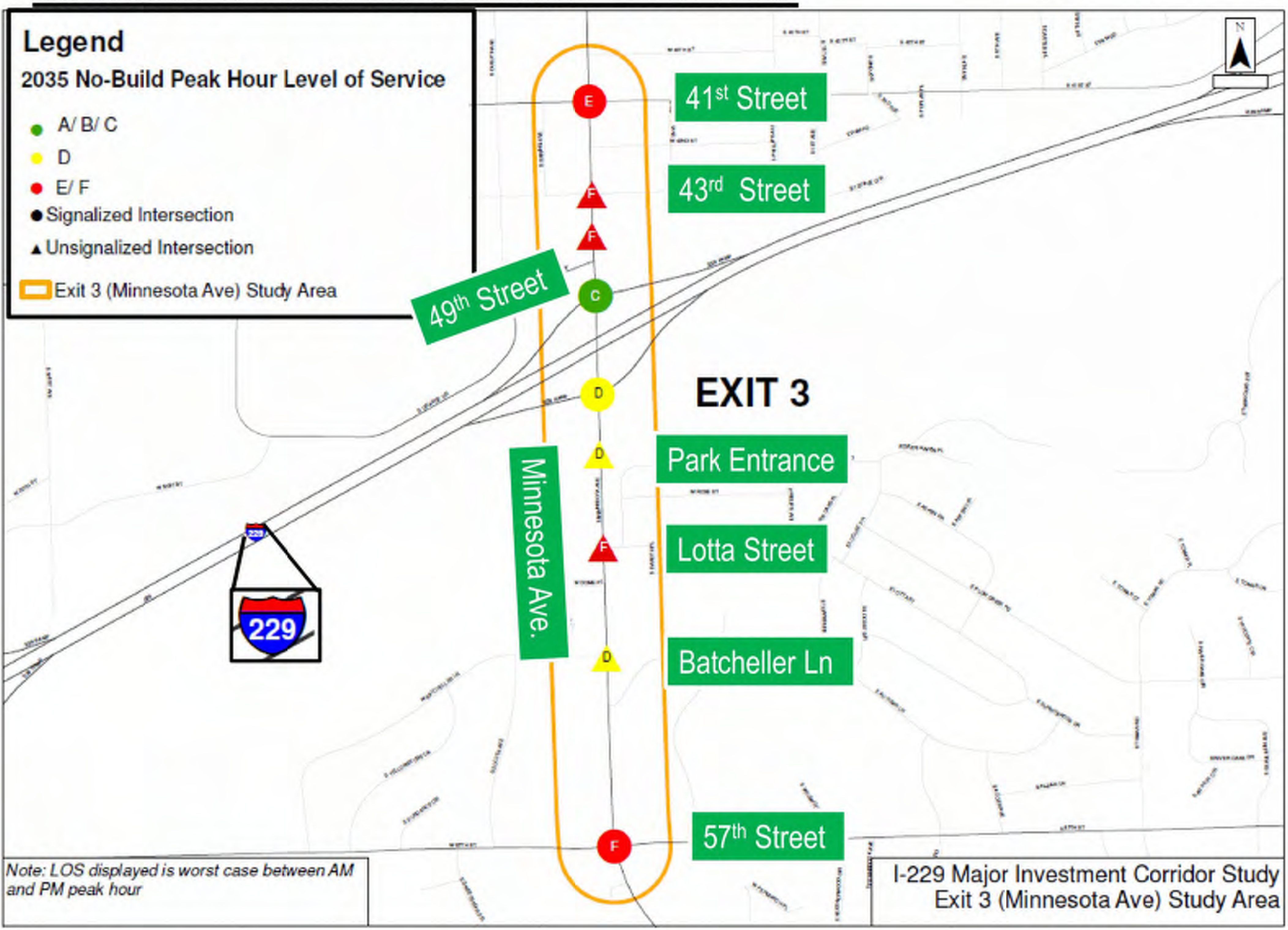
Federal Highway Administration (FHWA)

Exit 3 (Minnesota Avenue) Crossroad Study Goals

- Reduce traffic congestion
- Evaluate interchange options
- Integrate plans for the 49th Street Extension with the interchange options developed
- Improve pedestrian and bike access to the Big Sioux River Pathway
- Improve safety for corridor users
- Improve vehicle safety to Yankton Trail Park



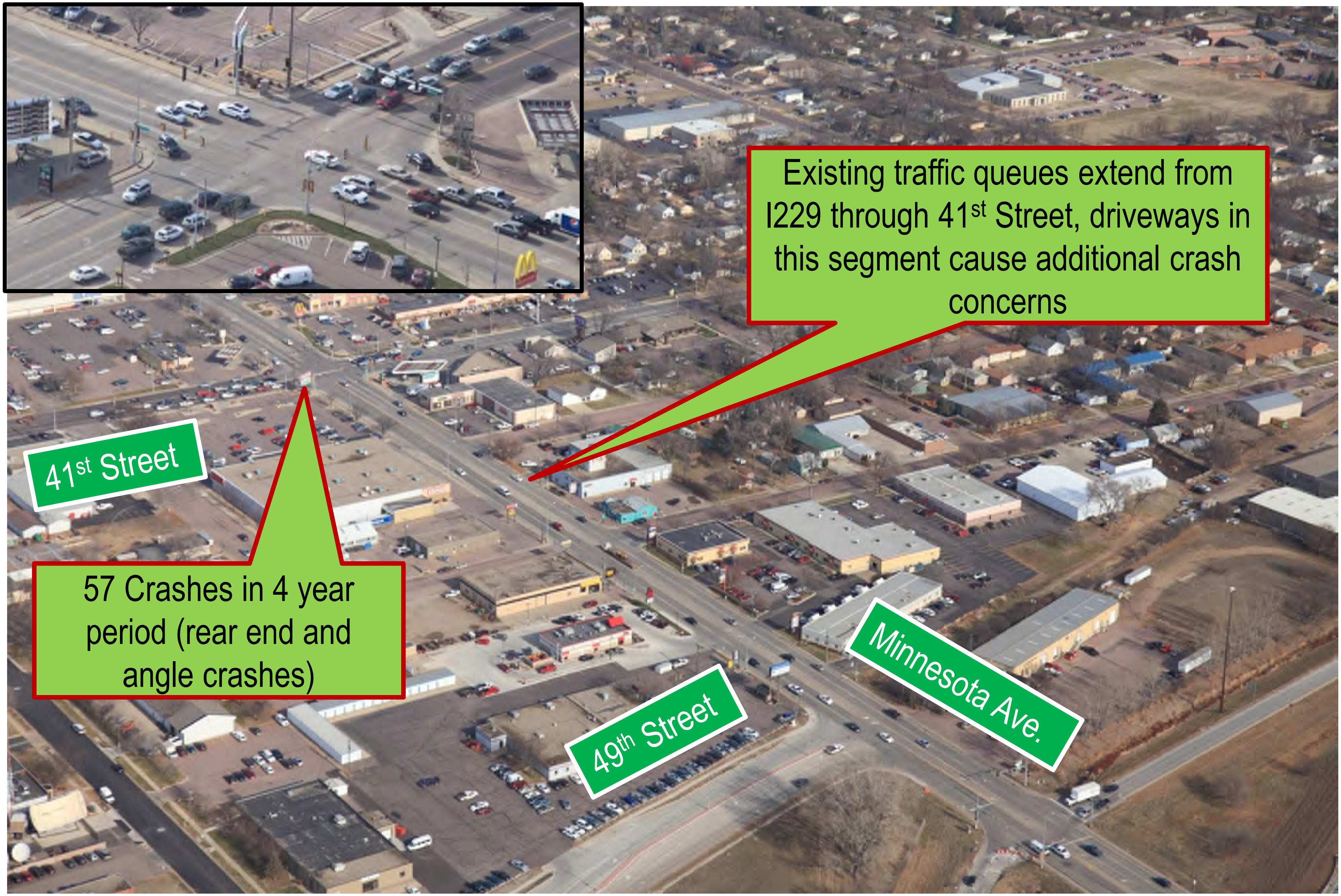
Minnesota Avenue Corridor Overview



Minnesota Avenue Corridor Overview

Minnesota Avenue Corridor Overview

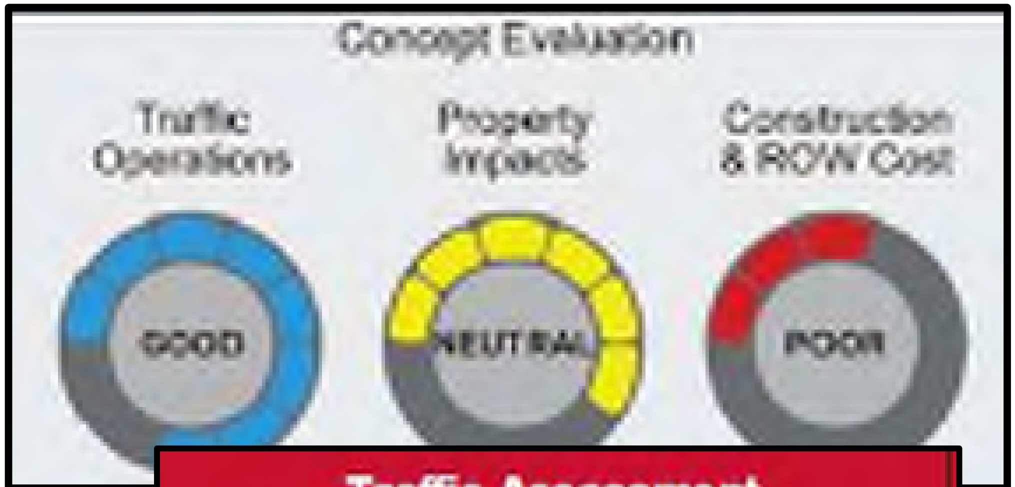
Minnesota Avenue Corridor Overview



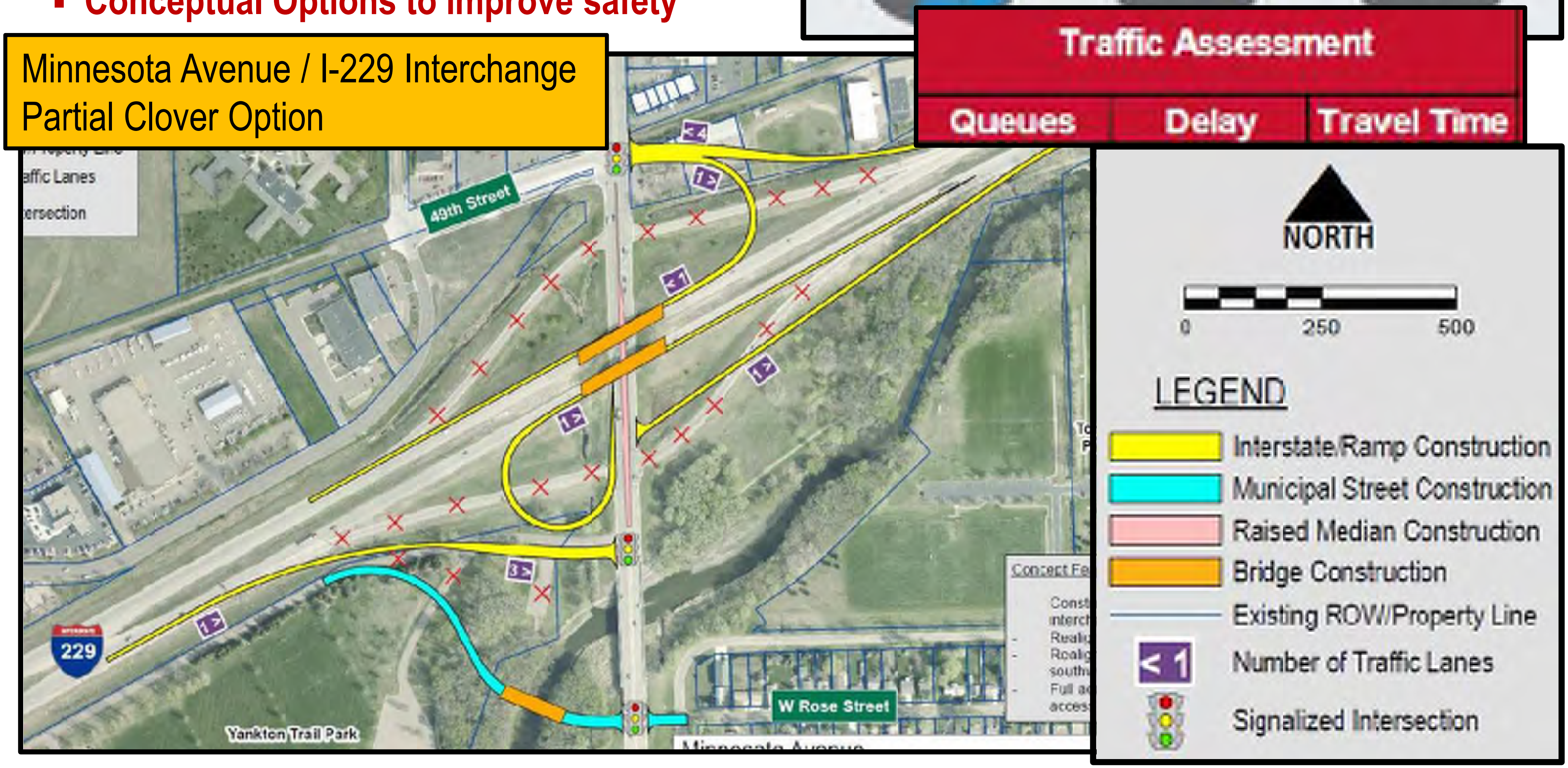
Conceptual Ideas for Minnesota Avenue

What you will be able to see tonight:

- 13 Interchange Conceptual Options
- 4 Corridor Options
- Access Changes to Yankton Trail Park
- Conceptual Options to improve safety



Minnesota Avenue / I-229 Interchange Partial Clover Option



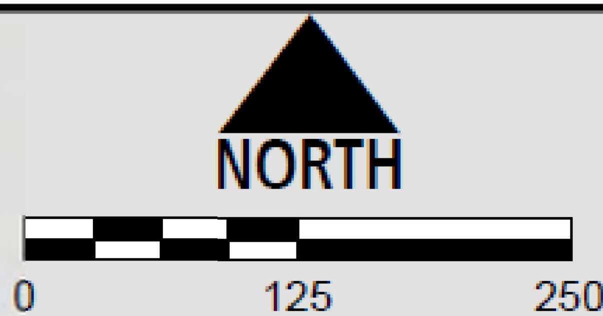
Conceptual Ideas for Minnesota Avenue

What you will be able to see tonight:

- 13 Interchange Conceptual Options
- 4 Corridor Options
- Access Changes to Yankton Trail Park
- Conceptual Options to improve safety

Minnesota Avenue – Raised Median with ¾ Movements when possible

Concept Evaluation



LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Bridge Construction
- Existing ROW/Property Line
- < 1 Number of Traffic Lanes
- Signalized Intersection

Next Steps for Minnesota Avenue

- **Finalize Composite Comparison Matrix**
  - Traffic Assessment
  - Environmental Screening
  - ROW Impacts
  - Overall Costs
  - Public Involvement Support

- **Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities**

- **Develop Priority Phasing Plan for I-229 Corridor and Sub-Study Corridor**

- **Schedule and Conduct next public meeting**

<u>PROJECT CONTACTS:</u>

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Ross Harris– HR Green, Inc.
515-657-5263 or rharris@hrgreen.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 3 – Minnesota Avenue Sub-Study

Thanks for Attending!!!!!

HRGreen

10TH STREET

JUNE 1ST, 2015

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE END OF PUBLIC MEETINGS #2 APPENDIX)
- COMMENTS (SEE END OF PUBLIC MEETINGS #2 APPENDIX)

Note: actual attendance count was 31 people (including 8 women)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 1st, 2015 7:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Amber Gibson	SECOG	605 367 5390	amber@secog.org
2	Brad Remmich	SDDOT		
3	Greg Boer	5415 S Western SF		
4	Travis Dressen	SDDOT - SF Area	605 367 5680	travis.dressen@state.sd.us
5	Chuck Gustafson	705 E Ridge RD SF SD	332-1000	cgustafson@mac.com
6	Hersh Patel	[illegible] Street	721 776 1476	[illegible]@siouxfalls.com
7	Bob Bohm	3600 S Dakota Ave	605 334 [illegible]	robert.bohm@[illegible]utilities.org
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SD DOT

CITY OF SIOUX FALLS PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study -- Informational Meeting for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3816P, PCN 044K **Project No.:** 207030

Meeting Date Monday June 1st 2015 7:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SDDOT	773-6488	pete.longman@state.sd.us
2	Steve Gramm	SDDOT	773-6641	Steve.gramm@state.sd.us
3	Paul Nikolas	SDDOT	367-5680	Paul.Nikolas@state.sd.us
4	Colin Moriarty	Gage Bros	336-118	cmoriarty@gagebrothers.com
5	[illegible]	840 S. Day	338-6900	—
6	Lodermeier Family LLC Barbara Anderson	840 S. Day SF 57103	338-6900	amandad840@aol.com
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PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, June 1st, 2015 7:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Tom Kelley	Gage Brothers	605 376 8150	
2	Dave Nelson	3413 Southern Cir.	366-7308	
3	Jason Kjenstad	HDR	605-977-7740	jason.kjenstad@hdrinc.com
4	Mark Elesson	101 S Cleveland	605-338-6231	MElesson@sio.midco.net
5	Ron McMahon	116 E Dakota Ave Suite A Pierre	605-776-1009	mmcmahon@dot.gov
6	Christina Bennett	SDDOT	605-773-4759	Christina.Bennett@state.sd.us
7	Gary Busselman	7201 E Madison ST SF SD 57110	605-351-5001	gary@garybuss.com
8	Edith Smith	Gage Brothers	605336 1180	esmith@gagebrothers.com
9	Sharon Fix	101 S. Cleveland Ave	(605)338-8151	fixd@midcontinent.com
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Interstate 229 Major Investment Study

Exit 6 – 10th Street Sub-Study

Informational Meeting
June 1st, 2015
7:30 pm to 9:00 pm

HDR

HRGreen

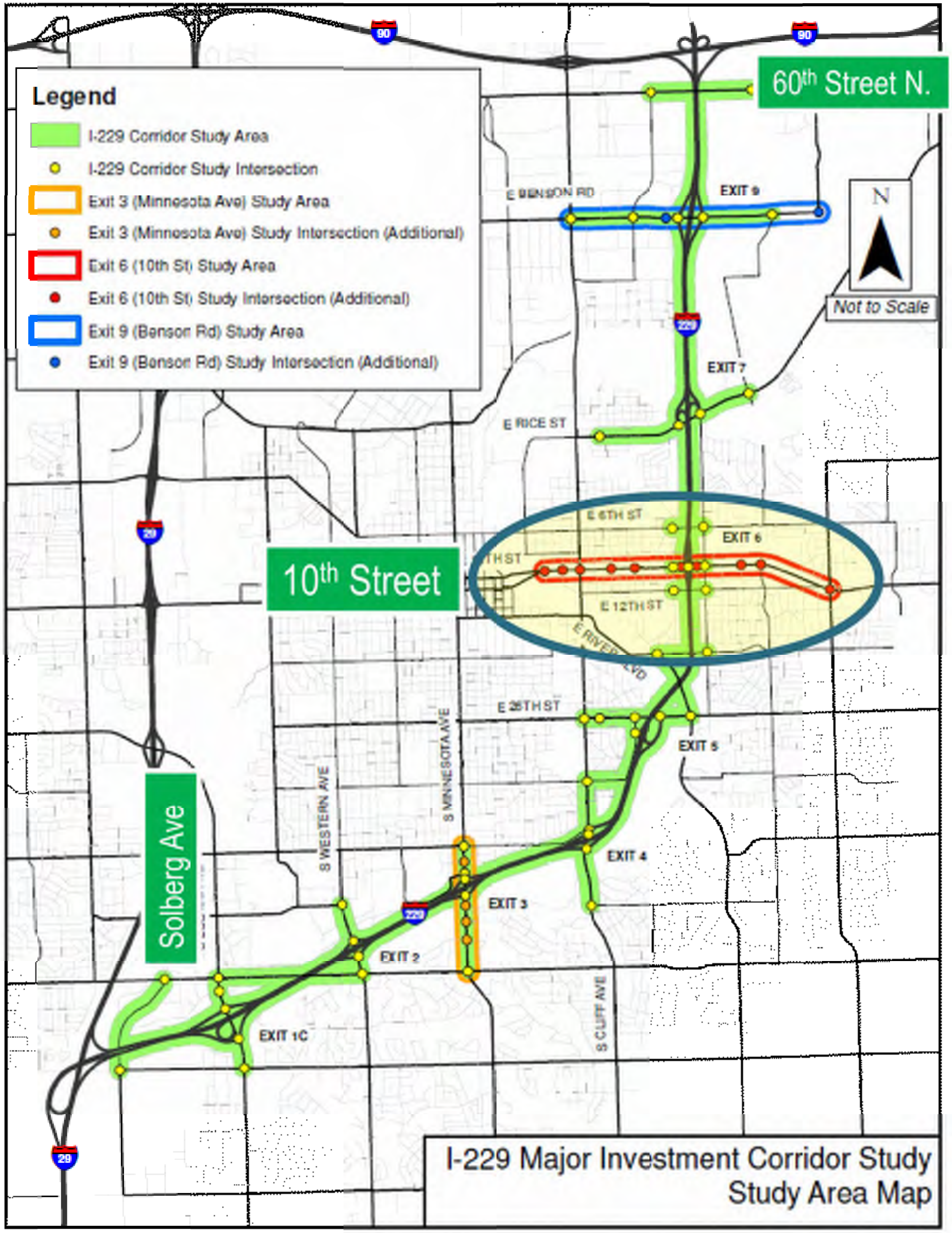
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Meeting will focus on:

Exit 6 – 10th Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

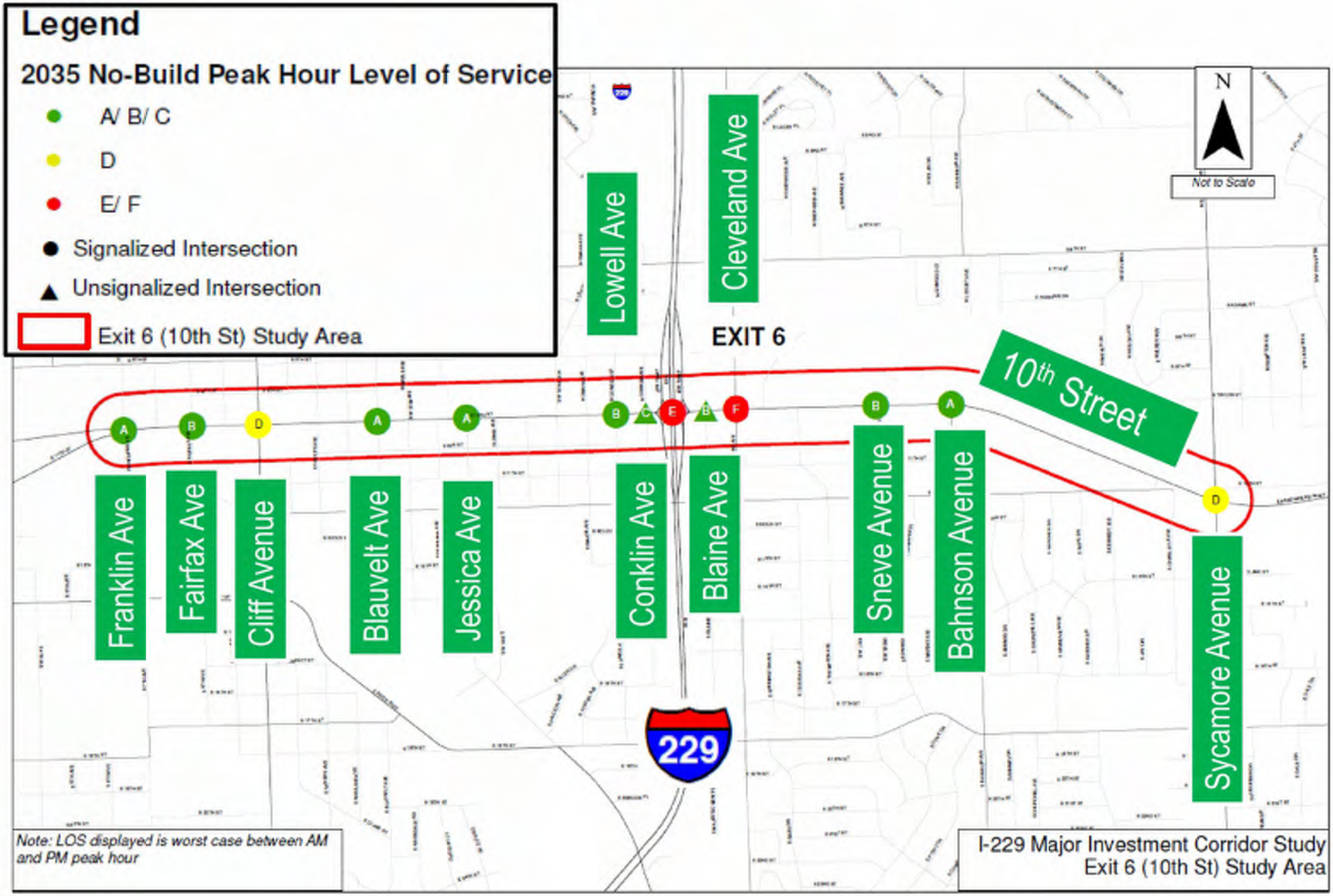
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

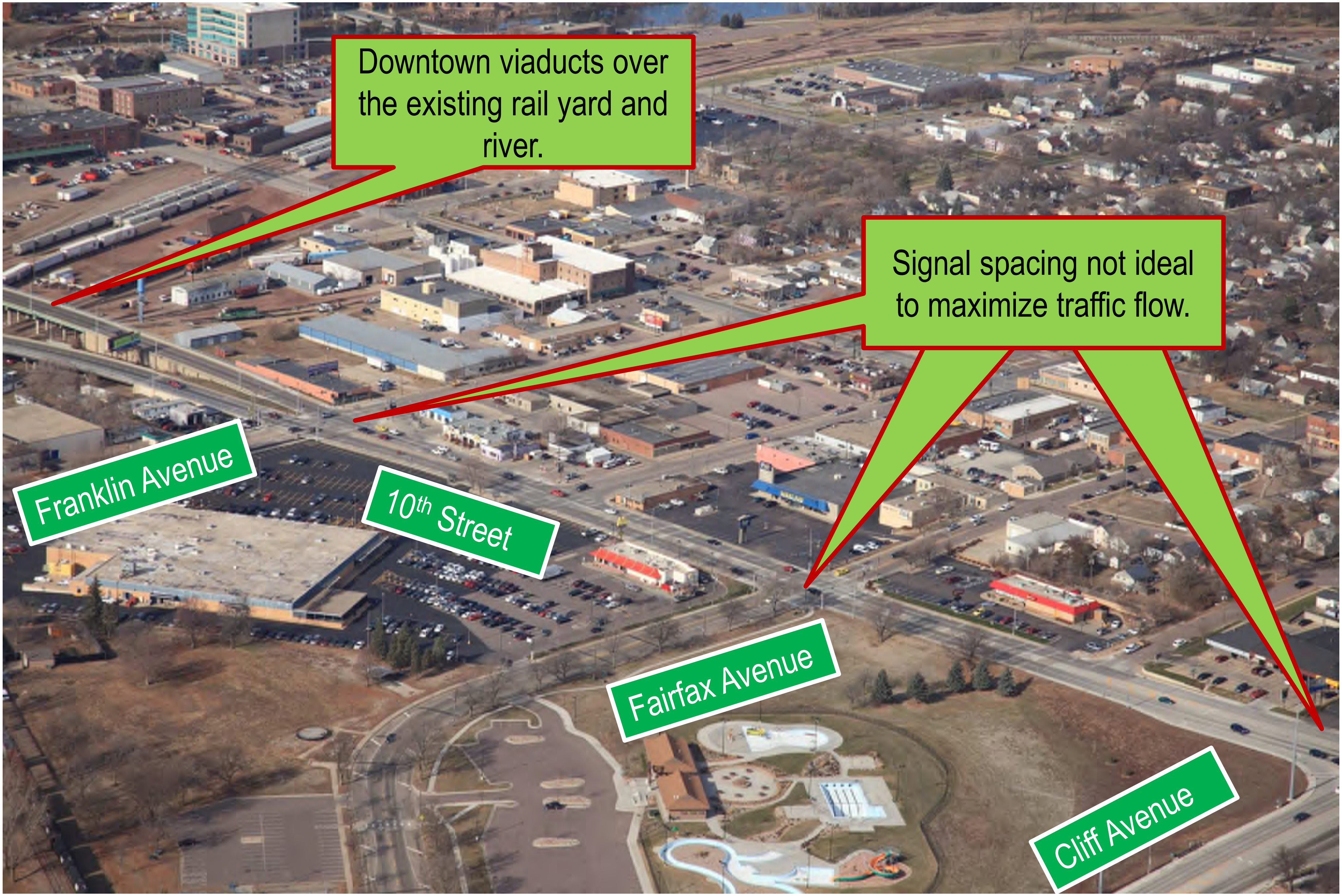
Exit 6 (10th Street) Crossroad Study Goals

- Reduce traffic congestion
- Develop Corridor Growth Plan to meet traffic demands but minimizing impacts to developed properties
- Improve pedestrian mobility
- Improve safety for corridor users
- Identify improvements to the interchange as well as the 10th Street and Cleveland Ave intersection

10th Street Corridor Overview

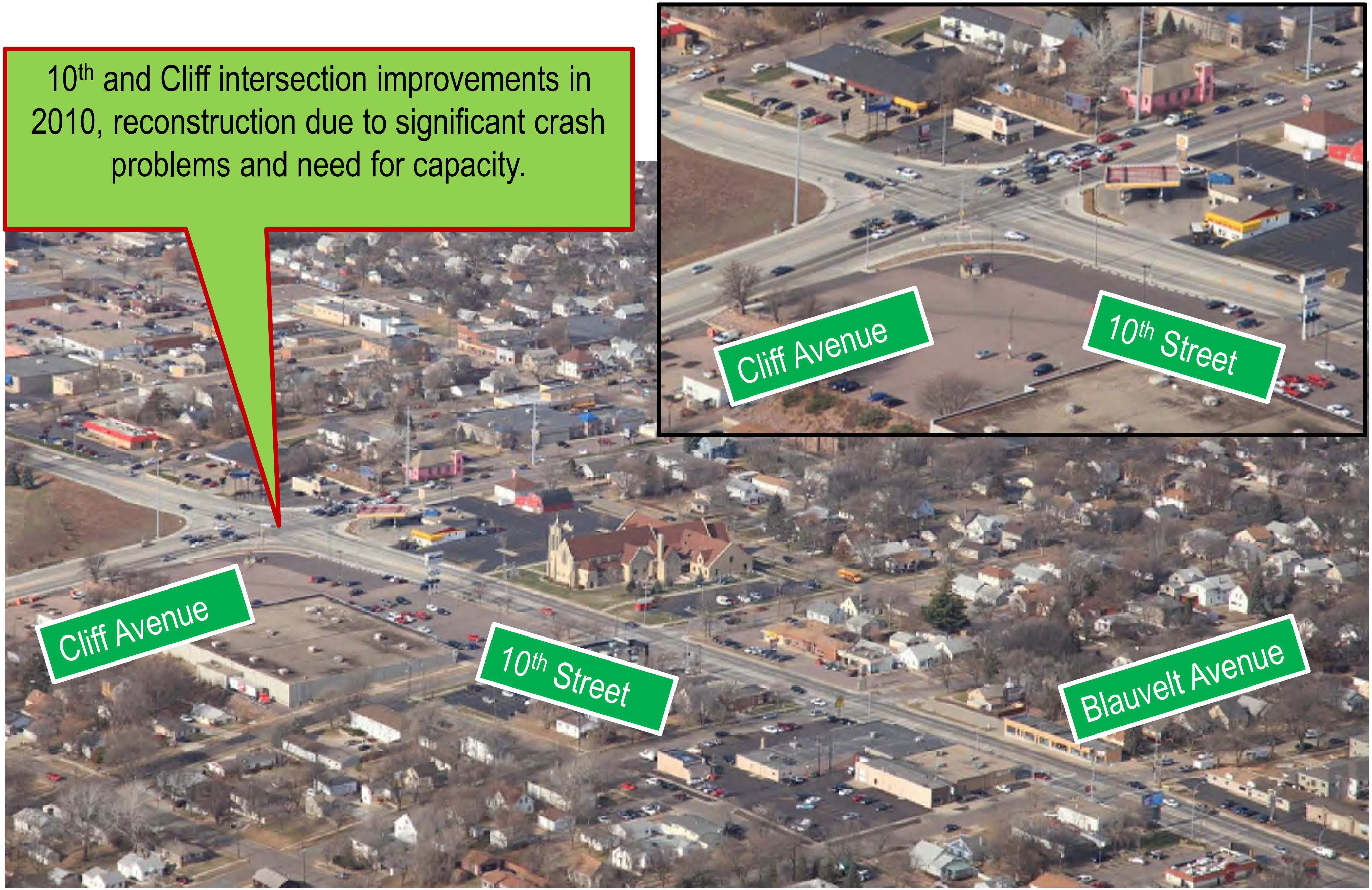


10th Street Corridor Overview



10th Street Corridor Overview

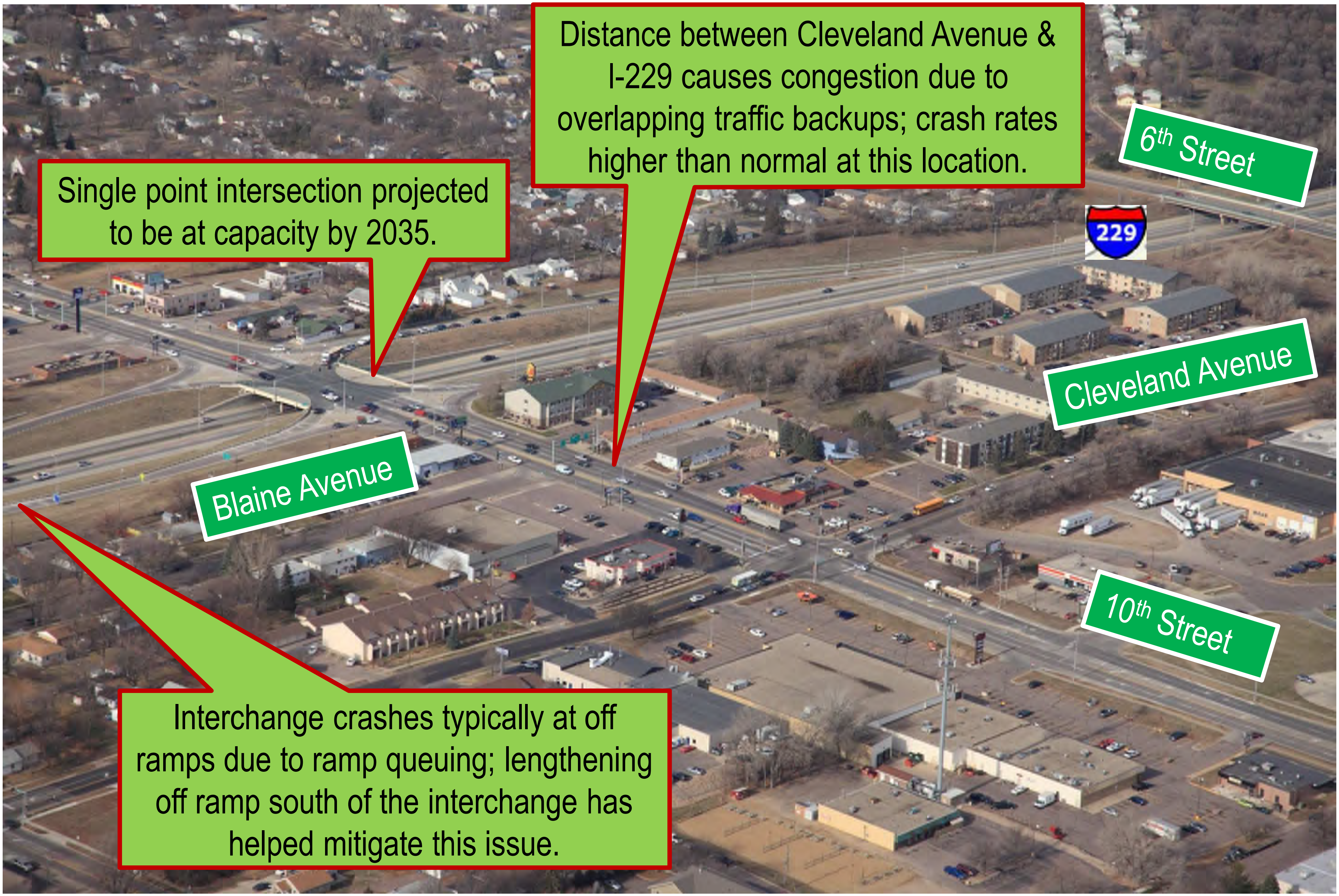
10th and Cliff intersection improvements in 2010, reconstruction due to significant crash problems and need for capacity.



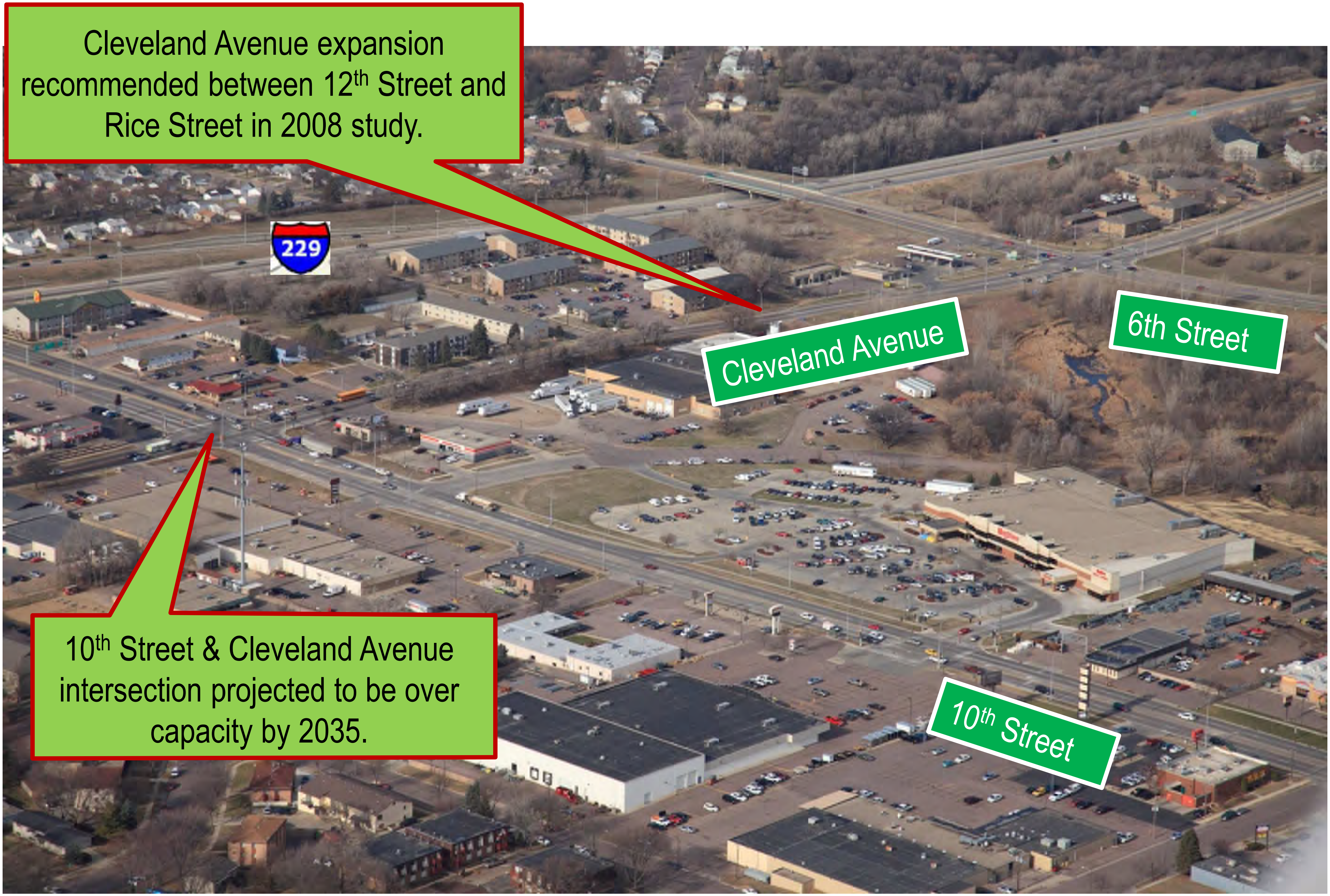
10th Street Corridor Overview

10th Street Corridor Overview

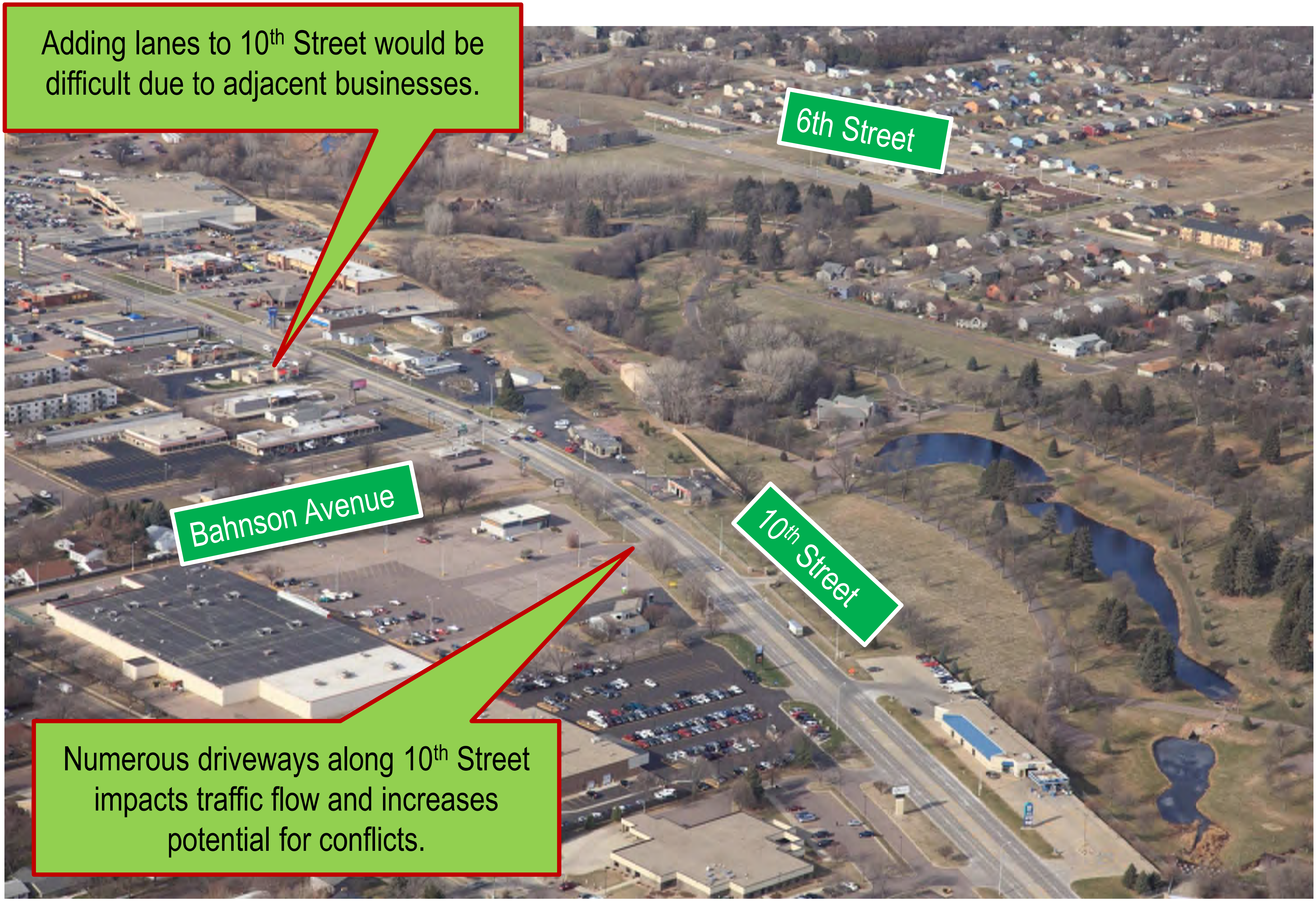
10th Street Corridor Overview



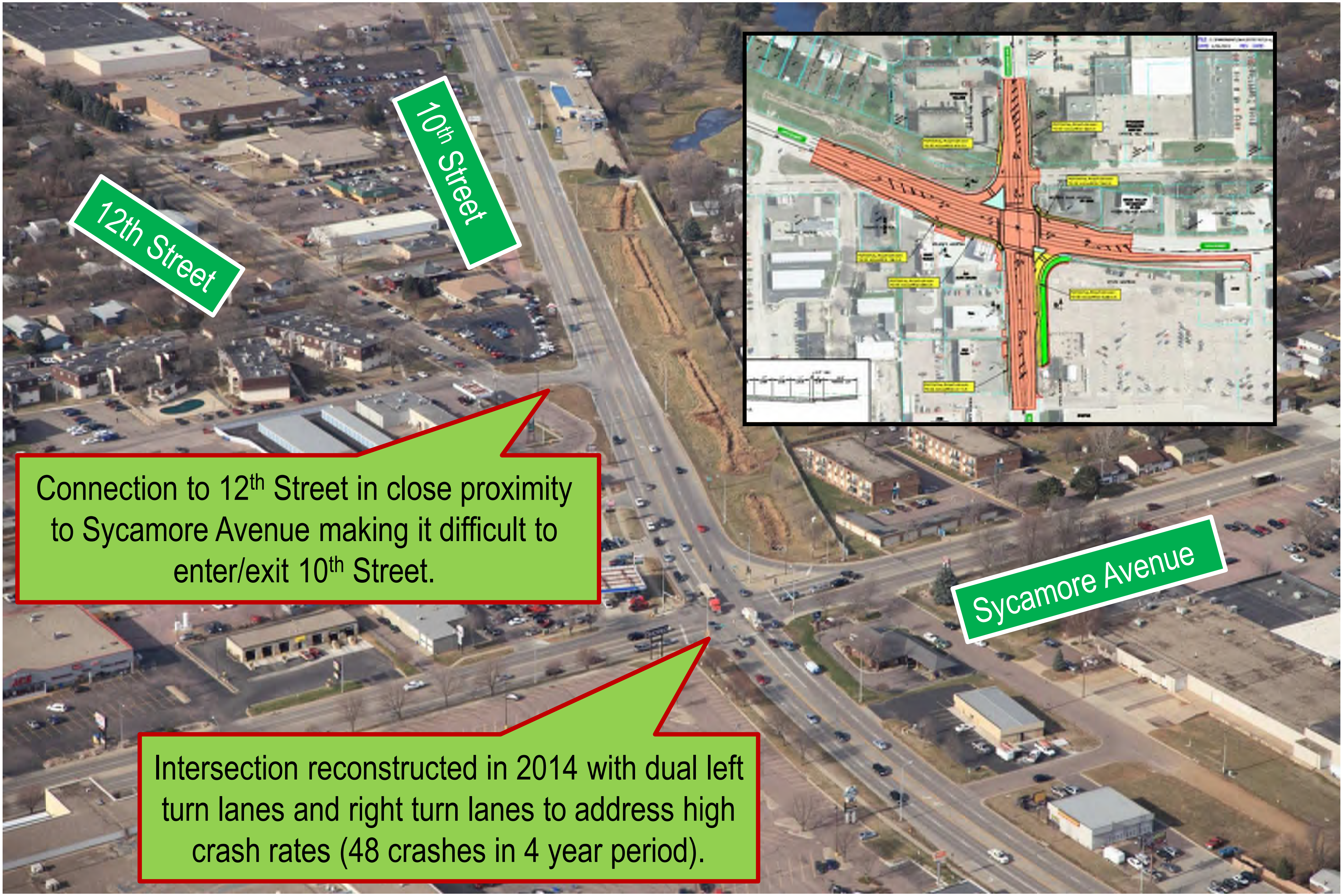
10th Street Corridor Overview



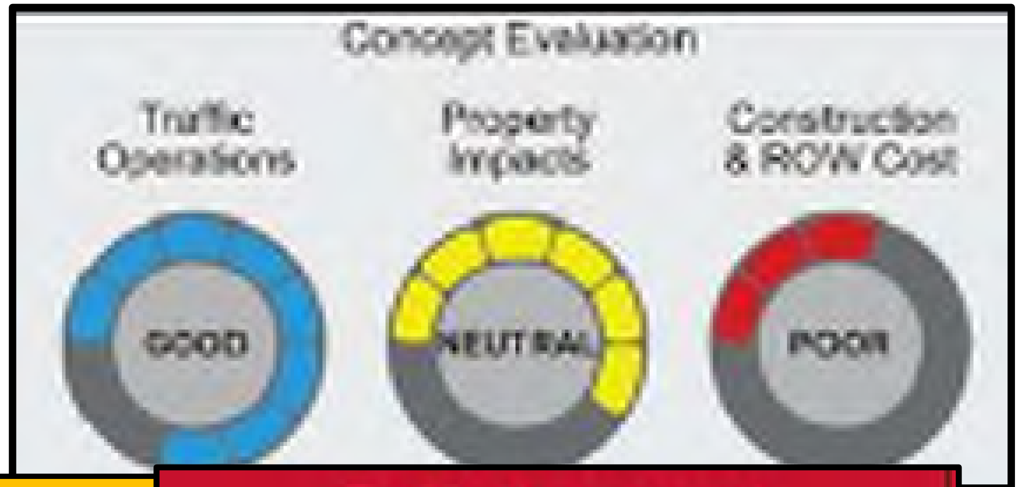
10th Street Corridor Overview



10th Street Corridor Overview



Conceptual Ideas for 10th Street Corridor



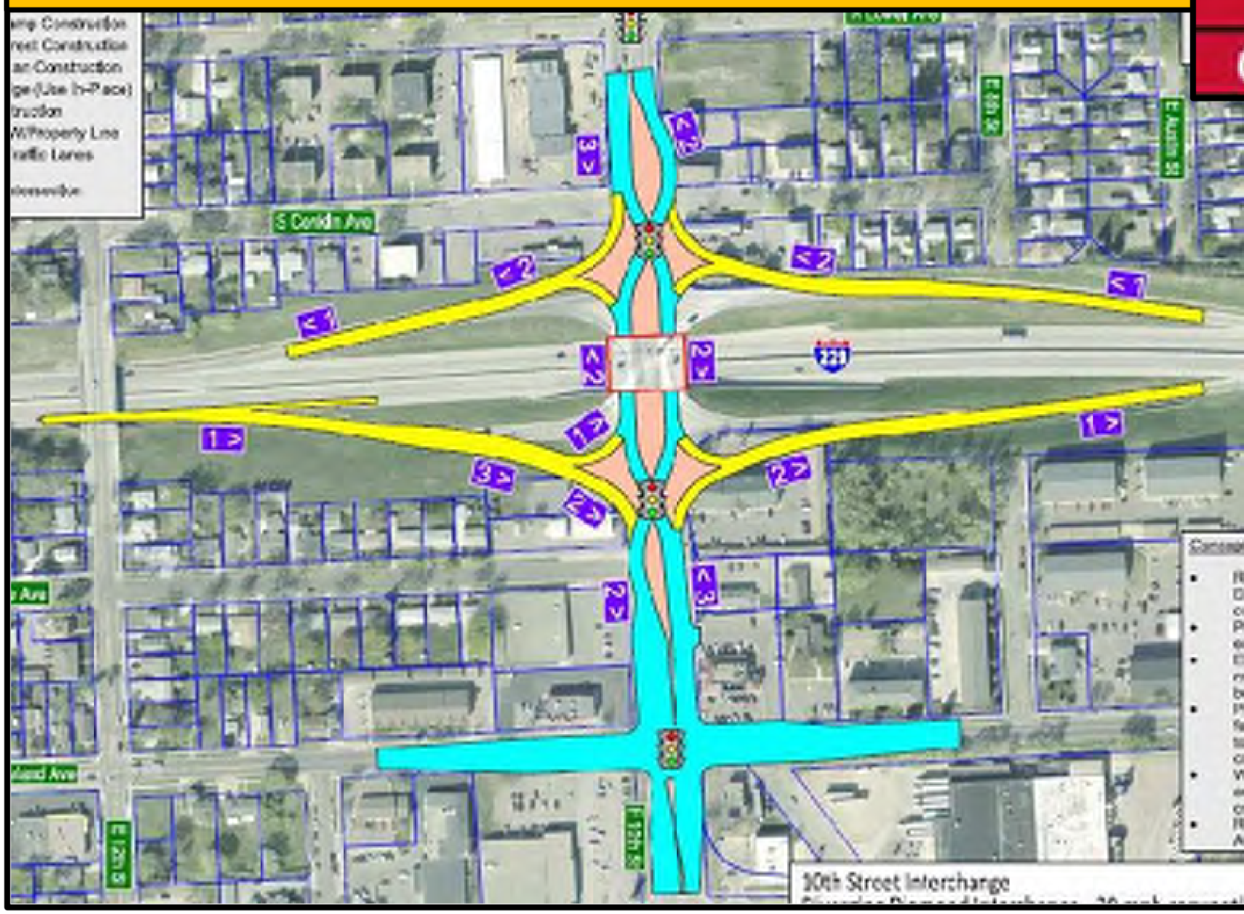
What you will be able to see tonight:

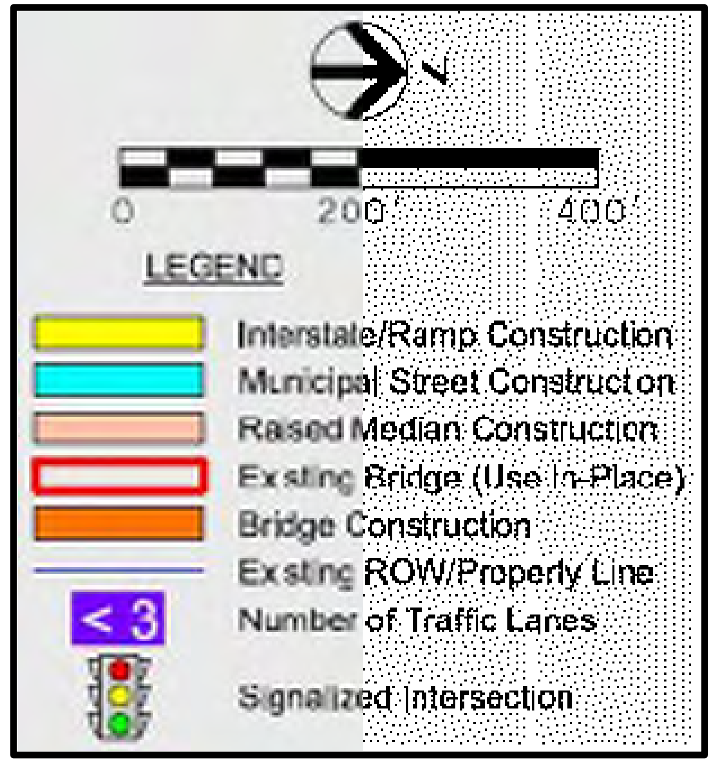
- 8 Interchange Conceptual Options
- 4 Corridor Options
- Median Changes or Driveway Closures to Improve Safety

Traffic Assessment

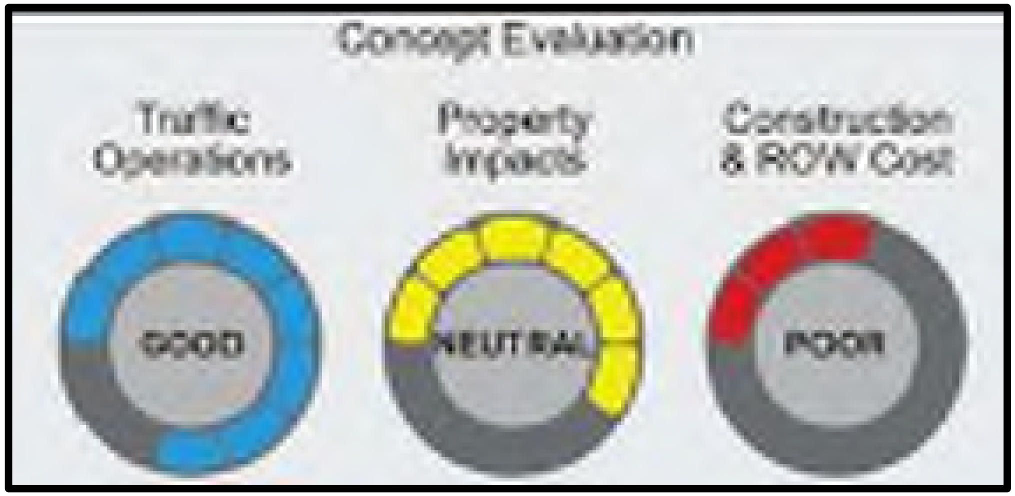
Queues | **Delay** | **Travel Time**

10th Street / I-229 Interchange Diverging Diamond Option



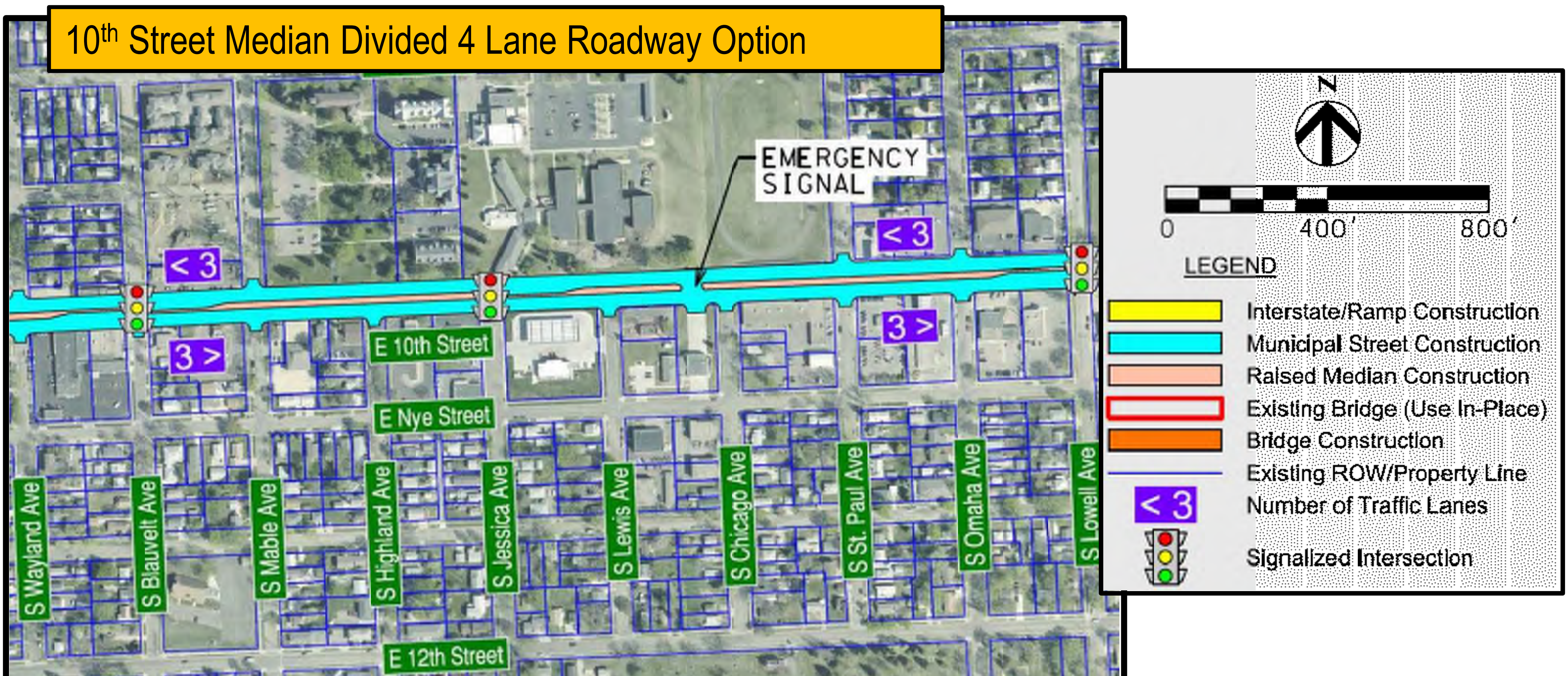


Conceptual Ideas for 10th Street Corridor



What you will be able to see tonight:

- 8 Interchange Conceptual Options
- 4 Corridor Options
- Median Changes or Driveway Closures to Improve Safety



Next Steps for 10th Street

- **Finalize Composite Comparison Matrix**
  - Traffic Assessment
  - Environmental Screening
  - ROW Impacts
  - Overall Costs
  - Public Involvement Support

- **Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities**

- **Develop Priority Phasing Plan for I-229 Corridor and Sub-Study Corridor**

- **Schedule and Conduct next public meeting**

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Chris Malmberg – HDR Engineering, Inc.
402-399-4959 or chris.malmberg@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 6 – 10th Street Sub-Study

Thanks for Attending!!!!!

HRGreen

Benson Road

June 2nd, 2015

- **Sign-In Sheets**
- **PowerPoint Slides**
- **Meeting Notes (See End of Public Meetings #2 Appendix)**
- **Comments (See End of Public Meetings #2 Appendix)**

Note: Actual attendance count was 20 people (including 6 women)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, June 2nd, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SD DOT	773-6488	pete.longman@state.sd.us
2	Ron McMahon	FHWA	776-1009	ron.mcmahon@dot.gov
3	Sara Bertsch	Argus Leader		sbertsch@argusleader.com
4	Kay Jolsted	lifeScape	[illegible]	kay.jolsted@lifescapesd.org
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CITY OF SIOUX FALLS PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 8618P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, June 2nd, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Amber Gibson	SECOG	605-367-5390	amber@secog.org
2	Doug Brockhouse	Banner Commercial	605-728-5800	dbrock@bannerca.com
3	Travis Dressen	SDDOT - SF Area	605-367-5680	travis.dressen@state.sd.us
4	Kurt Griffin	600 E 21st 57105	212 6035	1496-34@yahoo.com
5	Rick Kiula	Sioux Falls	521-6076	
6	Jason Kjenstad	HDR	605-977-7740	jason.kjenstad@hdrinc.com
7	Rush Smith	3500 E 60th St N	605-940-4943	
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 301CP, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, June 2nd, 2015 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Christina Bennett	SDDOT	605-773-4759	Christina.Bennett@state.sd.us
2	Chad Hartman	Sioux Falls	605-334-3204	Chad.hartman@ [illegible]
3	Rick Vander Haar	3408 N Potsdam Ave	605-366-1111	[illegible]@ [illegible]
4	Steve Gramm	SDDOT	773-6641	Steve.gramm@state.sd.us
5	Shannon Schultz	Minnehaha County H.D.	367-4316	sschultz@minnehahacounty.org
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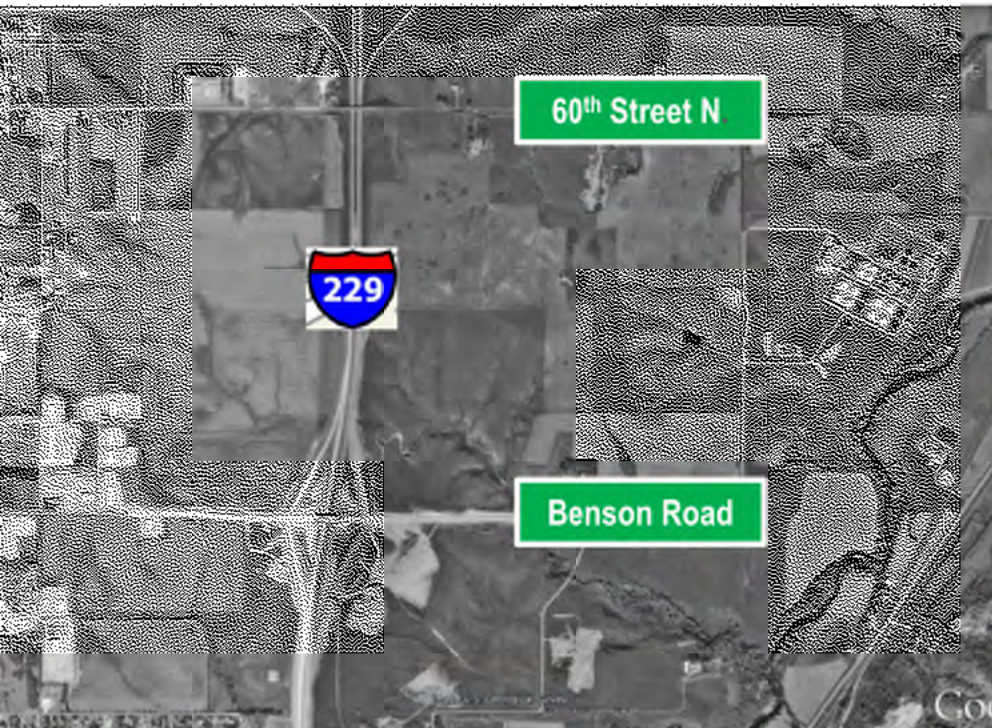


Interstate 229 Major Investment Study

Exit 9 – Benson Rd Sub-Study

Informational Meeting
June 2nd, 2015
5:00 pm to 6:30 pm

HDR

HRGreen

Study Area Map

I-229 Corridor Study

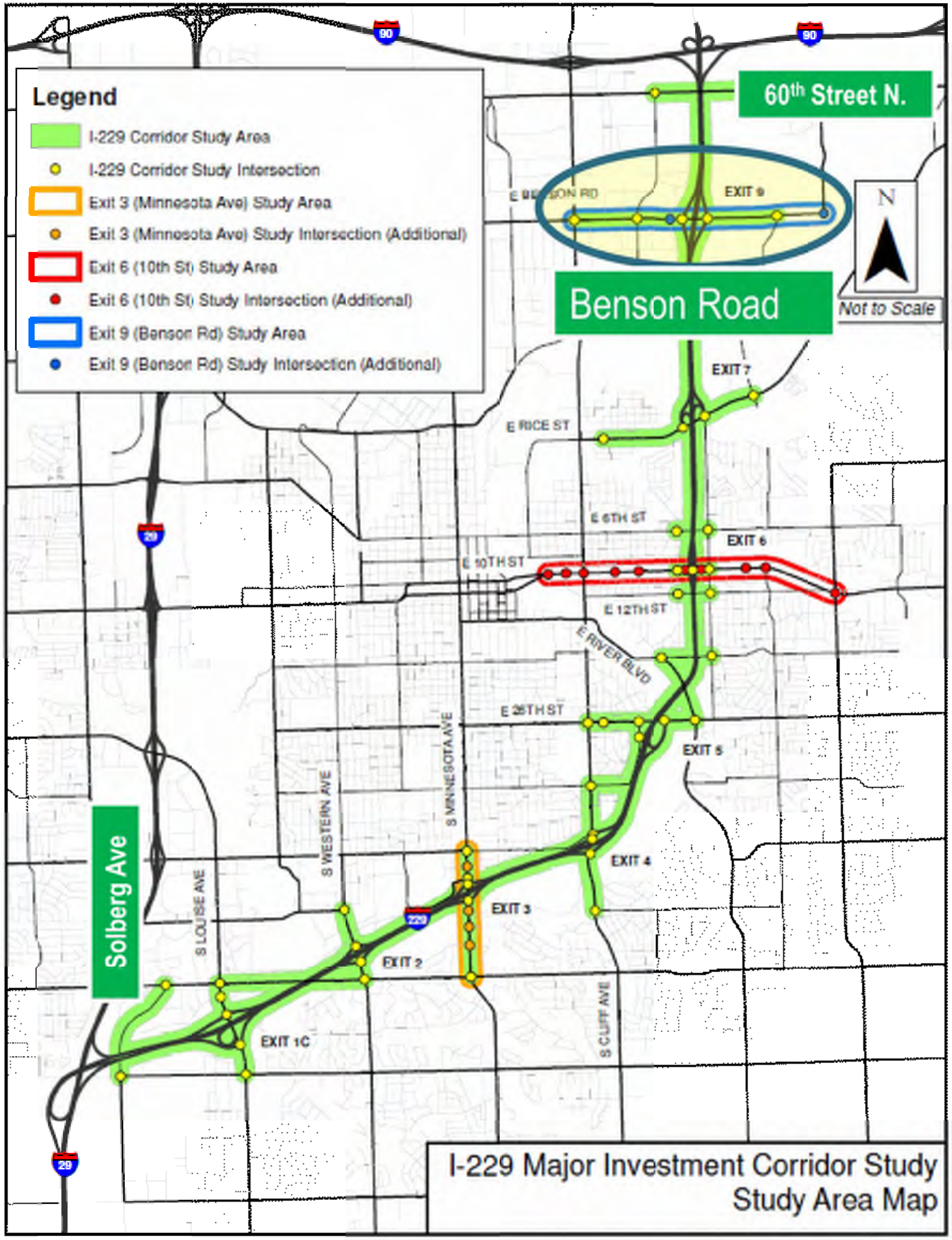
Solberg Avenue Overpass

to

60th Street N. Overpass

Meeting will focus on:

Exit 9 – Benson Road



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

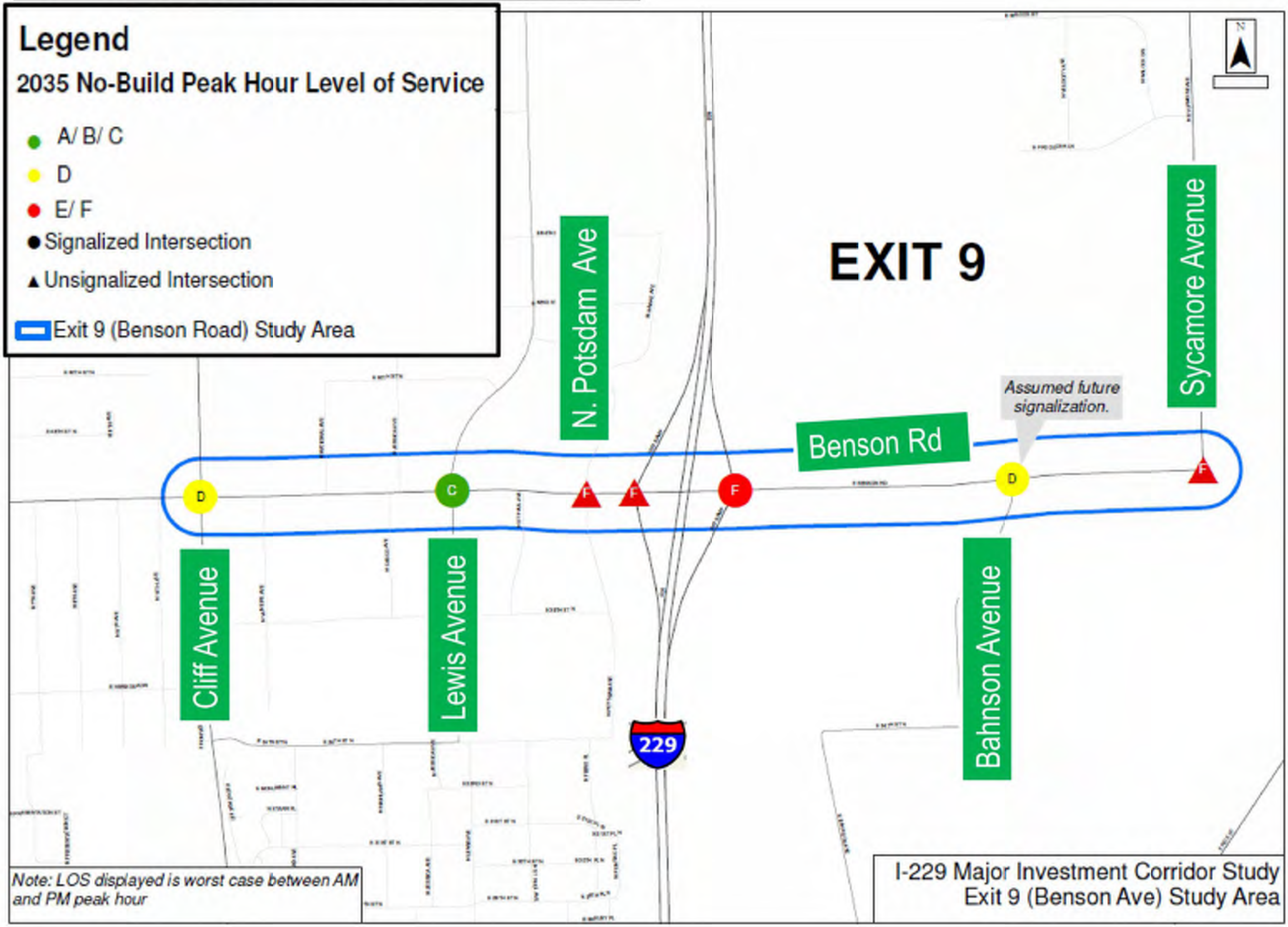
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

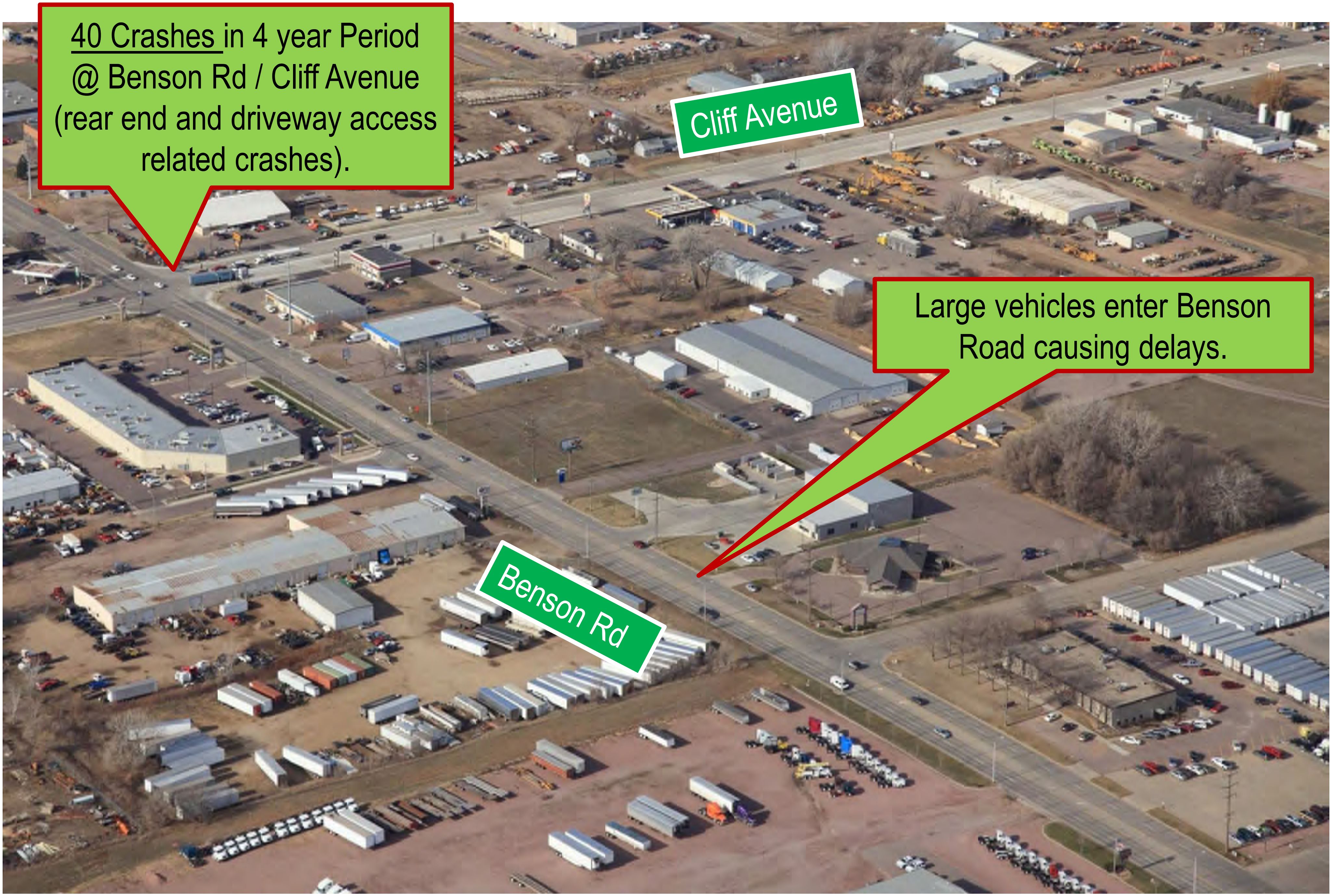
Exit 9 (Benson Road) Crossroad Study Goals

- Reduce traffic congestion at NB on/off interchange ramp terminal
- Develop Corridor Growth Plan to meet traffic demands from development taking place east of I-229
- Improve pedestrian mobility
- Make recommendations to improve corridor intersections
- Develop interchange alternatives to meet future traffic demands

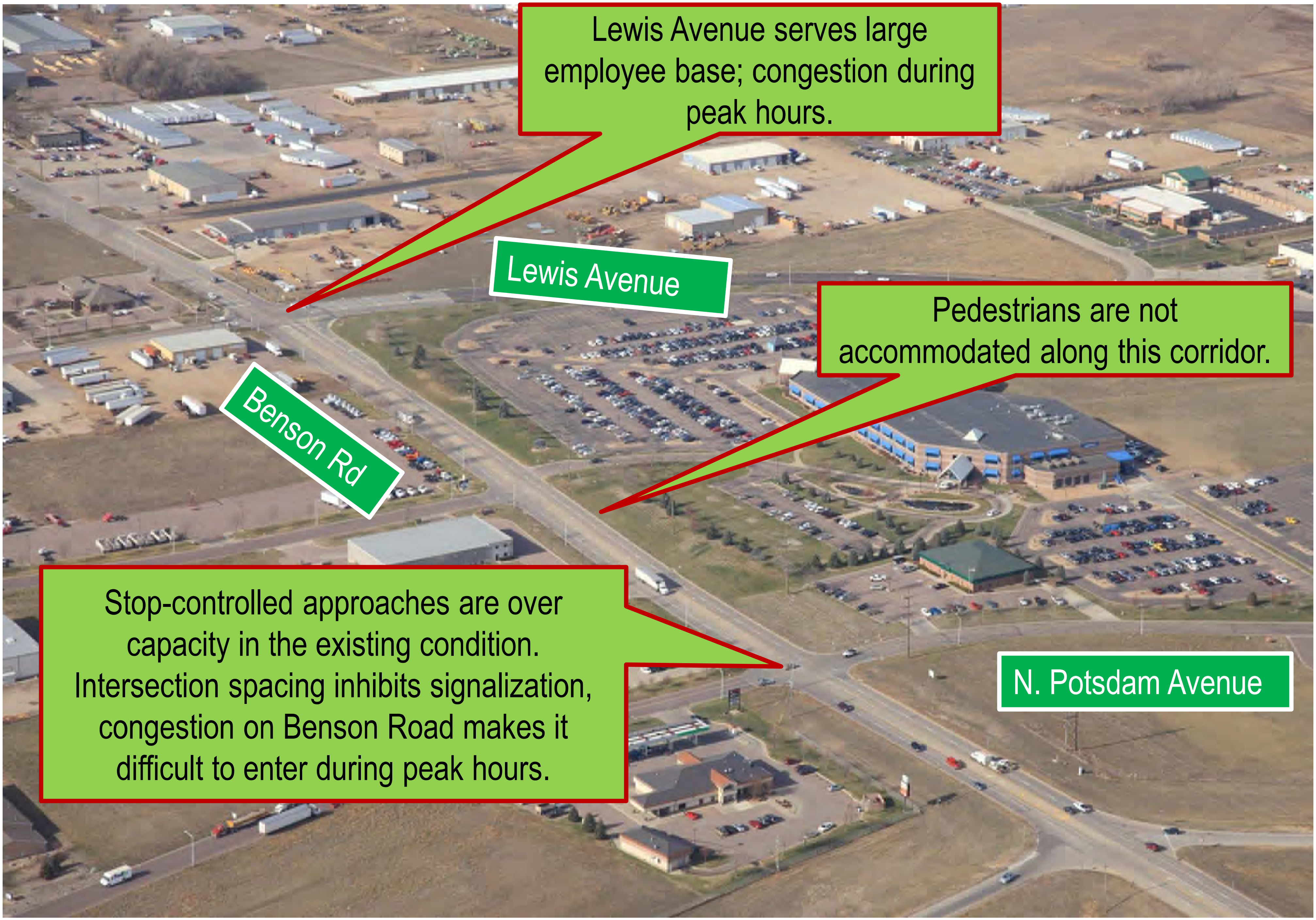
Benson Rd Corridor Overview



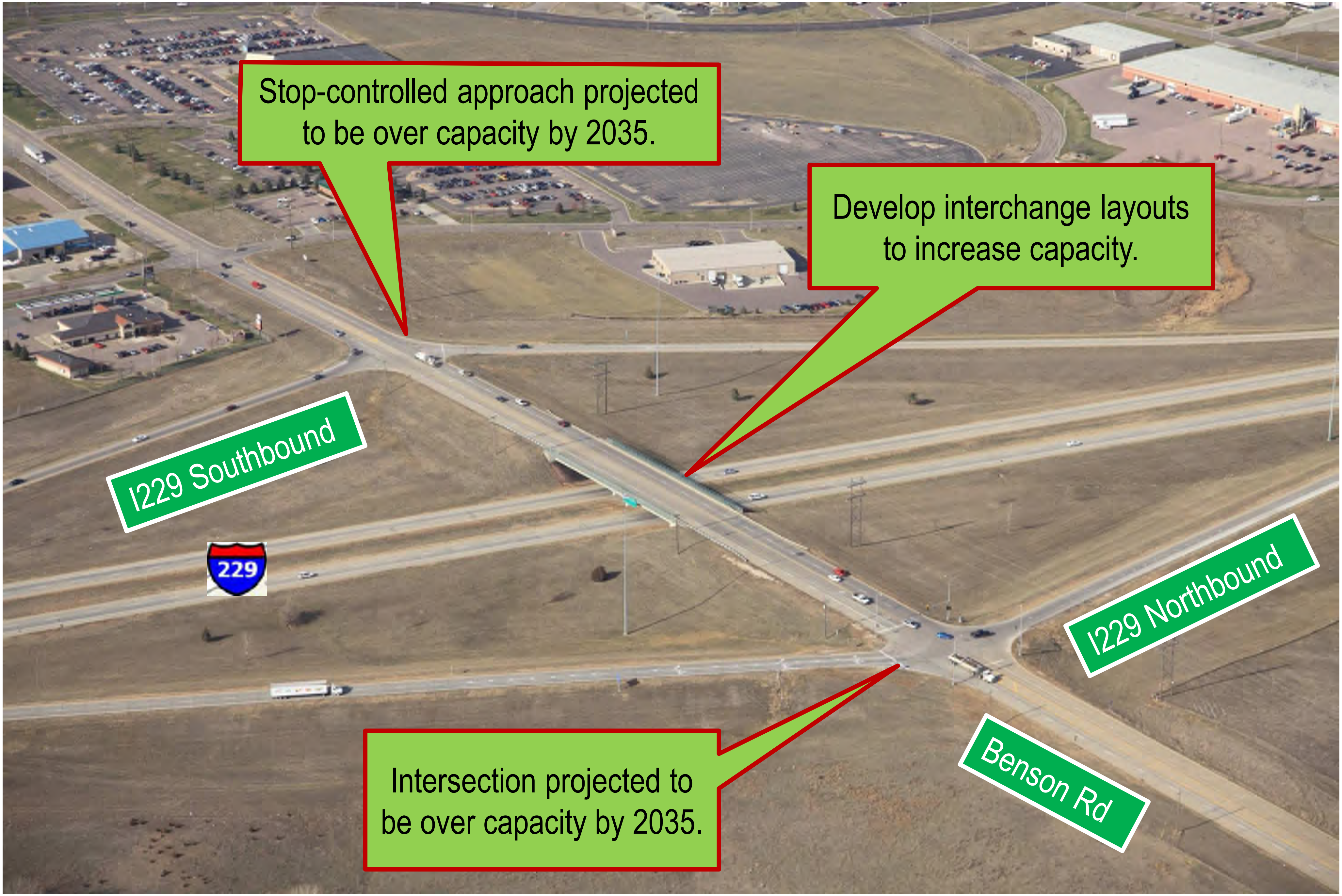
Benson Rd Corridor Overview



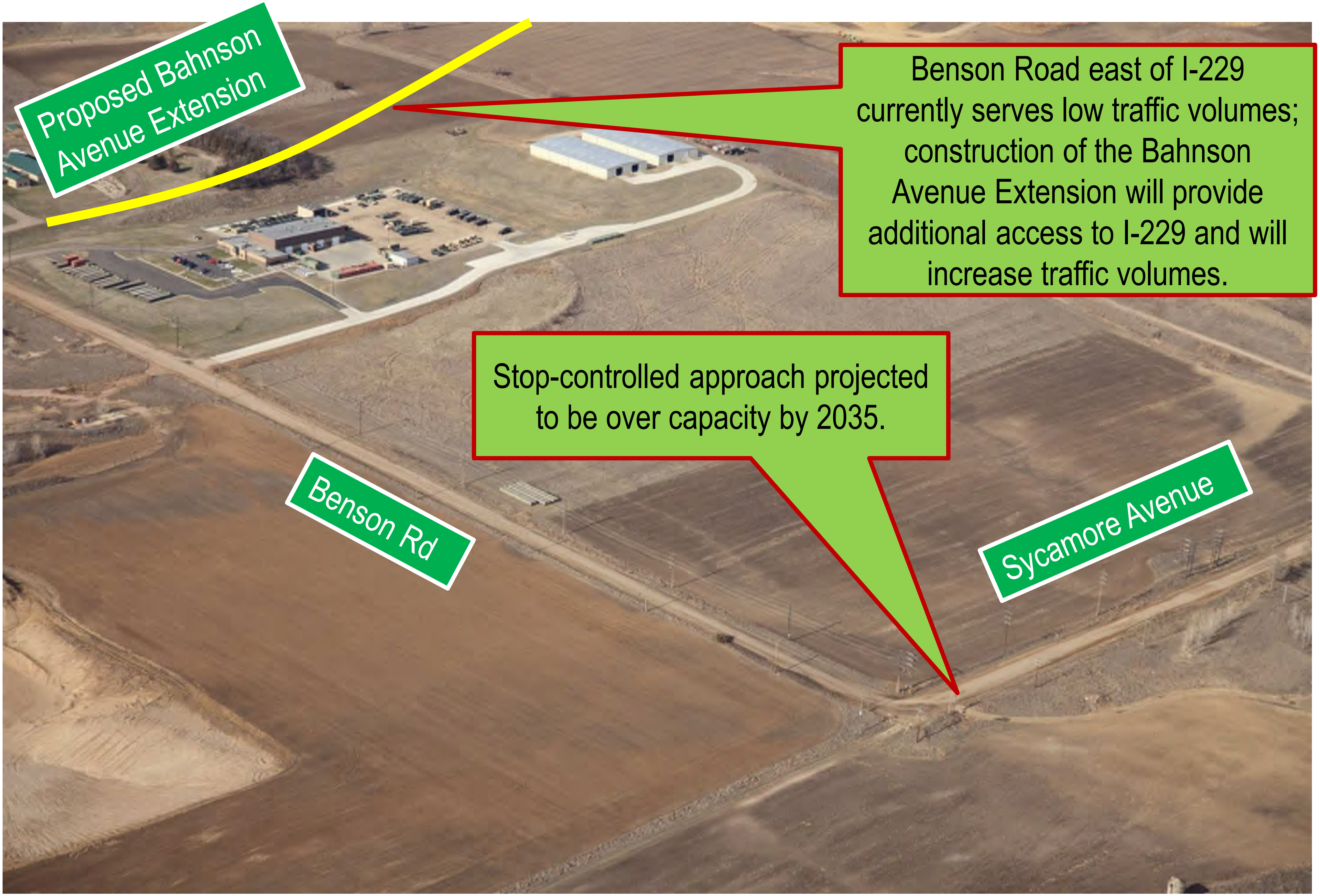
Benson Rd Corridor Overview



Benson Rd Corridor Overview



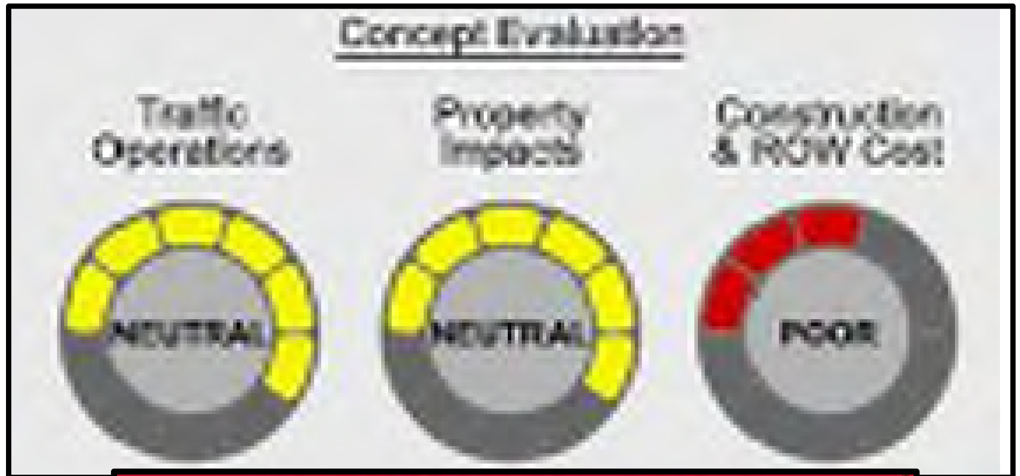
Benson Rd Corridor Overview

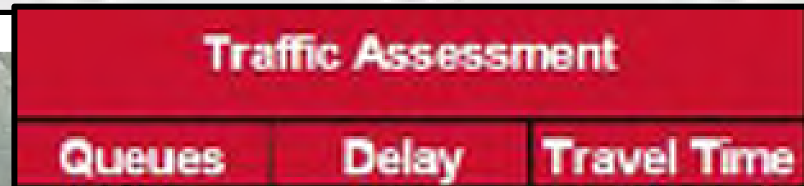


Conceptual Ideas for Benson Road

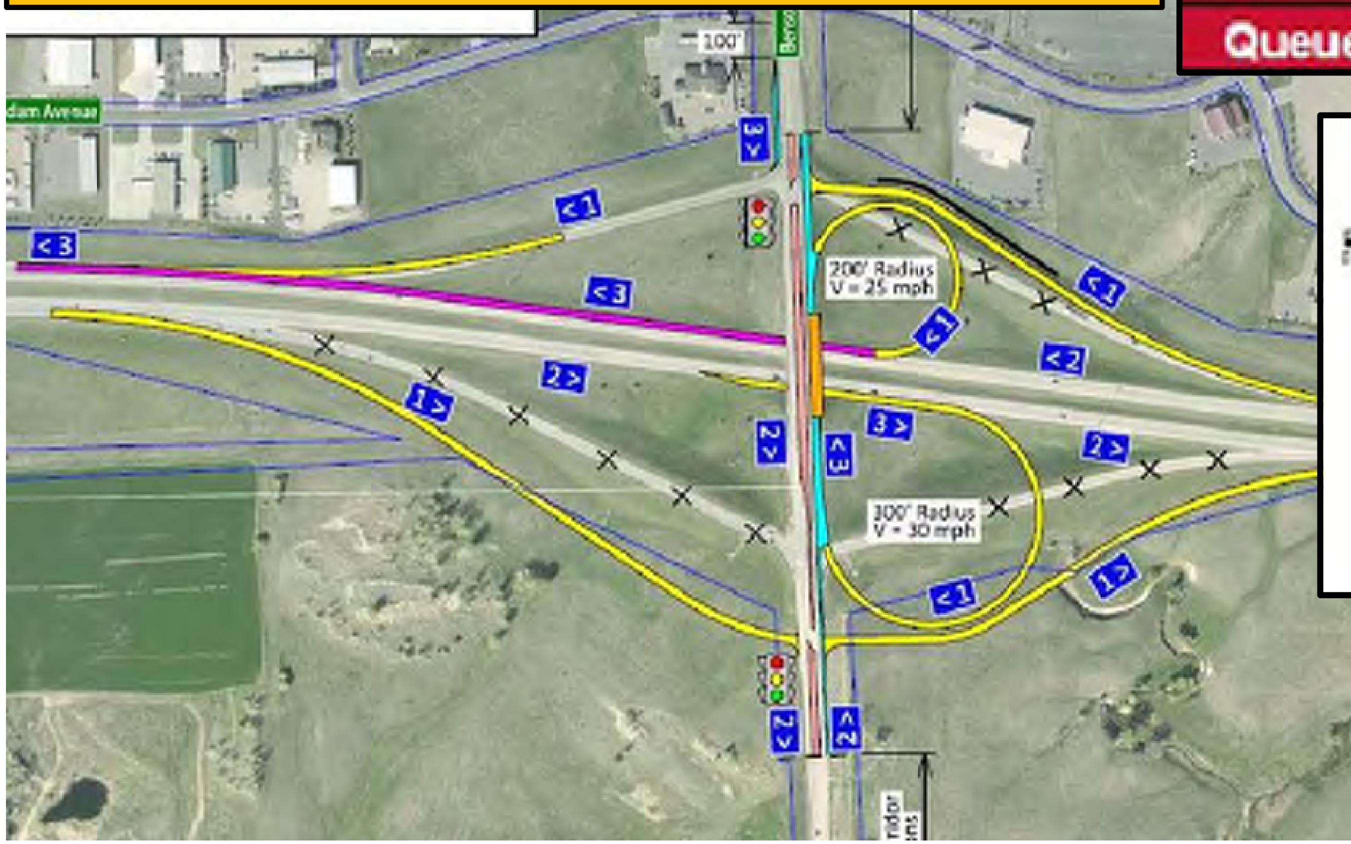
What you will be able to see tonight:

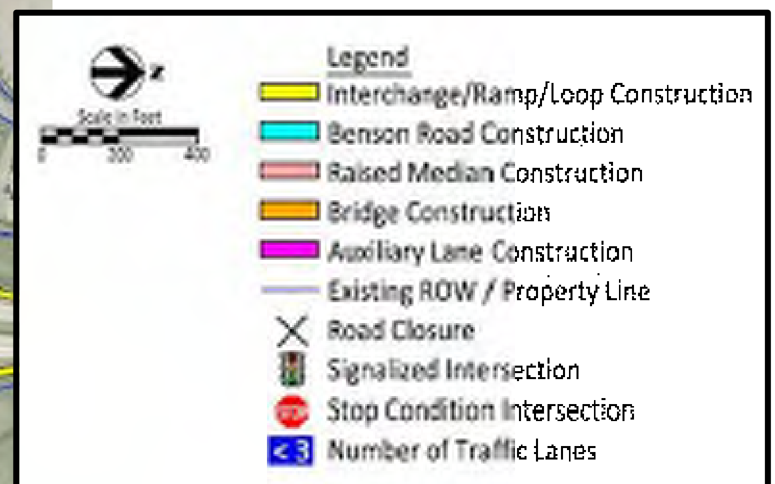
- 4 Interchange Conceptual Options
- 1 Corridor Option





Benson Road / I-229 Interchange Folded Diamond Option

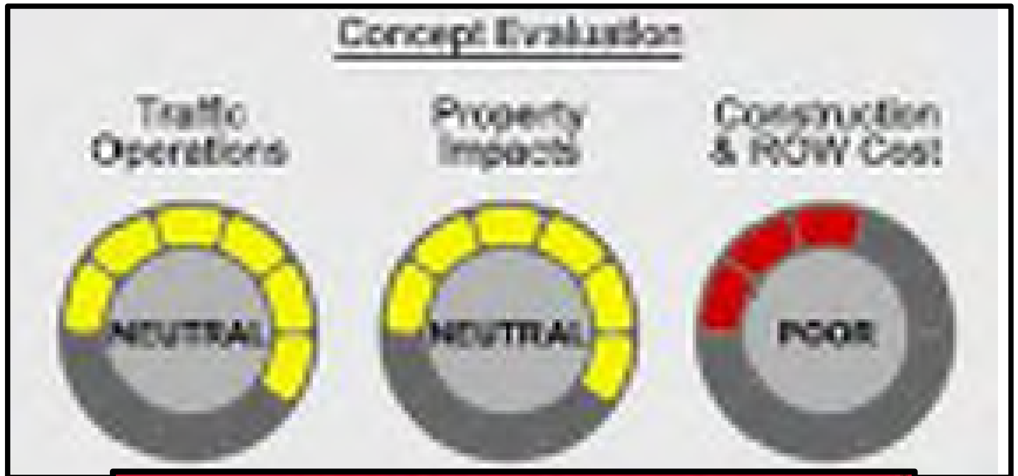




Conceptual Ideas for Benson Road

What you will be able to see tonight:

- 4 Interchange Conceptual Options
- 1 Corridor Option



Traffic Assessment

Queues	Delay	Travel Time

Benson Road Median Divided Section from Lewis to I-229

Next Steps for Benson Rd

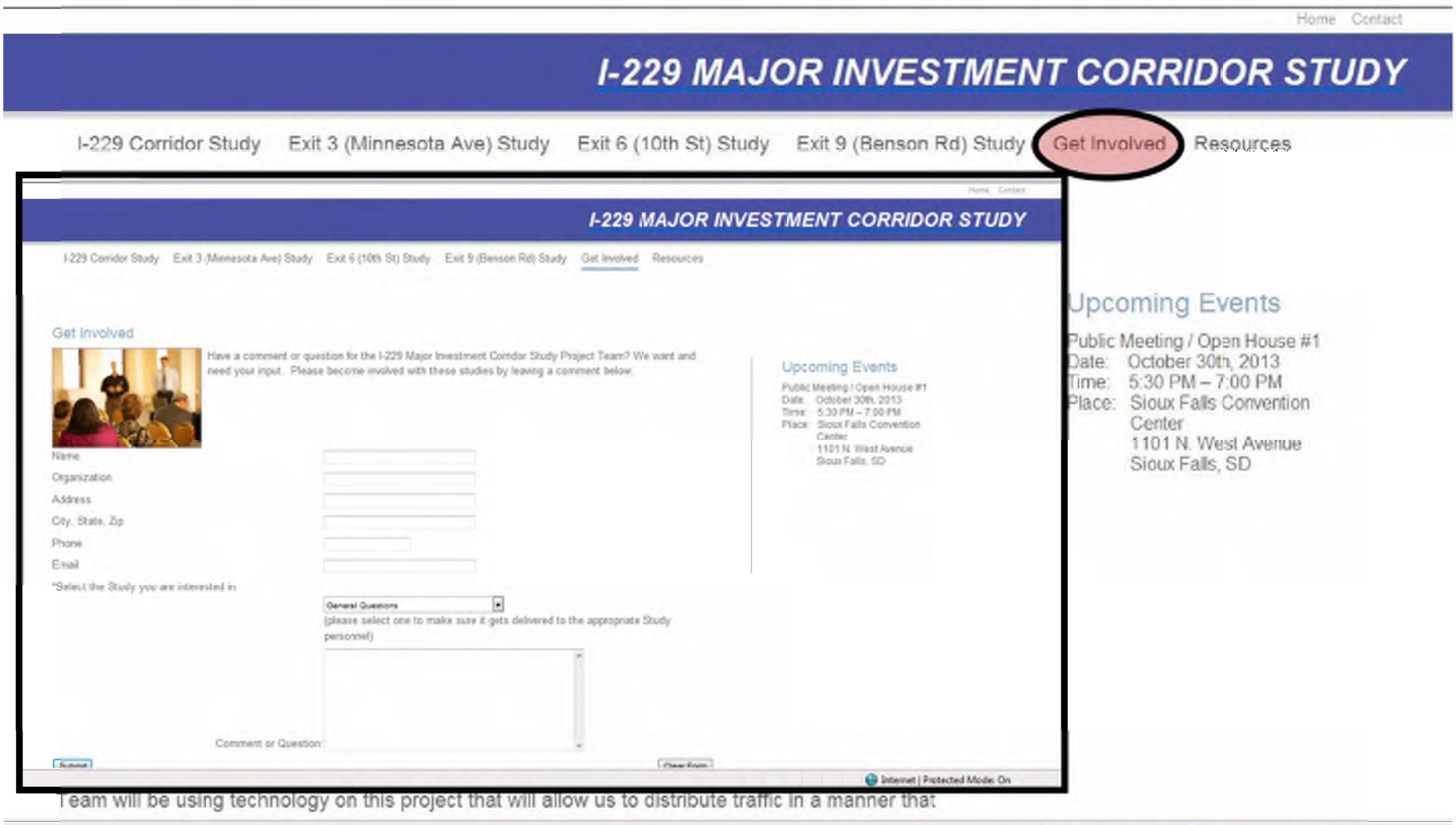
- **Finalize Composite Comparison Matrix**
  - Traffic Assessment
  - Environmental Screening
  - ROW Impacts
  - Overall Costs
  - Public Involvement Support

- **Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities**

- **Develop Priority Phasing Plan for I-229 Corridor and Sub-Study Corridor**

- **Schedule and Conduct next public meeting**

WWW.I229STUDY.COM



PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

James Unruh – HDR Engineering, Inc.
605-977-7740 or james.unruh@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 9 – Benson Rd Sub-Study

Thanks for Attending!!!!!

HDR

HRGreen

I-229 MAINLINE

JUNE 2ND, 2015

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE END OF PUBLIC MEETINGS #2 APPENDIX)
- COMMENTS (SEE END OF PUBLIC MEETINGS #2 APPENDIX)

SD DOT   CITY OF SIOUX FALLS PUBLIC WORKS

Note: Actual Attendance count was 18 people (including 7 women)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for I-229 Mainline Sub-Study 1

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0190(37)3615P PCN 04[illegible]K   **Project No.:** 207036

Meeting Date Tuesday, June 2nd 2015 7:00 PM   **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Steve Gramm	SDDOT 700 E. Broadway	773-6641	steve.gramm@state.sd.us
2	Amber Gibson	SECOG	367-5390	amber@secog.org
3	Jo Wahle			
4	Jason Kjenstad	HDR	605-977-7740	
5	James Unruh	HDR		
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Sign In Sheet

Subject: I-229 Major Investment Corridor Study – Informational Meeting for I-229 Mainline Sub Study 1

Client: City of Sioux Falls/South Dakota Department of Transportation

Project: PL 0100(87) 36[illegible]6P; PCN 044K

Project No.: 207050

Meeting Date: Tuesday, June 2[illegible], 2015 7:00 PM

Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	R[illegible] McMahon	FHWA	776-1009	[illegible].mcmahon@dot.gov
2	PETE LONGMAN	SDDOT	773-6488	pete.longman@state.sd.us
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Interstate 229 Major Investment Study

Mainline I-229 Sub-Study 1

Informational Meeting
June 2nd, 2015
7:00 pm to 8:30 pm

HDR

HRGreen

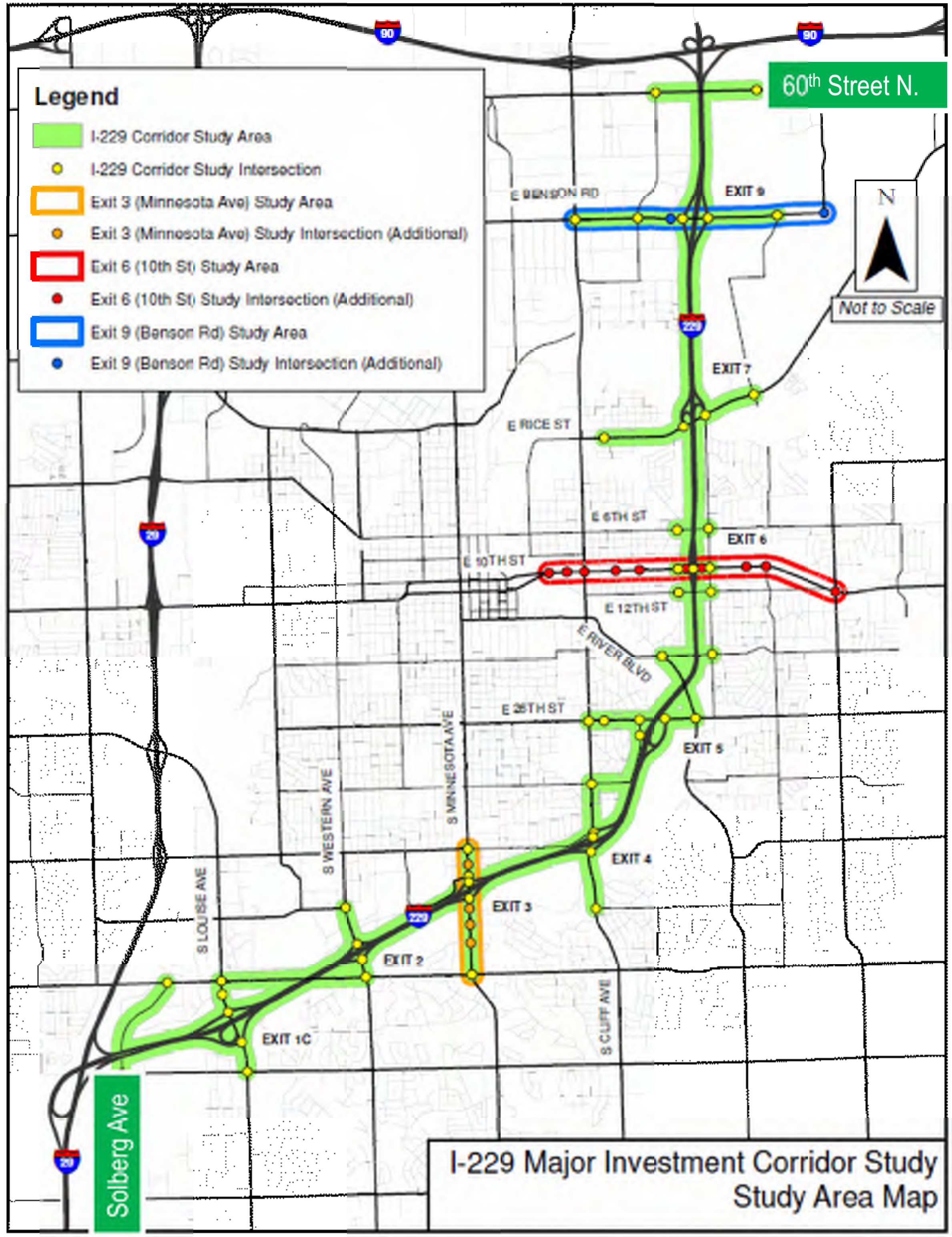
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass

to

60th Street N. Overpass



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

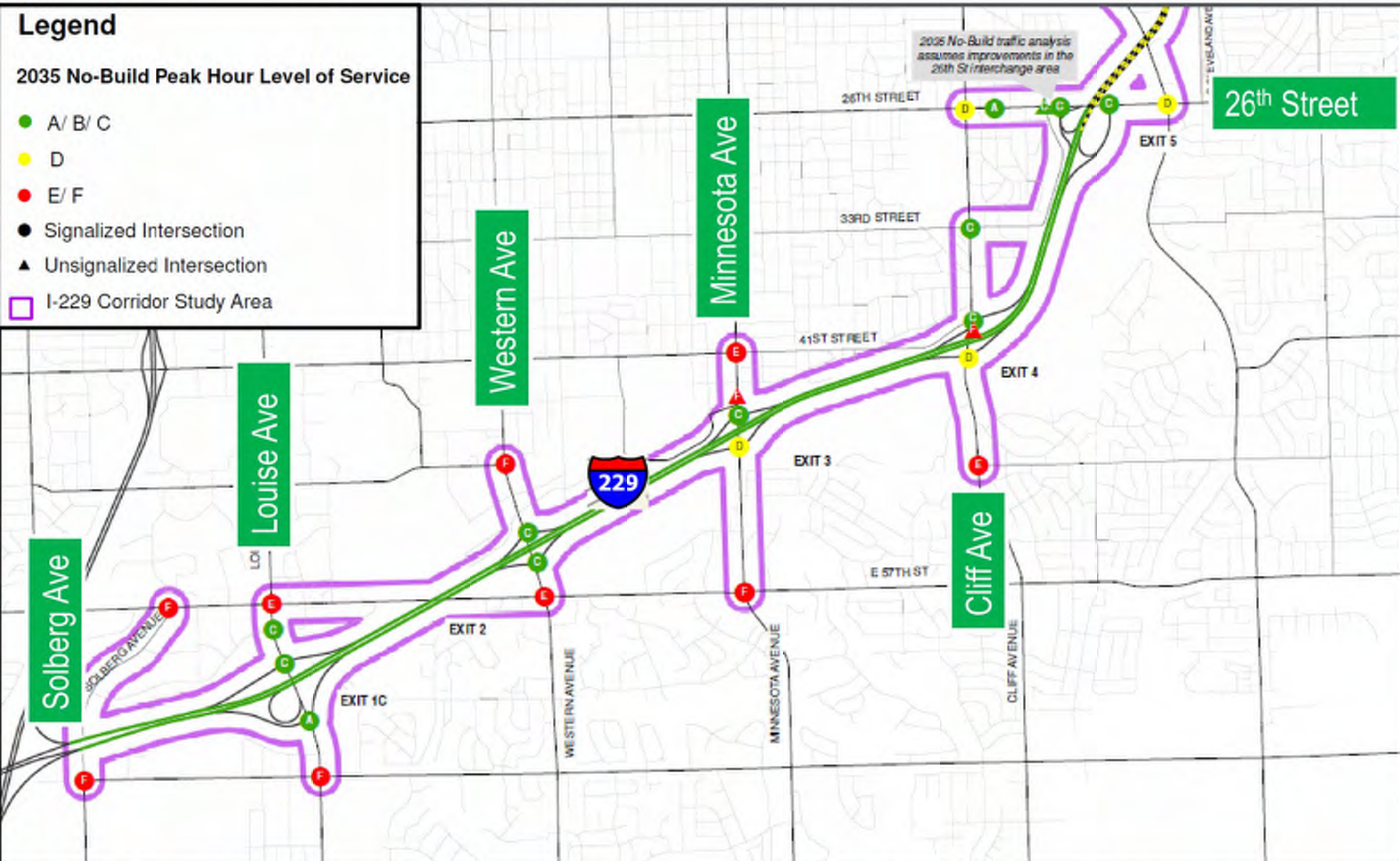
South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

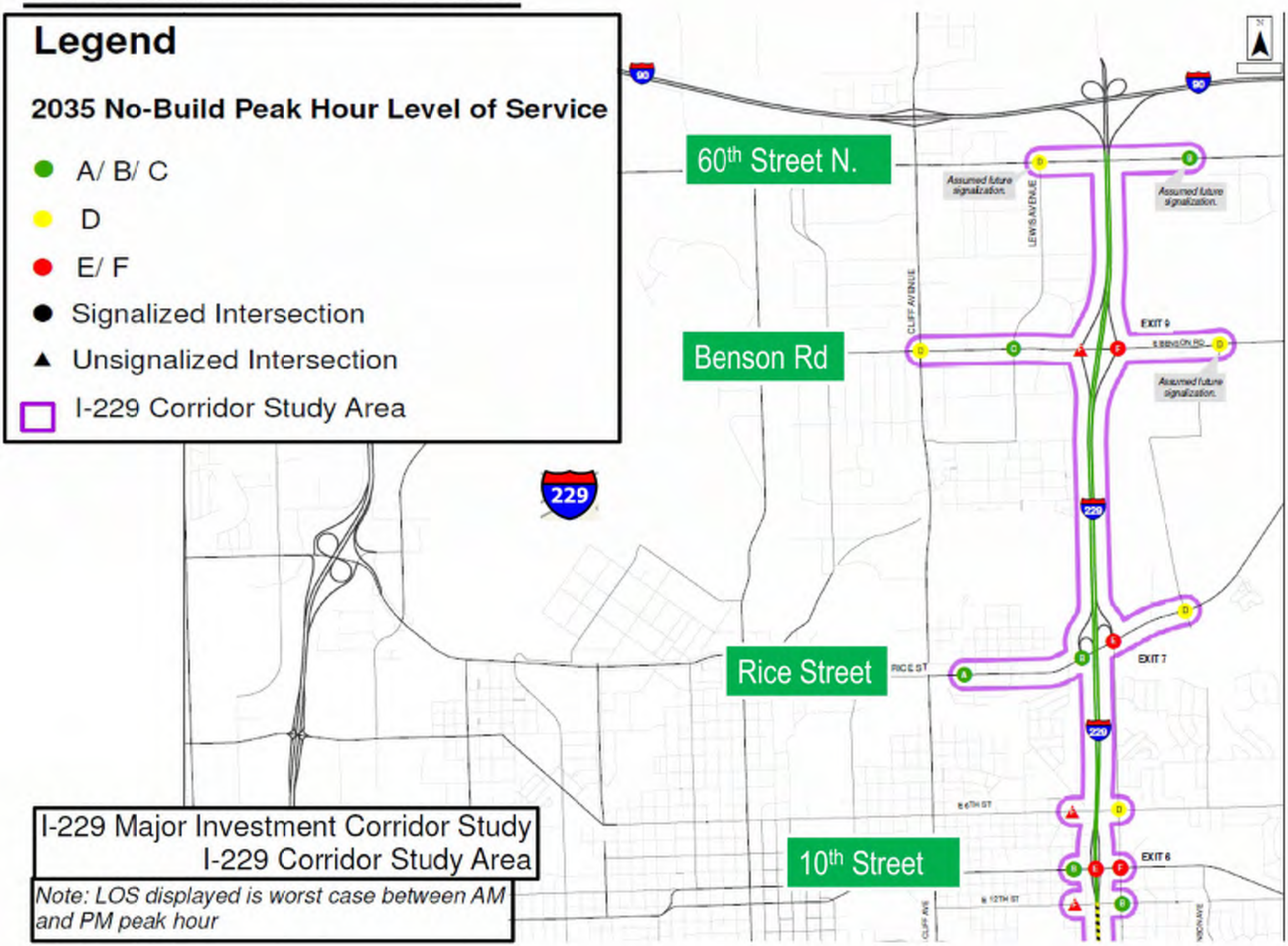
I-229 Corridor Overview



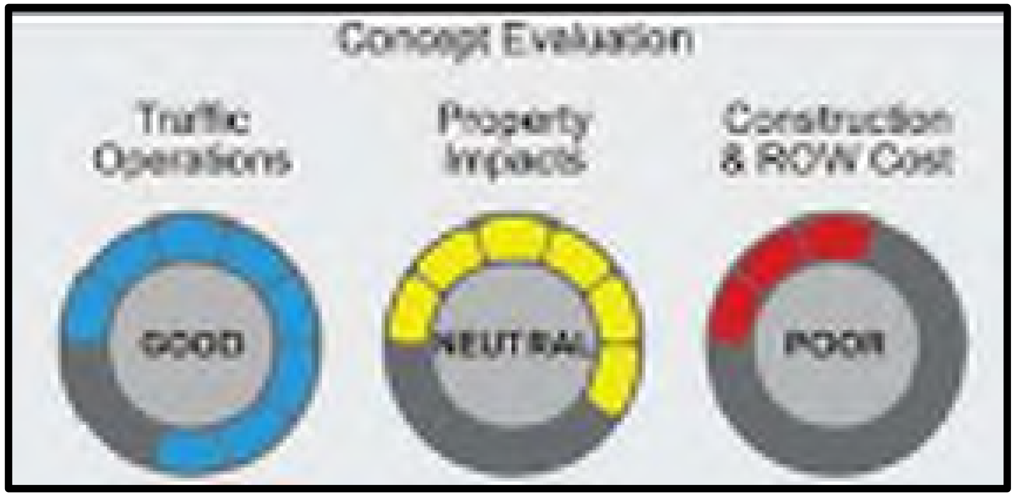
Note: LOS displayed is worst case between AM and PM peak hour

I-229 Major Investment Corridor Study
I-229 Corridor Study Area

I-229 Corridor Overview



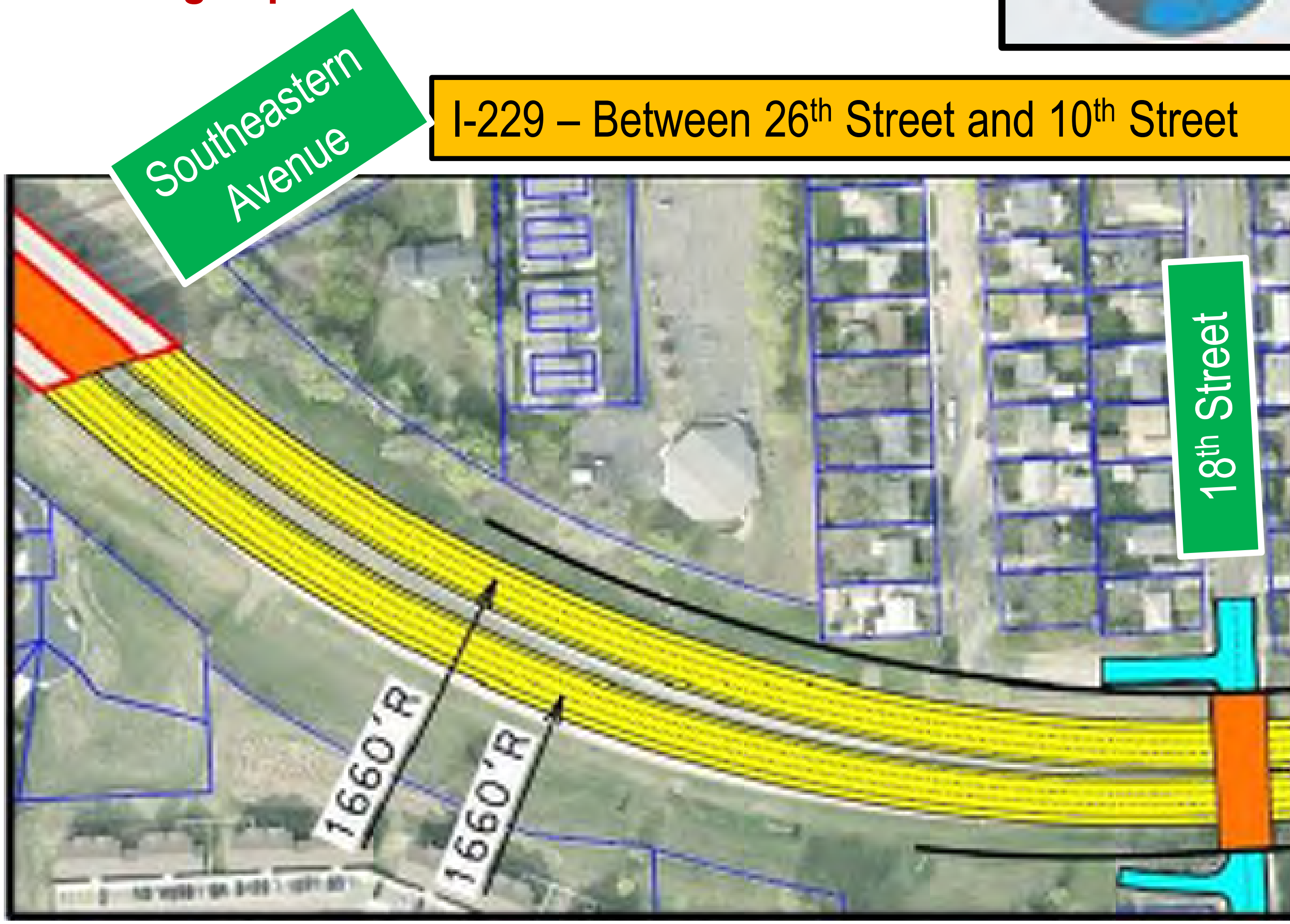
Conceptual Ideas for I-229 Mainline

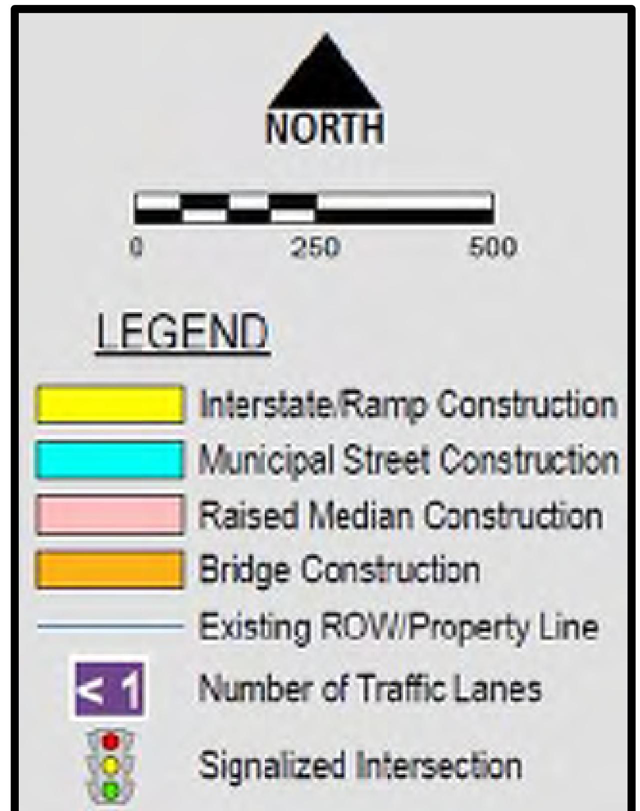


What you will be able to see tonight:

- **Additional 3rd Lane between 26th Street and 10th Street**
- **Modify design radius to allow for 65 mph design speed**

I-229 – Between 26th Street and 10th Street

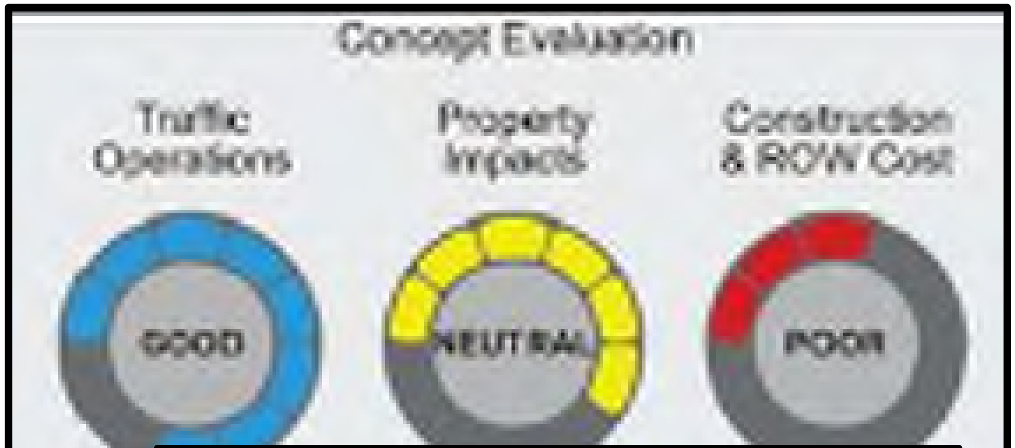


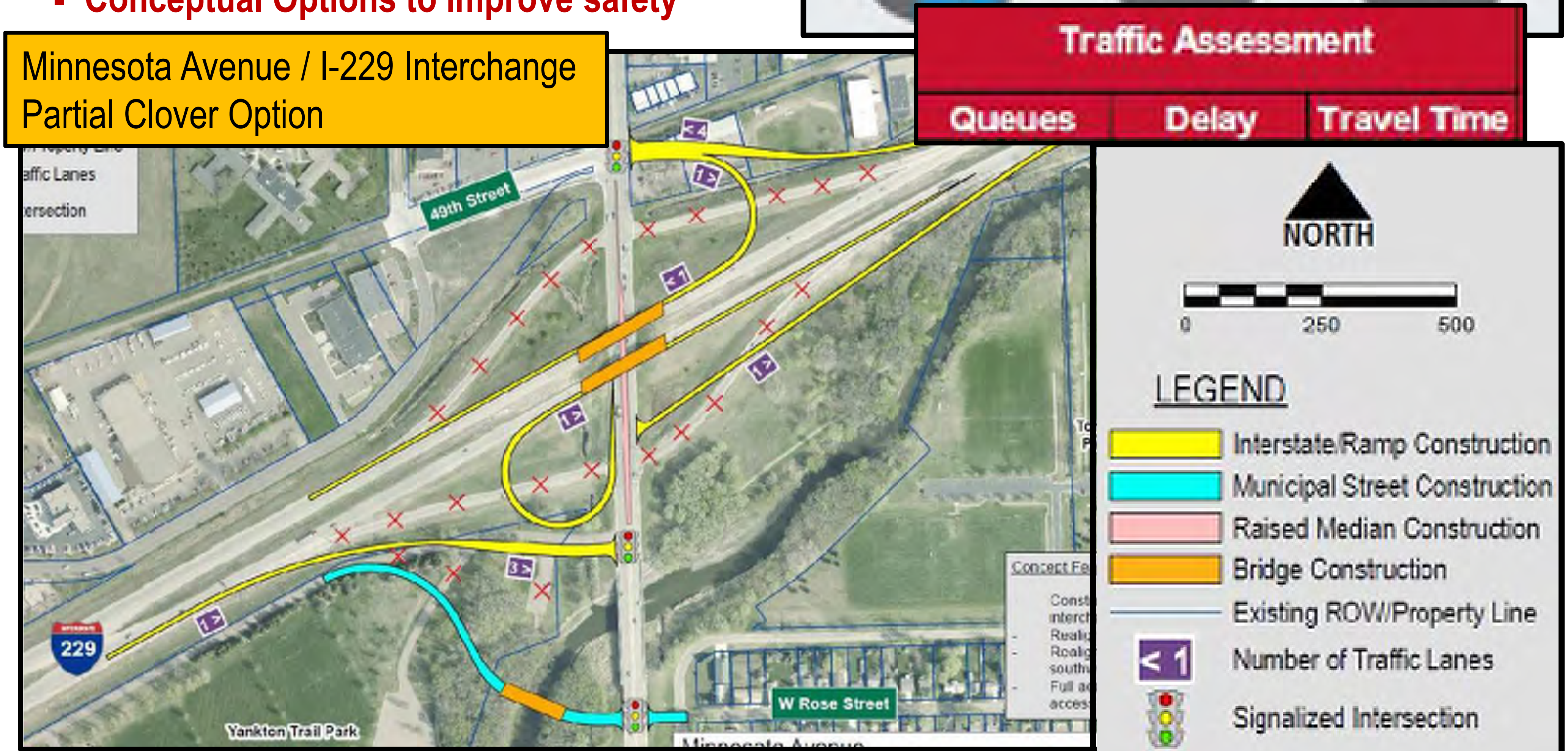


Conceptual Ideas for Minnesota Avenue

What you will be able to see tonight:

- 13 Interchange Conceptual Options
- 4 Corridor Options
- Access Changes to Yankton Trail Park
- Conceptual Options to improve safety

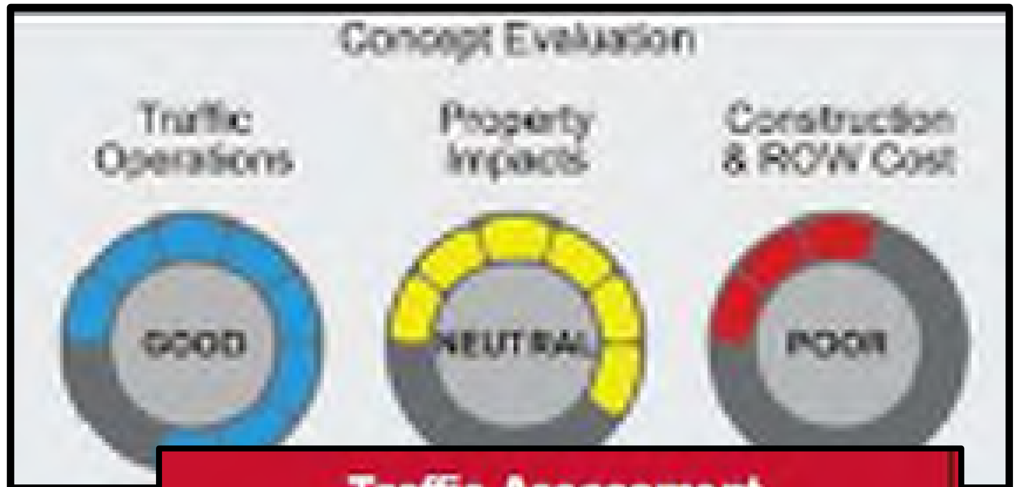




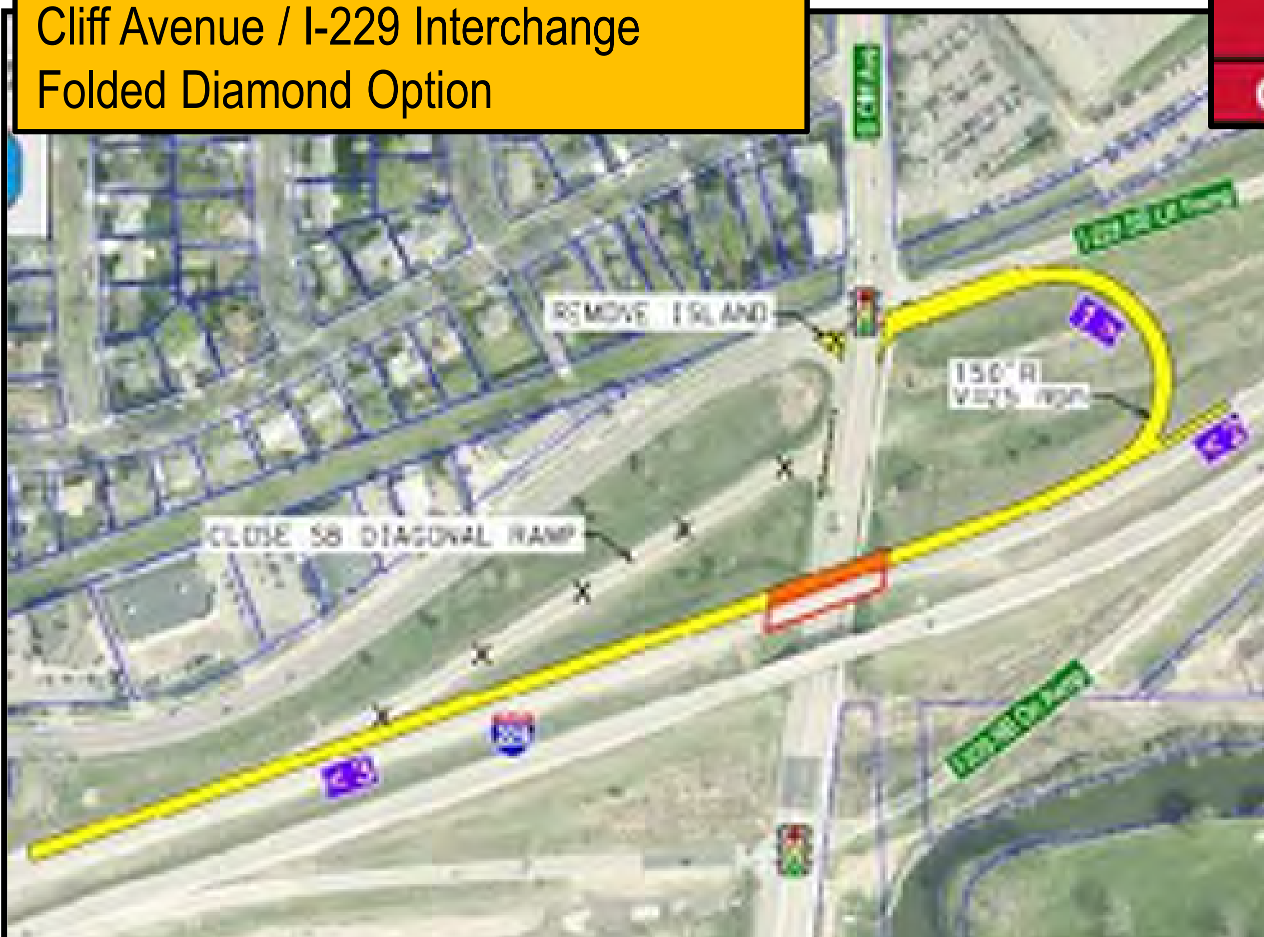
Conceptual Ideas for Cliff Avenue

What you will be able to see tonight:

- 3 Interchange Conceptual Options

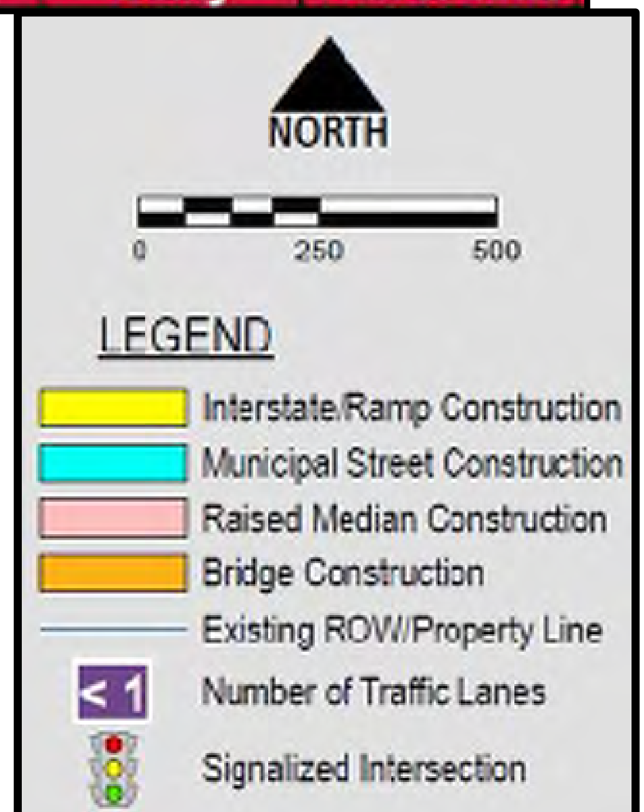


Cliff Avenue / I-229 Interchange
Folded Diamond Option

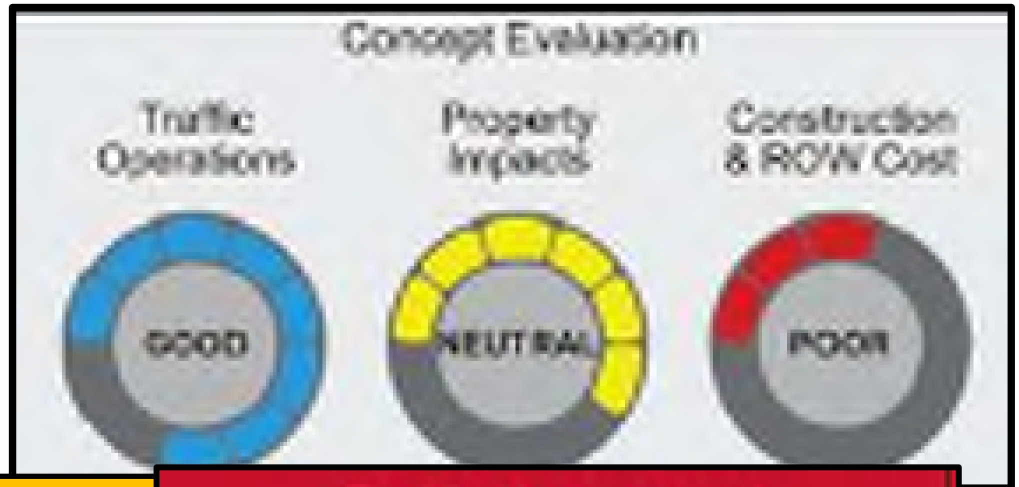


Traffic Assessment

Queues	Delay	Travel Time



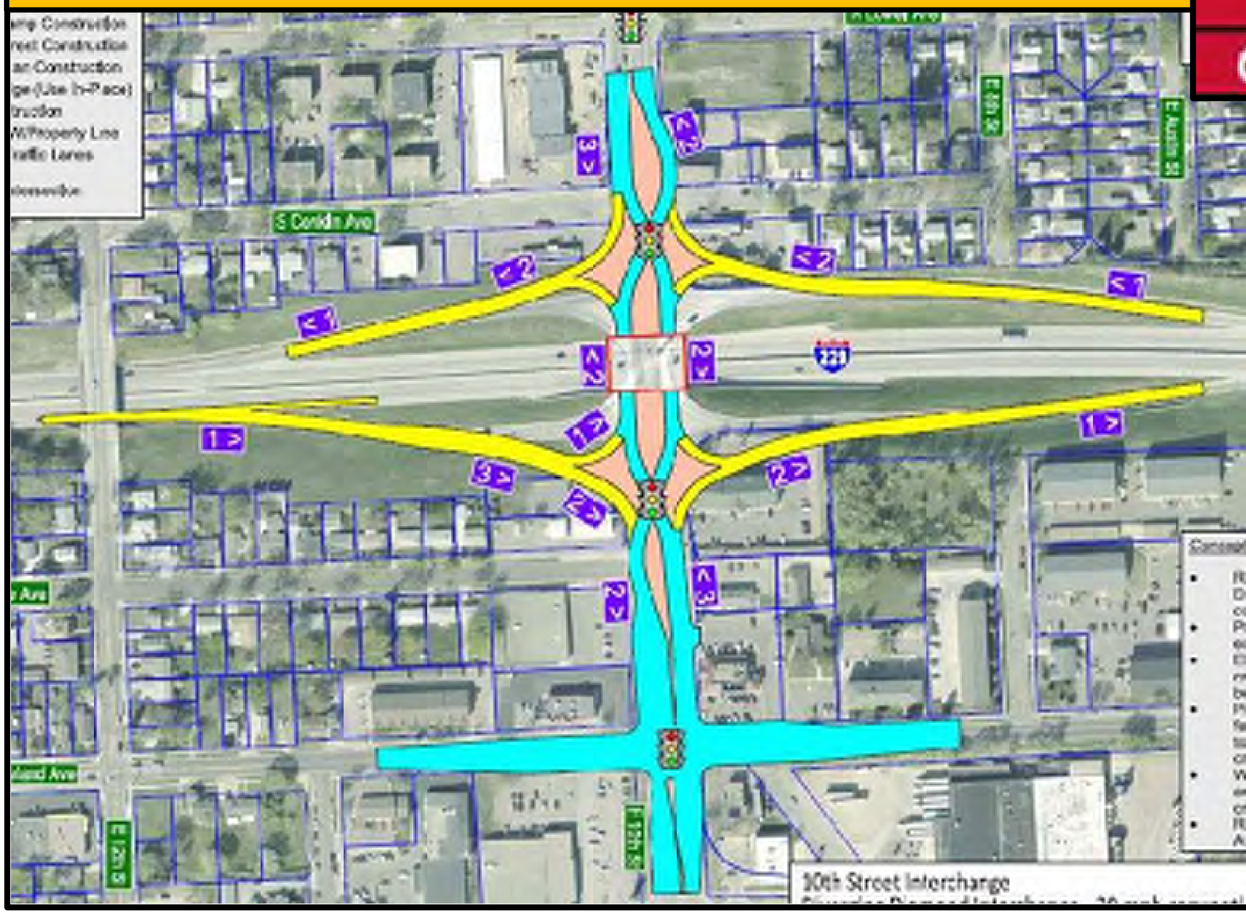
Conceptual Ideas for 10th Street Corridor



What you will be able to see tonight:

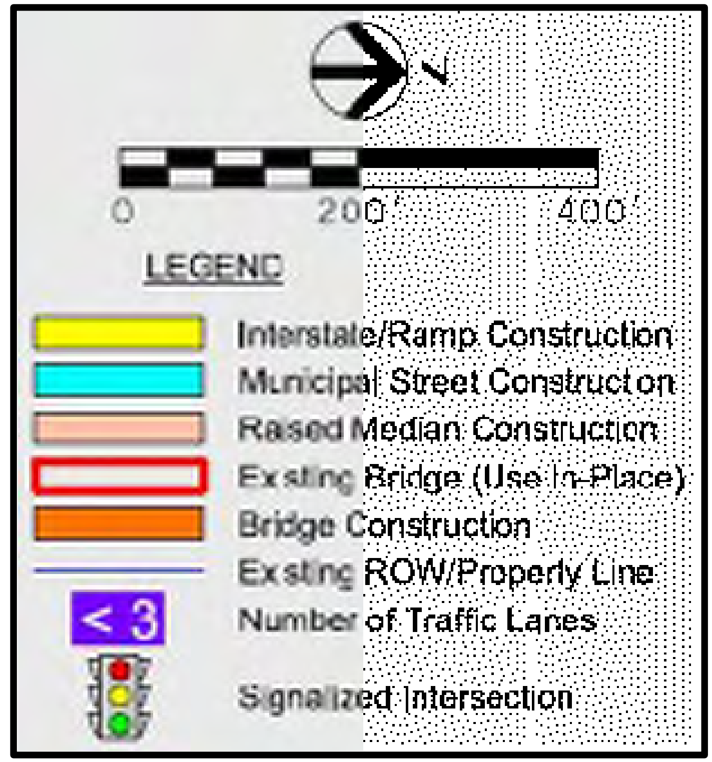
- 8 Interchange Conceptual Options
- 4 Corridor Options
- Median Changes or Driveway Closures to Improve Safety

10th Street / I-229 Interchange Diverging Diamond Option

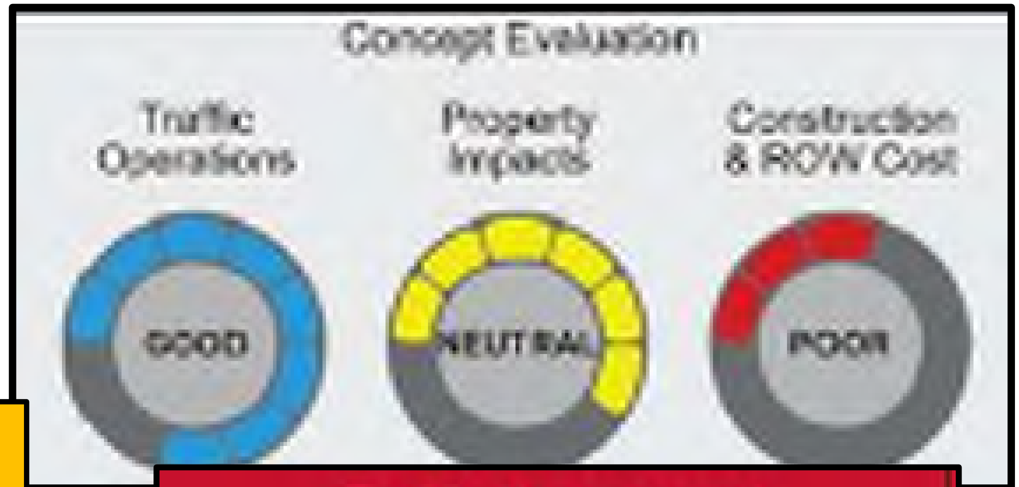


Traffic Assessment

Queues	Delay	Travel Time

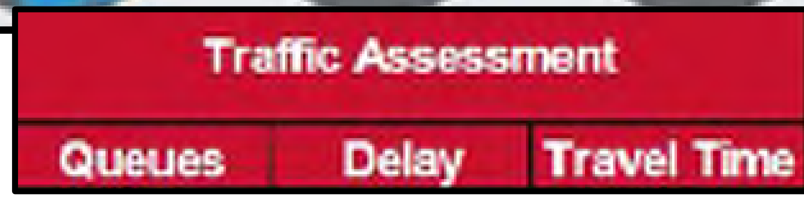


Conceptual Ideas for Rice Street Interchange

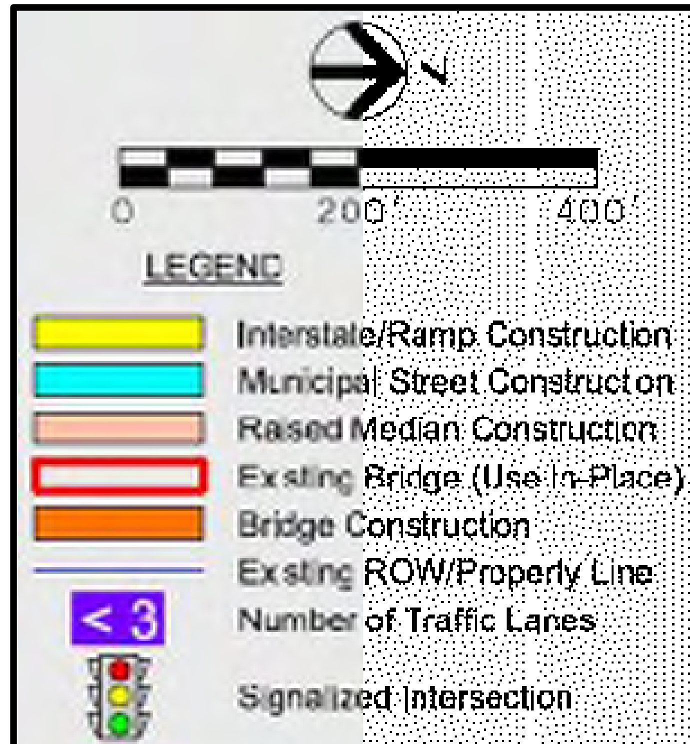


What you will be able to see tonight:

- 1 Interchange Conceptual Options



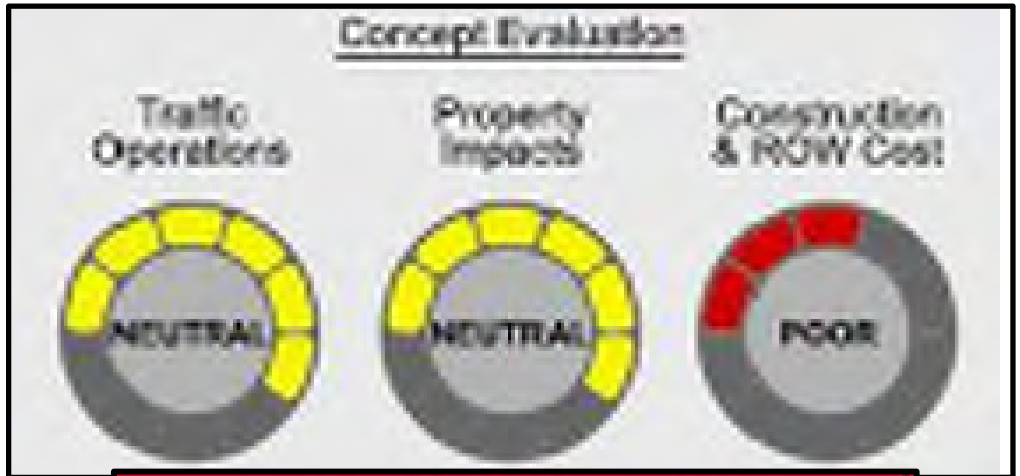
Rice Street / I-229 Interchange Folded Diamond Improvements



Conceptual Ideas for Benson Road

What you will be able to see tonight:

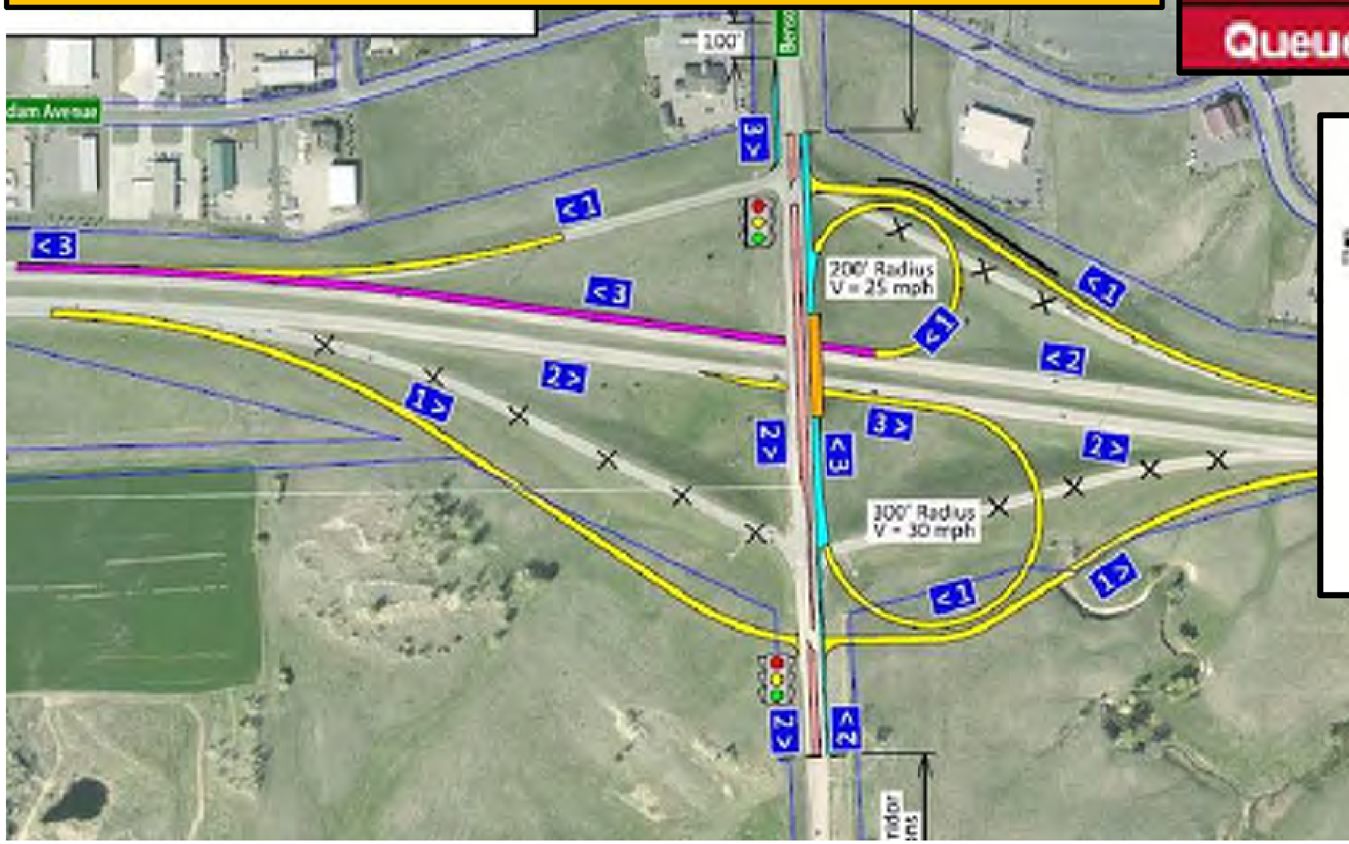
- 4 Interchange Conceptual Options
- 1 Corridor Option

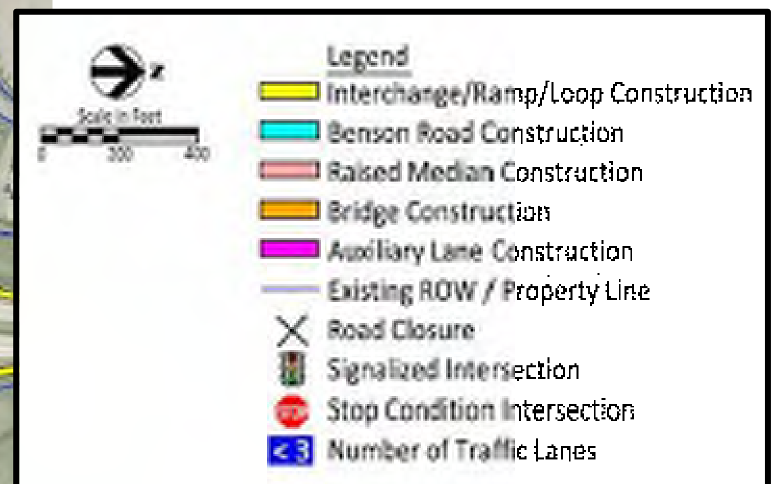


Traffic Assessment

Queues	Delay	Travel Time

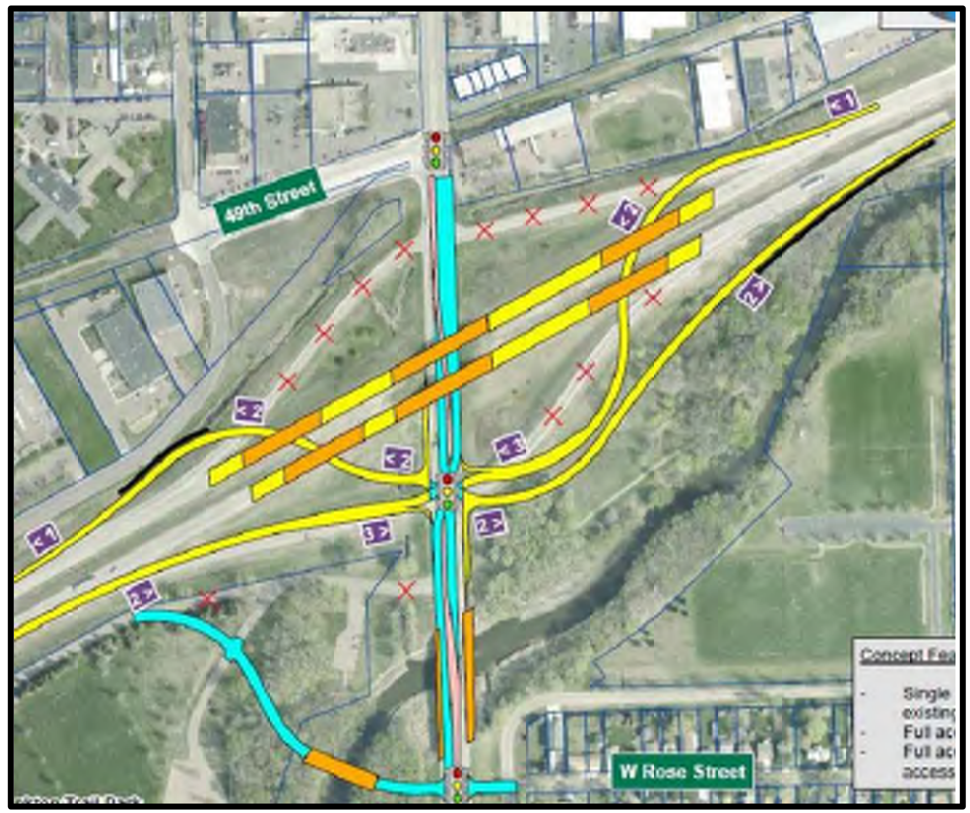
Benson Road / I-229 Interchange Folded Diamond Option



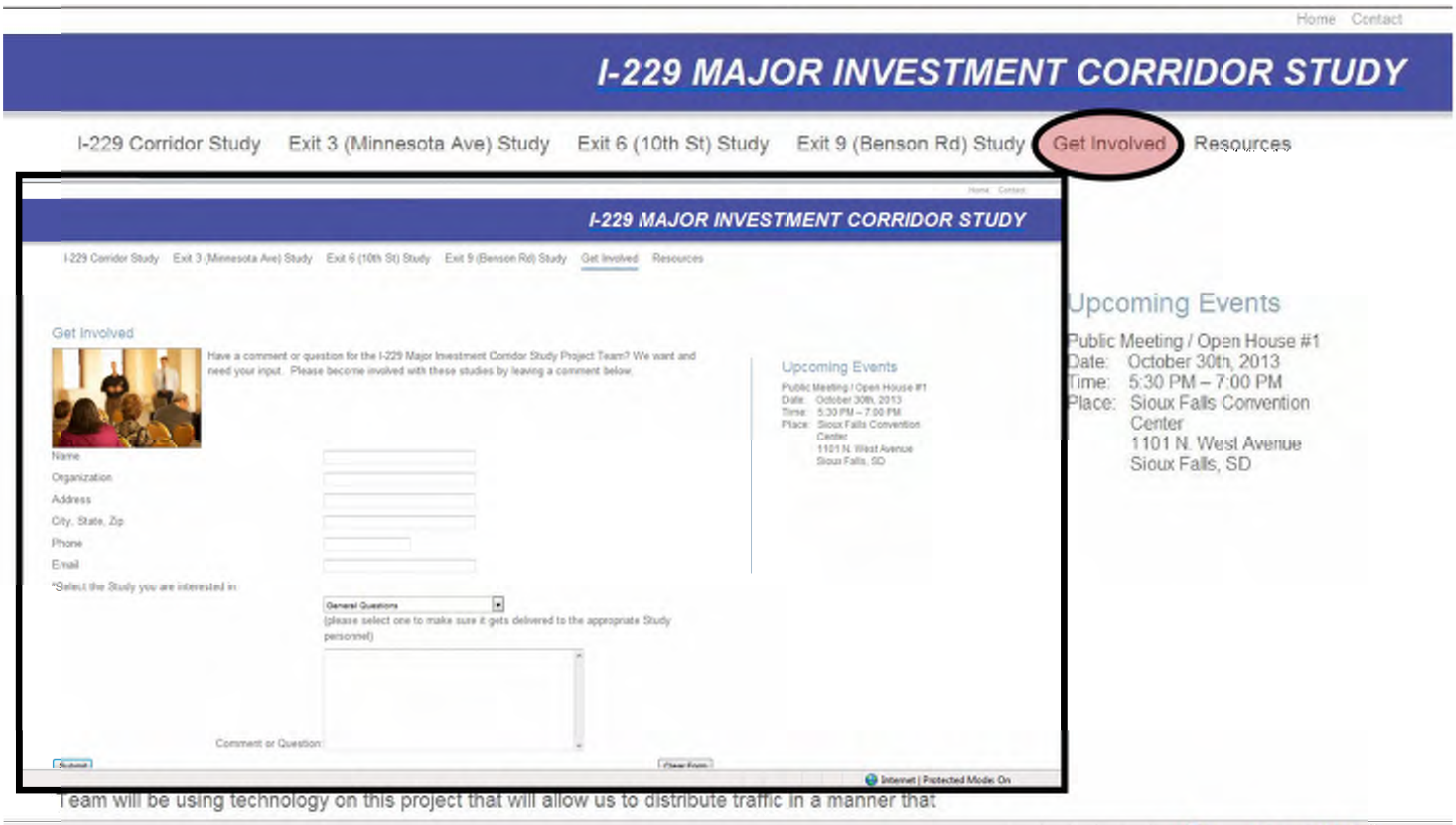


Next Steps for I-229

- Finalize Conceptual Options for all Sub-Studies
- Review Public Comments
- Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities
- Develop Priority Phasing Plan for I-229 Corridor and Sub-Study Corridor
- Determine what "ITS" applications could improve the I-229 corridor safety
- Schedule and Conduct next public meeting



WWW.I229STUDY.COM



PROJECT CONTACTS:

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Dave Meier – HDR Engineering, Inc.
402-399-1068 or dave.meier@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study

Mainline I-229 Sub-Study 1

Thanks for Attending!!!!!

HDR

HRGreen

MEETING NOTES

Memo

Date:	Tuesday, June 02, 2015
Project:	I229 MIS Public Meeting Debriefing Summary
To:	Project Study Advisory Team (SAT)
From:	HDR
Subject:	***Debriefing Summary / Meeting Comments***

Sub-Study 1 - I-229 Corridor:

- Mixture of interchange types confuses drivers. Should apply consistency in upgrading existing interchanges.
- Re ITS – Whatever advance information that can be provided to drivers via ITS features is a good thing.
- Concern about pavement noise. The I-229 pavement seems to generate a lot of noise.

Sub-Study 2 - Minnesota Ave:

- Prefer concepts with NO median on Minnesota north of 49th St.
- Don't see anything in the concepts shown that will improve operations on Minnesota outside the interchange area, particularly at 41st St and 57th St.
- Need to look at the sources of traffic congestion beyond the study limits.
- There were no operations problems on Minnesota until the traffic signals were added at the I-229 interchange ramps.
- Additional bicycle access across the I-229 corridor would be better if NOT on Minnesota.
- What about offsetting the school start time to avoid the morning peak period?
- Prefer interchange concepts without the traffic signals at the ramp terminals.
- Keep pedestrian and bike access separate from Minnesota Ave (off-alignment). Possibly aligned with Phillips or maybe with Duluth, Center or Spring. An overpass is preferred to an underpass.
- Improve bicycle/pedestrian access across I-229 on Minnesota and provide connection to Phillips corridor north of I-229.
- Like Minn-9 best. OK with right-turning traffic yield to pedestrians.
- Like the relocated Yankton Trails Park access concept with full access. Right-in/right-out for park access would not be good. Rose St connection to east as shown will not work – too steep a grade.
- Southbound ramp terminal intersection offset from 49th St is better – worried about ramp to/from 49th traffic speeding if the approaches are lined up.
- Post No Right Turn on Red for right turns onto of from ramp terminals to enhance safety of bike/pedestrian crossings.
- Significant population living northwest of 49th and Duluth that would benefit from improved pedestrian access.
- Believe there are issues with the railroad ROW easements that place limitations on use.
- Railroad ROW is not wide enough for street width shown on the Minn-C2 concept.
- 49th St should be perpendicular to Minnesota Ave. A horizontal curve to set up a 90-degree intersection would limit speeds on 49th and the ramps. Also have concern for angle of turn for trucks from eastbound 49th to southbound Minnesota.

- Like Minn-9 concept best except for park entrance right-in/out. Relocate the park access, but connect it to the existing trail parking lot to minimize impacts on forested area of park along river. Use the pavement from the existing drive from Minnesota for replacement trail parking.
- Relocated park access impacts Frisbee's drive.
- Need to provide pedestrian/bicycle connectivity between Minnesota Ave, Yankton Trail Park and Tomar Park.
- One person suggested studying a roundabout at Phillips with the 49th extension east alternative.
- One person commented that they preferred the loop ramps that remove left turns from Minnesota.

<u>Sub-Study 3 - 10th Street:</u>

- Potential noise issues with split diamond concepts due to added one way ramp connectors.

<u>Sub-Study 4 – Benson Road:</u>

- Need only one set of ramps (half interchange) at 60th St N.
- SPUI interchange at 10th St and elsewhere have worked well. Is it a potential concept at Benson Rd?
- During peak periods traffic on Benson Rd typically lets traffic from Potsdam onto Benson Rd.
- If concrete casting plant (Gage Bros. Concrete) relocates to the Benson Rd area, beams up to 120 feet long may be transported onto I-229 at the Benson Rd interchange. Plant relocation could involve up to 60 trailers/day for all products shipped and materials received. Intrigued by DDI concept.
- Concern that none of concepts shown have features to address strong eastbound to southbound right turns onto I-229 entrance ramp. Dual right turn with two-lane ramp for some distance may be needed.
- Prefer that Benson Rd interchange get big capacity increase and do nothing at 60th St N. 60th St N has good I-229 trail crossing potential if there are no interchange ramps.
- 54th St N would be a good new I-229 trail crossing corridor.
- Minimal pedestrian use is expected along the Benson Road corridor due to the commercial and industrial land use in the area.

COMMENTS

Comment 01

Sioux Falls, SD 57108-2102

Benson: improve flow EB Benson → SB 229
If + when Interchange comes to 60th N, will NEED alternative Bike/Ped Crossing eg @ 54th N.

Consider Rail to Trail 26th → MN → West (49th St)

Comment 02

Please evaluate dual lanes for SB movement from eastbound Benson. Very poor LOS at PM peak. This affects Potsdam and Lewis Intersections.
At least increase radius if leaving on ramp right turns at one lane.

Comment 03

*10th St. Corridor
I think there needs to be more attention paid to providing safe, convenient, and accessible access for bicycle, pedestrian, and public transportation users. More traffic lanes does not produce less congestion. There needs to be a more profound design that accommodates non-motorized transportation ~~mode~~ users. I-229 is a major barrier that has been identified as troublesome for getting people who walk, bike, or ride the bus.

(optional)
Name:
Address:
Phone:
Email:

I really like the concept of the diverging diamond on 10th St. as well as the service road access that would connect 10th & 6th St. I believe that the idea that 10th & 6th can be parallel urban arterials that provide safe, convenient, and timely travel to-and-from downtown ~~in terms~~ is great in terms of east-west travel.

Comment 04

6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

Fax: 605-977-7747

Need to include other modes of Transit in the evaluations!
Long-Term: Rail to Trail along 49th all the way to Cliff/26th would be Brilliant!

Any MN Exit that dumps onto 49th St will Turn it into an Extension of the freeway + Prevent Other users

Any Freeway access from 6th or 12th will ↑↑↑ Traffic on these Streets & complete the Bike/Pedestrian BLOCK from crossing except at huge, High Speed intersections

Comment 05

I think there needs to be a major consideration of the impacts to the entire Minnesota Ave. corridor to downtown/airport. Need to consider impacts to the ability to safely and conveniently bike, walk, and riding the bus. While I think bicycle/pedestrian access across I-229 should be first-and-foremost, ~~publ~~ access to public transportation needs to be seriously considered in an area that doesn't already have fixed route service available to them. Otherwise they are left with a singular option of ~~vehicles~~ single occupant vehicle trips, which I do not believe that any of the concepts address lessening the impacts of ~~traffic~~ future traffic congestion. There needs to be more of a focus on increasing bike/ped/transit access.

Comment 06

RE: I-229 Corridor Study – Minnesota Ave Interchange

As a volunteer member of the American Heart Association Advocacy Committee I strongly encourage this I-229 corridor study consider all roadway users (motorized and not) equally as it seeks to improve the way people move in and around the corridor. Interstates within cities have repeatedly proven to be significant barriers to the free movement of people. This is as true in Sioux Falls as it is in cities all over the world.

The American Heart Association identifies living actively as an important factor in preventing heart disease and preserving heart health. The possibility of active living is greatly enhanced by removing barriers to movement. Public roads and public spaces that are safe for the most vulnerable users are of primary importance.

I am particularly mindful of the southernmost portion of I-229 as it stands as a wall cutting the southern core of the city off from major pathways of desire: the river, the parks, the bike path. Directing these pathways of desire to traffic dense Western Ave, Minnesota Ave and Cliff Ave presents significant challenges to users. A person need only navigate these three interchanges a few times, counting the conflicts that present themselves before realizing these spaces were not meant for users who choose to power themselves.

Please rework the Minnesota Ave interchange seeking to give an equal level of safety to all roadway users, motorized and not. Use it then as a model throughout the city.

Comment 07

I am concerned for the ability of all citizens to safely cross I-229, including cyclists and pedestrians who are trying to access the Multi-Use trail from the growing southern Sioux Falls neighborhoods. Please keep this in mind at the Minnesota Ave interchange. Thank you for the opportunity to comment

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Comment 08

Comments I would like to see some sort of bike/pedestrian bridge over/under I-229 near the Yankton Trails Park area. Getting from south Sioux Falls via bicycle is terribly difficult. Thank you

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Comment 09

Please include me in any future planning around 10th Street. I am a commercial property owner Comments around 10th and Cleveland, so I am particularly interested in any future plans. I appreciate your making this public and inclusive.

Comment 10

Something that I feel needs to be addressed concerning the I-229 corridor is the unsafe traffic conditions at Cliff Avenue on the north side of I-229. The current traffic light set-up forces northbound drivers to risk their lives to get on westbound I-229. The main problem for this is the amount of traffic going southbound, and the timing of the lights. The traffic heading south through the intersection is going downhill and generally driving rather faster than the speed limit. The traffic coming off I-229 and turning south on Cliff Avenue is usually going pretty fast too, as the green light is short, and no one wants to wait. Additionally, eastbound traffic on 41st street turning south on Cliff Avenue faces only a yield sign. Knowing that the southbound traffic is heavy and fast when southbound Cliff Avenue or westbound 41st Street have a green light, the eastbound 41st Street traffic turning south has a brief window to gun it and head south on Cliff Avenue. Sitting in the northbound Cliff Avenue turning lane, waiting to turn west onto the westbound I-229 on ramp becomes a crap-shoot. It's unsafe to turn across the two lanes of southbound Cliff Avenue when Cliff Avenue has a south green light, or when westbound traffic off I-229 has a green light, or when both those lanes have a red light, and the southbound traffic coming off 41st Street speeds south s during the brief window of time when only northbound Cliff Avenue has the green light. When it's busy, especially before and after school, and after 5:00, there is no safe time to turn left from Cliff Avenue onto the I-229 on-ramp.Consequently, every car taking that route has to gun it, and hope the southbound traffic hits the brakes. This situation is clearly unsafe now. As traffic grows, it will get worse. A simple fix, for now, would be to time the lights a little different, or at least a little longer, and add a red light in place of the yield controlling southbound Cliff Avenue traffic from 41st Street. When all southbound and westbound traffic has a red light, those cars headed for southbound I-229 would have a safe, clear path. Time the light long enough to allow 6 cars to get through. Another, simple way to improve the traffic situation would be to widen the lane where traffic turns south onto Cliff Avenue from 41st Street. If that lane were twice as wide, 41st Street traffic trying to get on the on-ramp for I-229 south could do so without having to pull into the right lane of southbound Cliff Avenue. That lane should still have the traffic light in place of the yield sign. It wouldn't take much of a traffic study to see the issues at that intersection. Spending a half hour observing at 7:30 a.m. on a school day would tell you all you need to know.

Comment 11

Thanks for the reply. To be honest, I poked around a lot in the site I sent the message from, but did not see the part you link here. It looks interesting and it looks like it's designed to alleviate the exact problem I wrote about. Some questions- Would there be another lane added where the loop comes onto SB I-229, so that I'm not trying to merge into 65 mph (ha ha- wish they were going that slow) traffic while accelerating up a hill on a curve? What would be the purpose of the retaining walls shown between I-229 and the existing SB on-ramp? Is there a time frame yet on when this work will be started?

APPENDIX -

CLIFF AVENUE AND RICE STREET PUBLIC MEETINGS – JUNE 22ND, 2016

RICE STREET

JUNE 22ND, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- COMMENTS
- POWERPOINT SLIDES

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 5 – Rice Street Exit 7
Date:	Wednesday, June 22, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 8 Participants

Comments & responses noted:

1. Trucking firm on North side Rice, east of I-229 (Kunkel Truck Lines)
   - Concern for Eastbound truck ingress to property.
   - What is the purpose of the proposed median? Response: Median is the preferred treatment for arterials carrying more than 20,000 veh/day (City)
   - Are the proposed corridor improvements similar to W 12th Street near I-29? Response: Yes (City)
   - Will the railroad have one track or two? Response: BNSF has not indicated how many tracks there may be in the future. They have not ruled out the potential for expansion.
   - Business owns both existing drives on the north side of Rice St. An adjacent business to the east (Eastgate Towing) also has access to Rice St via the eastern of the two drives.
   - The proposed backage road would require 15-20 feet of embankment.
   - Existing security at the drives is provided by security cameras only. The business intends to add gates. Proposed widening on Rice St will make it more difficult for the business to position the gates.

2. Business southeast corner of Bahnson Ave (Myrl & Roy's Paving)
   - Recommend that project planners expect more railroad traffic.
   - Recommend consideration of eastbound in-bound trucks queueing when trains are in the crossing. Response: It is expected that the number of unit trains/day will remain about the same but local trains could increase to 3-4 per day (City).
   - The Cleveland realignment option is a step backward because it inhibits direct access to I-229.

3. Gravel Company – East side of Cleveland
   - When the railroad crossing is blocked, there will be no way out of our business if a median is built on Cleveland.

4. Proposed improvements on Rice St will increase speeds on Rice and create more problems with slow turning trucks. Response: Satisfying both commuter and industrial traffic is a challenge.

5. Between 4:00 – 4:30 pm, trucks waiting for a gap in Rice St traffic to turn out block the railroad crossing.

6. A railroad grade separation is needed.

7. What is the timeline for construction of Rice St improvements? Response: the I-229 study will include recommendations to prioritize improvements over a time span of more than 20 years. Widening Cleveland Ave to a 5-lane roadway is anticipated to be a near term project (City).

8. Eastbound right turn lane has been considered to allow westbound left lane to be added, but it is needed to hold traffic when railroad crossing is blocked.

9. Why is that more important than queuing traffic waiting for left turn traffic in the morning?

10. The railroad track should be realigned south to its original alignment farther south of Rice St.

11. The mine pit south of Rice St is now used mostly for recycling and has an indefinite remaining life.

12. Not opposed to realignment of Cleveland Ave if it can be shifted farther west or south toward the residential development.

13. When will SD-100 be constructed to Rice Street? Response: In about two years.

14. Why do the I-229 bridges need to be redone before improvements along Rice St?

15. On Concept Rice-5, would a roundabout be located where the ramps intersect Rice St? Response: A signalized intersection similar to the one at I-229 and 10th St would be located at the ramp terminals.

16. What is the benefit of the proposed median? Response: Vehicle crash mitigation and reduction of turning movement conflicts.

17. Have studies been conducted regarding the safety of U-turns? Response: 57th & Southeastern project has been the source of some complaints about u-turns. 12th Street is working OK. A 30% reduction in crashes has been determined by analysis of previous median construction projects (City).

18. Senior driver comment – Medians cause confusion because drivers often cannot exit an adjacent property the same way they entered it.

19. Do not see a lot of semi-trailer trucks on Rice St west of I-229.

20. Business West Side of Cleveland South of Rice
    - Have been operating since 1991. Have only 70 employees, who may go on-site to service customers.
    - There are truck operations in and out of the site.
    - The site contains 50 storage spaces for customer RV's and campers storage.
    - Customers like that the storage spaces are close to I-229 access ramps.

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Rice Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Wednesday, June 22, 2016 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	BRAD REMMICH	PIERRE	773-3093	bradley.remmich@state.sd.us
2	Brigitte Fawkes	1208 N Lowell ave	605-310-7930	
3	Steve Gramm	700 E. Broadway Ave	773-6641	Steve.gramm@state.sd.us
4	Jason Kjenstad	6300 S. Old Village Pl	977-7740	jason.kjenstad@hdrinc.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Rice Street Sub-Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Wednesday, June 22, 2016 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Andy Vandel	Pierre	773-4421	andy.vandel@state.sd.us
2	Jason Kjenstad	HDR	605-977-7740	jason.kjenstad@hdrinc.com
3	Josh Callahan	1501 N. Cleveland Ave Sioux Falls	605-521-6586	josh.callahan@simpsecurity.com
4	Troy Miller	Sioux Falls	605-553-8729	TMILLER@SIOUXFALLS.ORG
5	Colleen Adler	1301 N. Lowell Ave SF 57103	339-2630	ca47dakota@gmail.com
6	Jackie Nash	2100 Tricia Lane 57103	338-1870	jackie830n@yahoo.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Rice Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Wednesday, June 22, 2016 5:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	PETE LONGMAN	700 EAST Broadway – PIERRE	773-6488	pete.longman@state.sd.us
2	Christina Bennett	700 E Broadway-Pierre	773-4759	Christina.Bennett@state.sd.us
3	Tom Lehmkuhl	700 E. Broadway	773.3721	tom.lehmkuhl@state.sd.us
4	DEAN DELASHMUTT	1207 N VIOLET PL	496 1108	
5	Dhan Khapangi	1000 N Broken Bow Ave	605 360 3544	
6	Jesse Callahan	1501 N Cleveland Ave	334 9357	info@smpsecurity.com
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R3B
LOOKS good
FOR CLEVELAND

Comment Card

I-229 Major Investment Corridor Study – Rice Street Sub-Study

Public Open House

PL 0100(87) 3616P, PCN 044K

June 22, 2016

FUTURE: 4 LANES – HMMM?

Comments:

RICE ST – C2

MEDIAN BETWEEN JESSICA & WAYLAND: (AND TO SAVE MONEY),

REDO DRAINAGE ON JESSICA – REMOVE MERIDIAN

RICE ST – 1 TRUCKING FIRM RATHER INCONVIENCED FOR TRIPS

NORTH BOUND. SOUTH BOUND IS "DO-ABLE" BACK ACCESS ACCESSABLE TO I-229?

Name: DEAN DELASHMUTT Address: 1207 N VIOLET PL

Phone: 605 496 1108 E-mail:

For your comments to be considered, please return by July 7, 2016.
Comments can also be e-mailed to: sausen@siouxfalls.org

Interstate 229 Major Investment Study

Exit 7 – Rice Street

Public Meeting
June 22nd, 2016
5:00 pm to 6:30 pm

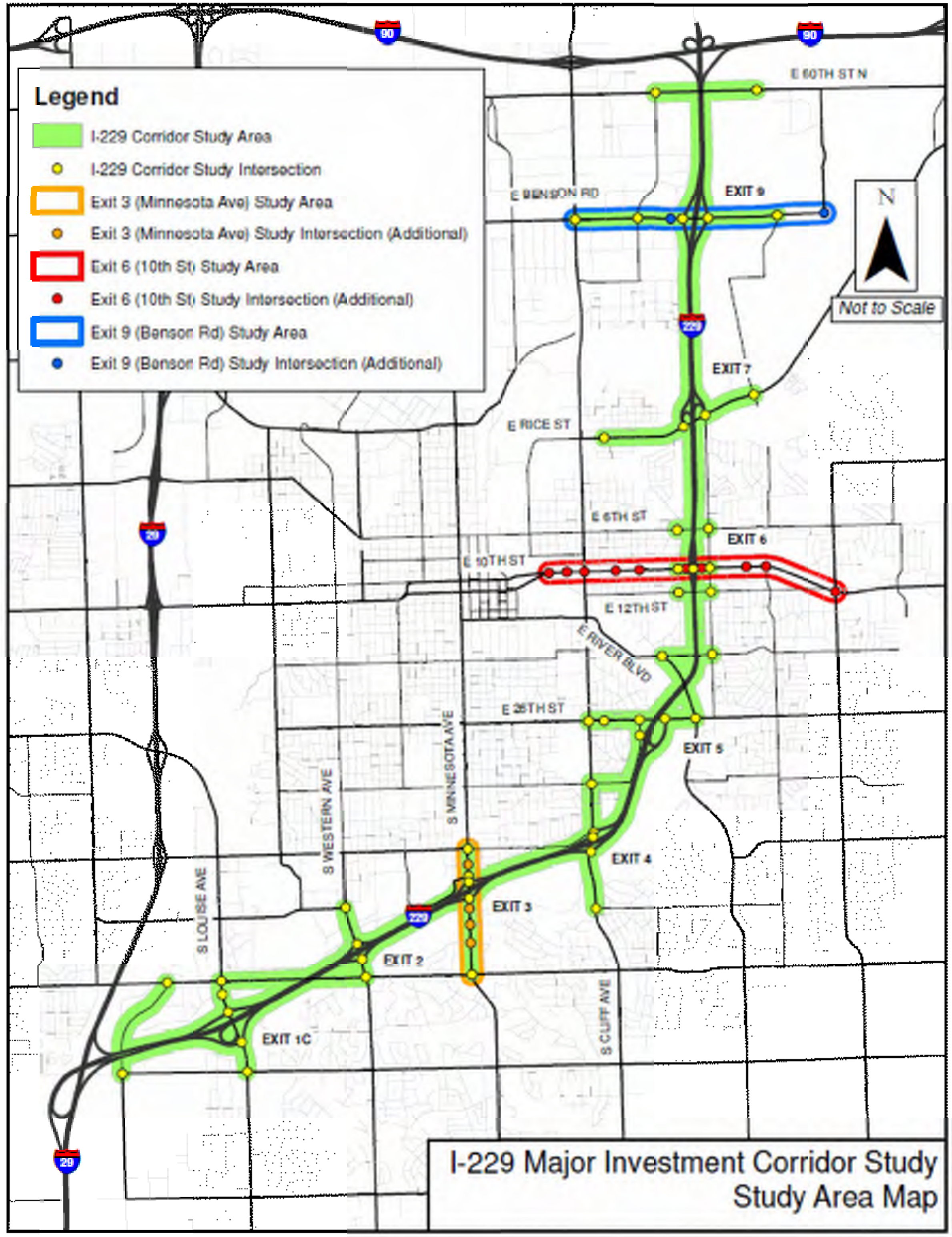
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road
Added Exit 4 – Cliff Avenue
Added Exit 7 – Rice Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

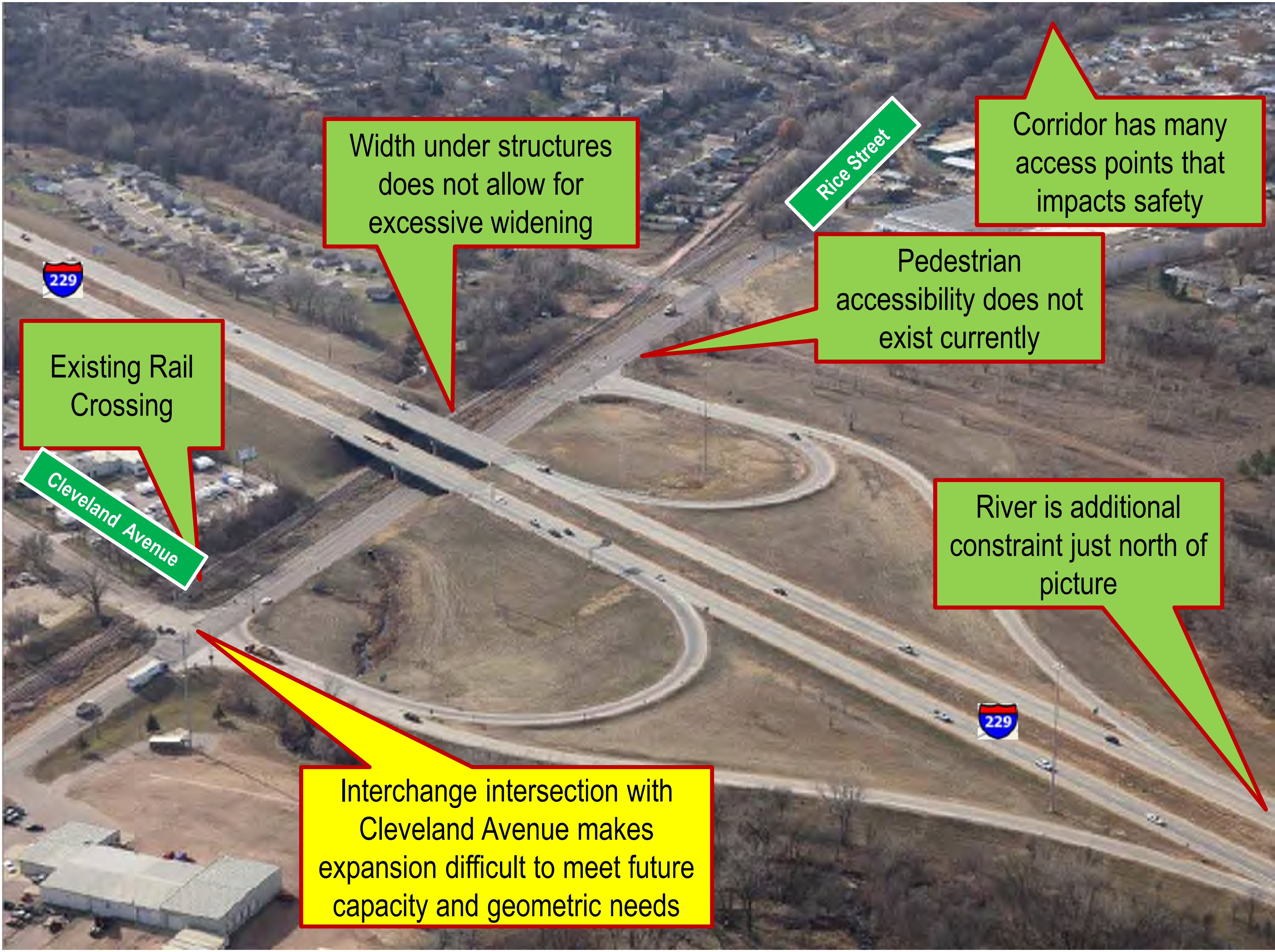
City of Sioux Falls

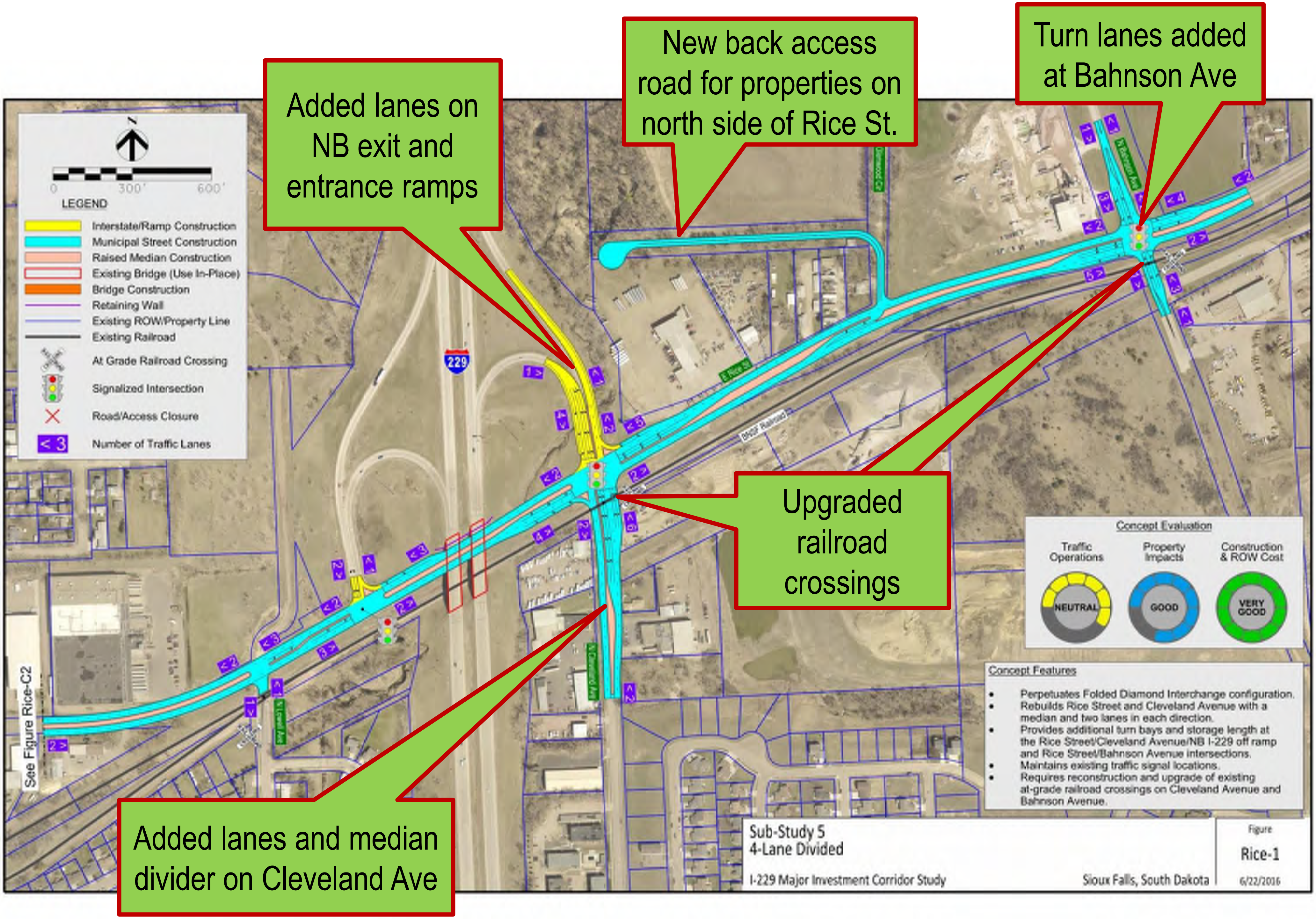
Sioux Falls Metropolitan Planning Organization (MPO)

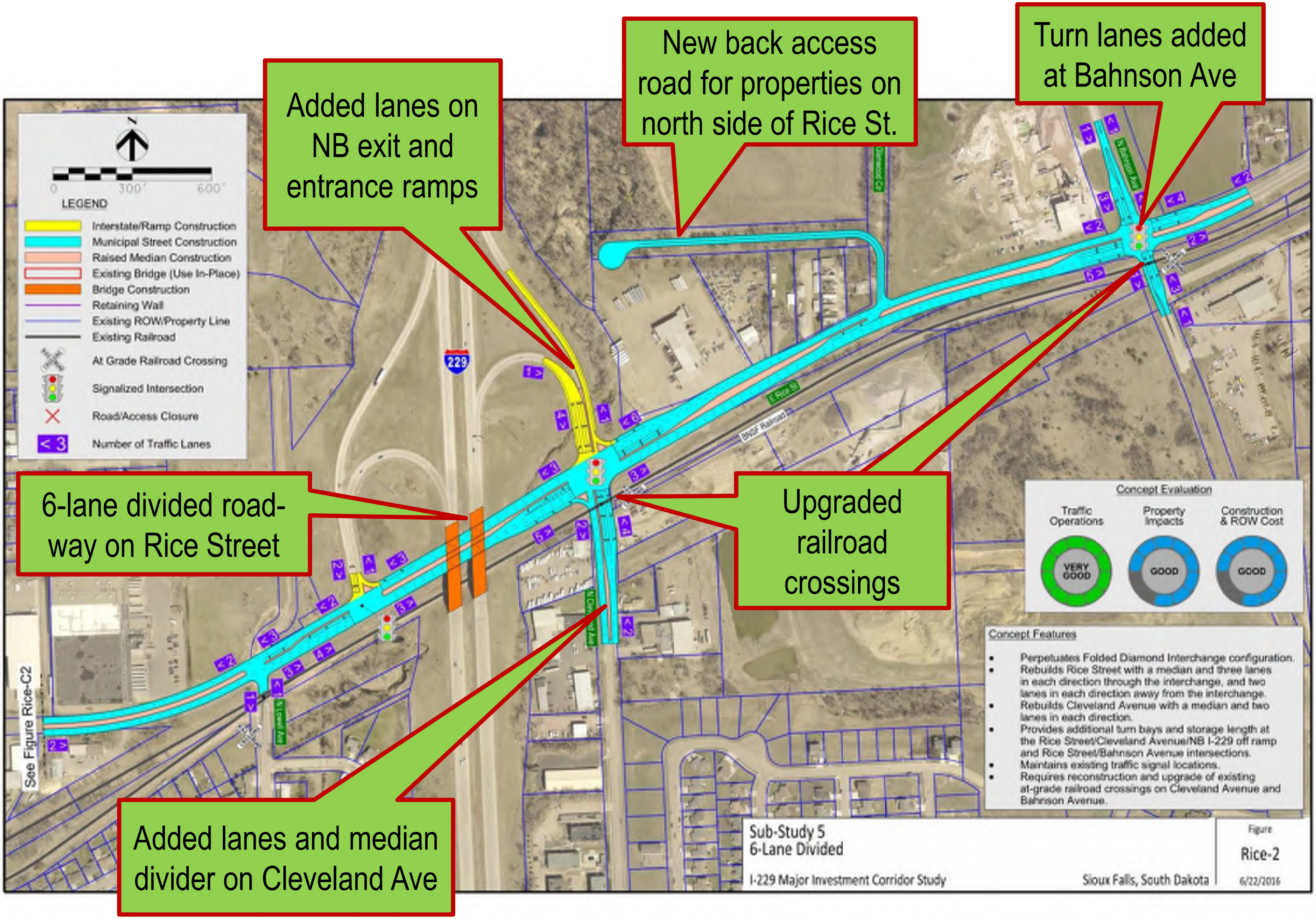
Federal Highway Administration (FHWA)

Exit 7 (Rice Street) Crossroad Study Goals

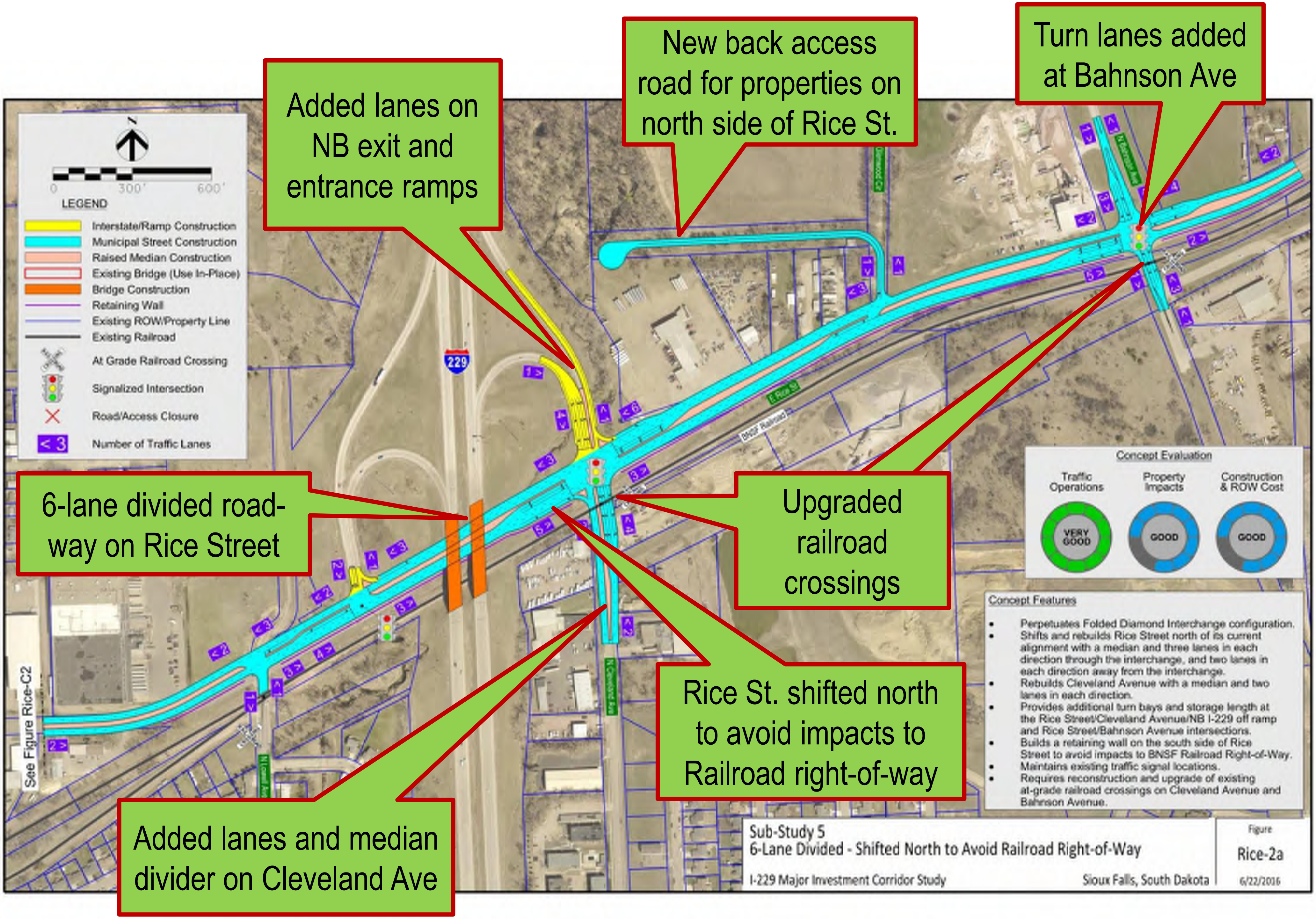
- Reduce traffic congestion
- Provide and Interchange that will meet the future capacity requirements
- Improve pedestrian mobility
- Improve safety for corridor users


Width under structures does not allow for excessive widening
Rice Street
Corridor has many access points that impacts safety
Pedestrian accessibility does not exist currently
229
Existing Rail Crossing
Cleveland Avenue
River is additional constraint just north of picture
229
Interchange intersection with Cleveland Avenue makes expansion difficult to meet future capacity and geometric needs

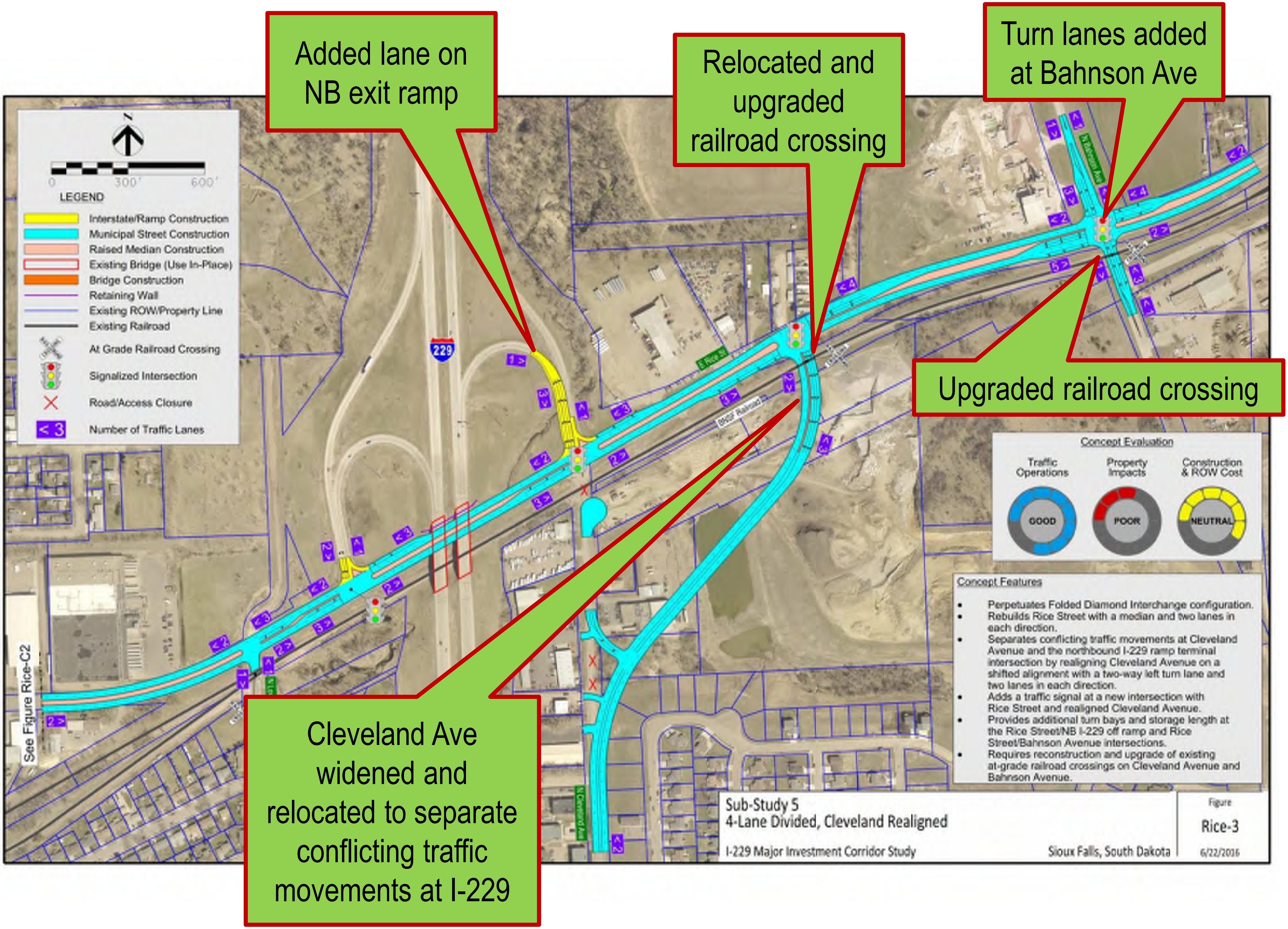

Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
Upgraded railroad crossings
Added lanes and median divider on Cleveland Ave
LEGEND
0 300' 600'
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
N Cleveland Ave
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
NEUTRAL
GOOD
VERY GOOD
Concept Features
Perpetuates Folded Diamond Interchange configuration.
Rebuilds Rice Street and Cleveland Avenue with a median and two lanes in each direction.
Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
Maintains existing traffic signal locations.
Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
4-Lane Divided
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-1
6/22/2016



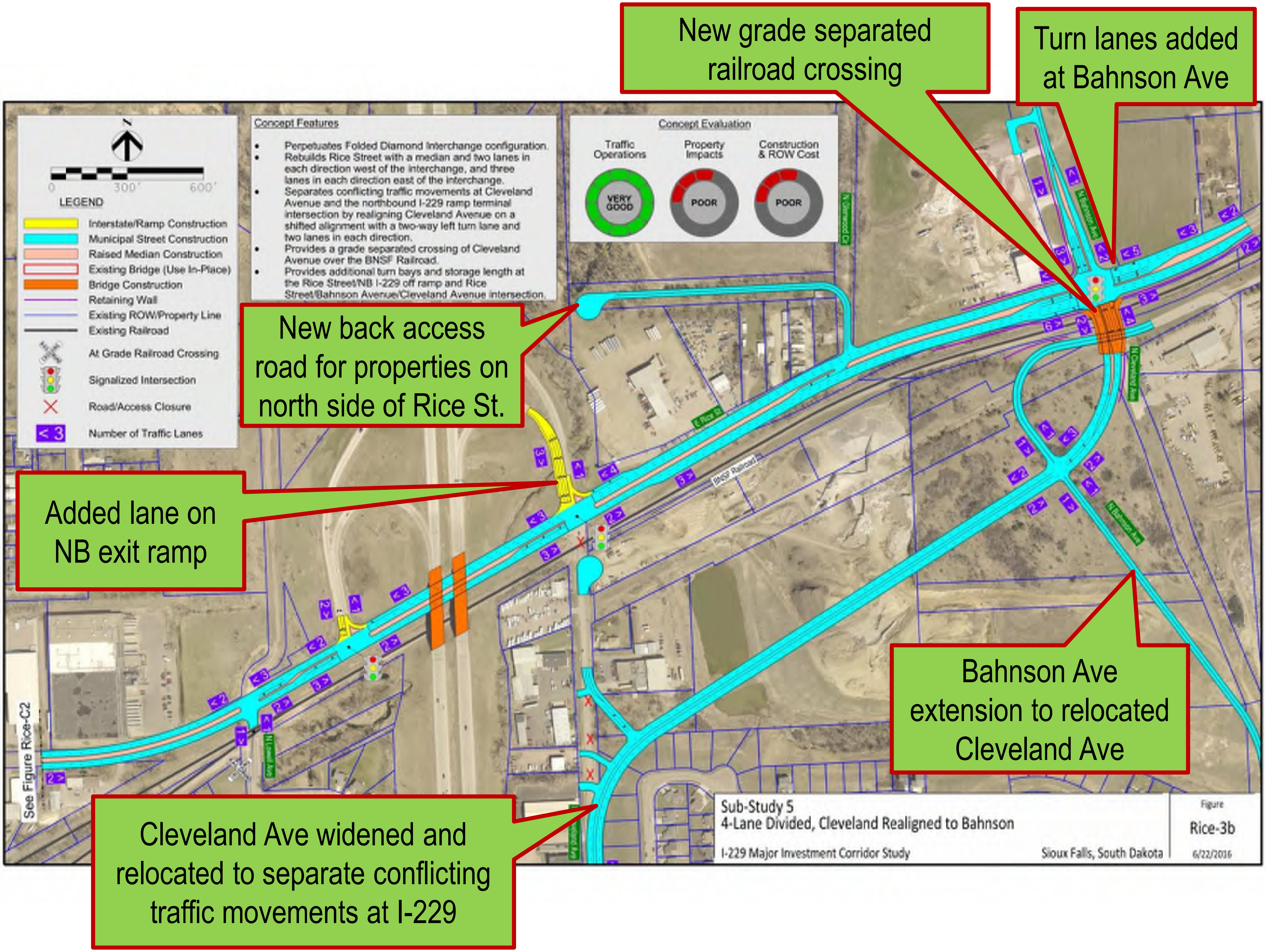
Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
6-lane divided road-way on Rice Street
Upgraded railroad crossings
Added lanes and median divider on Cleveland Ave
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
GOOD
GOOD
Concept Features
Perpetuates Folded Diamond Interchange configuration.
Rebuilds Rice Street with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
Rebuilds Cleveland Avenue with a median and two lanes in each direction.
Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
Maintains existing traffic signal locations.
Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
6-Lane Divided
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-2
6/22/2016



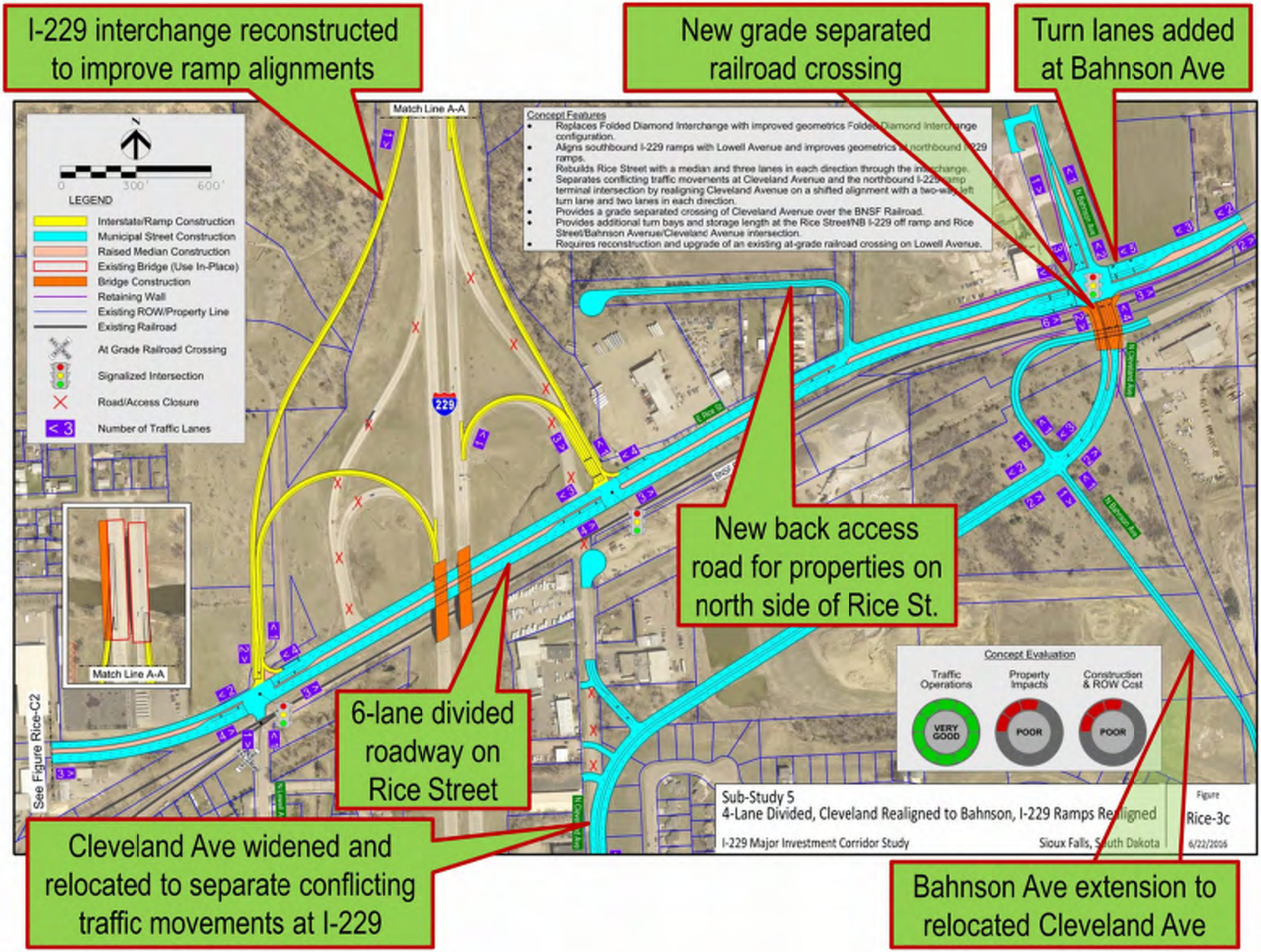
Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
6-lane divided road-way on Rice Street
Upgraded railroad crossings
Rice St. shifted north to avoid impacts to Railroad right-of-way
Added lanes and median divider on Cleveland Ave
LEGEND
0 300' 600'
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
GOOD
GOOD
Concept Features
• Perpetuates Folded Diamond Interchange configuration.
• Shifts and rebuilds Rice Street north of its current alignment with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
• Rebuilds Cleveland Avenue with a median and two lanes in each direction.
• Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
• Builds a retaining wall on the south side of Rice Street to avoid impacts to BNSF Railroad Right-of-Way.
• Maintains existing traffic signal locations.
• Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
6-Lane Divided - Shifted North to Avoid Railroad Right-of-Way
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-2a
6/22/2016



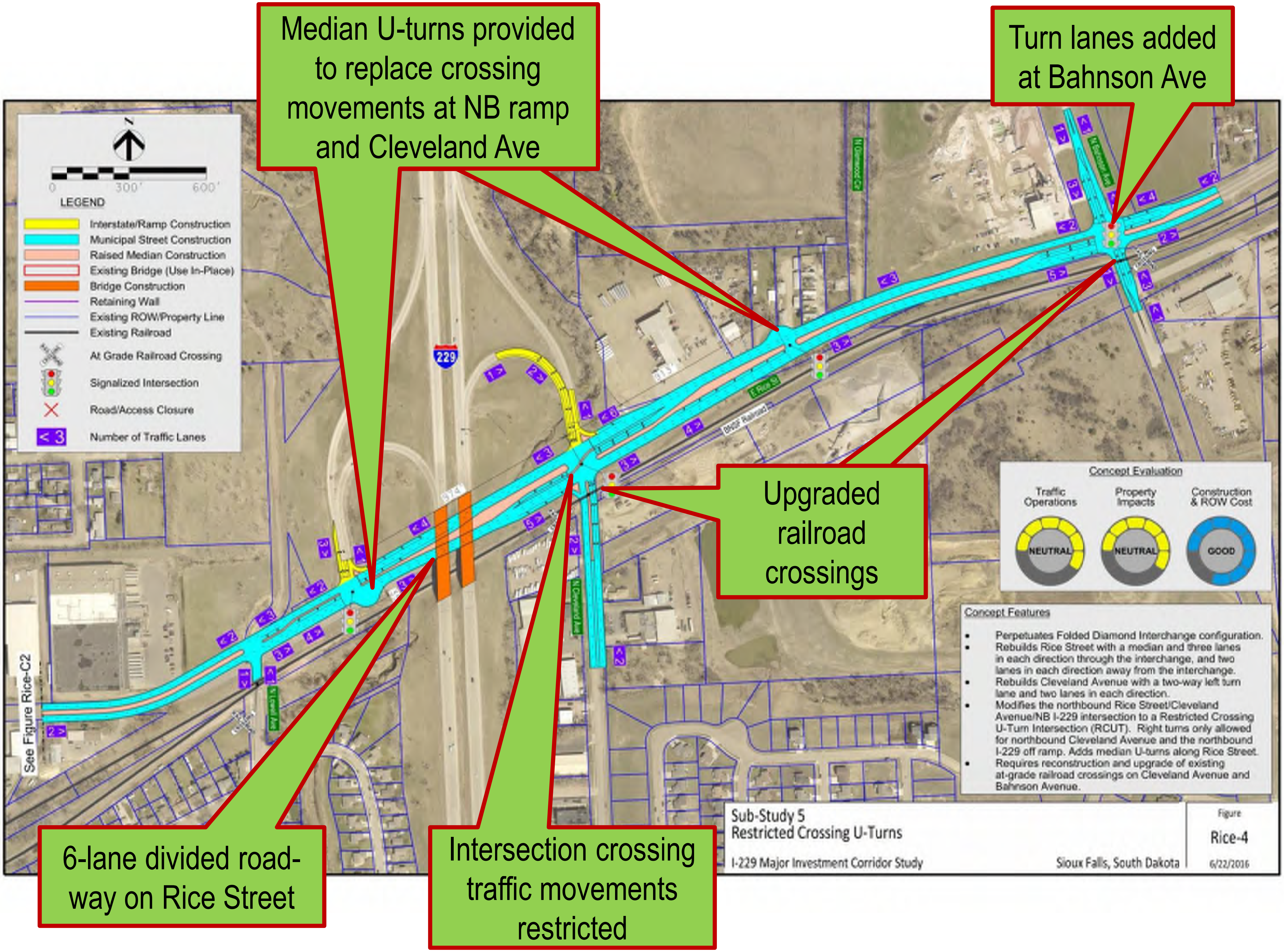
Added lane on NB exit ramp
Relocated and upgraded railroad crossing
Turn lanes added at Bahnson Ave
Upgraded railroad crossing
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
N Cleveland Ave
N Bahnson Ave
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
POOR
NEUTRAL
Concept Features
• Perpetuates Folded Diamond Interchange configuration.
• Rebuilds Rice Street with a median and two lanes in each direction.
• Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
• Adds a traffic signal at a new intersection with Rice Street and realigned Cleveland Avenue.
• Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
• Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
4-Lane Divided, Cleveland Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3
6/22/2016

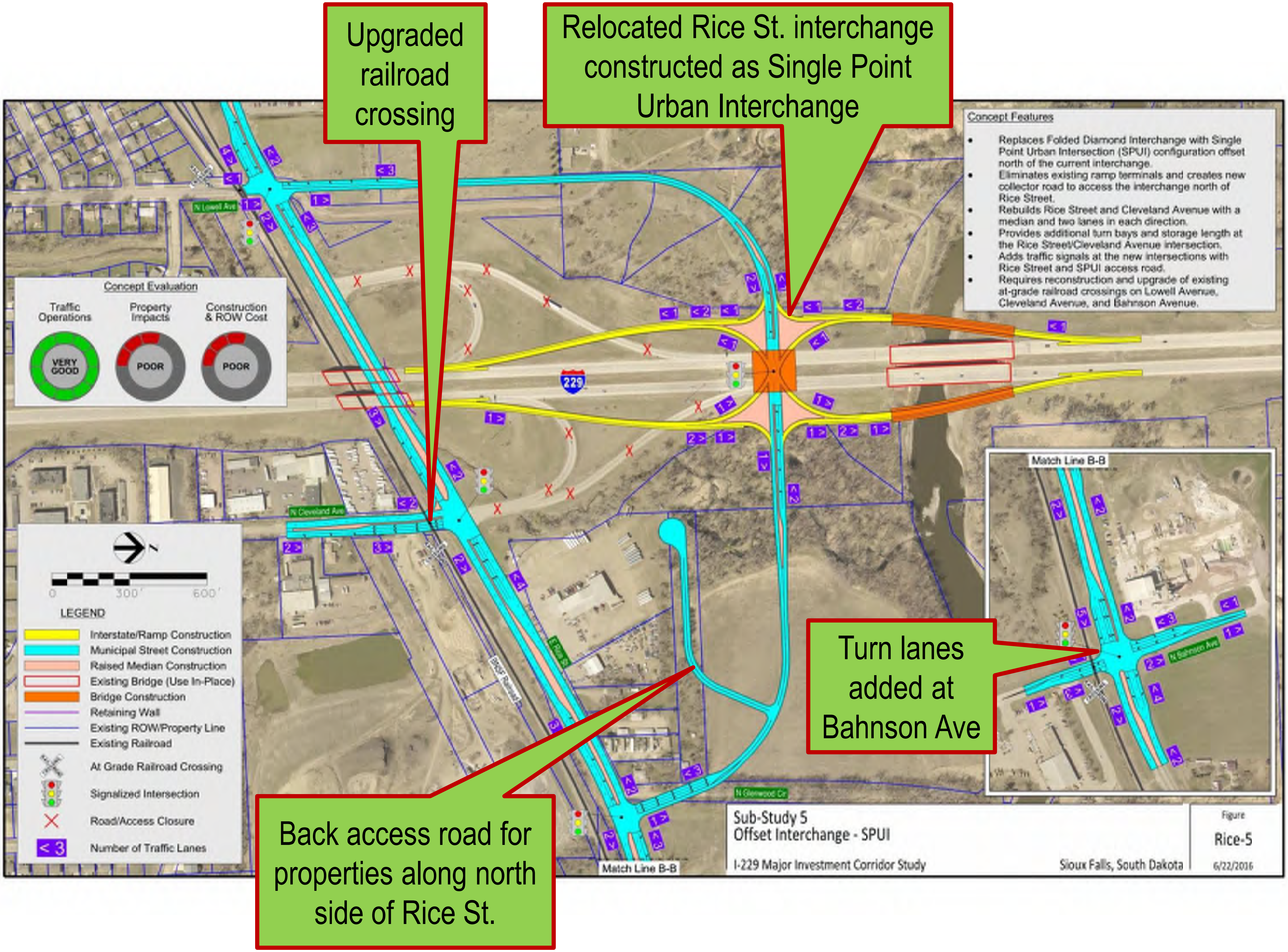


New grade separated railroad crossing
Turn lanes added at Bahnson Ave
New back access road for properties on north side of Rice St.
Added lane on NB exit ramp
Bahnson Ave extension to relocated Cleveland Ave
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
Concept Features
• Perpetuates Folded Diamond Interchange configuration.
• Rebuilds Rice Street with a median and two lanes in each direction west of the interchange, and three lanes in each direction east of the interchange.
• Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
• Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
• Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersection.
Concept Evaluation
Traffic Operations
VERY GOOD
Property Impacts
POOR
Construction & ROW Cost
POOR
E Rice St
BNSF Railroad
N Bahnson Ave
N Cleveland Ave
See Figure Rice-C2
Sub-Study 5
4-Lane Divided, Cleveland Realigned to Bahnson
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3b
6/22/2016

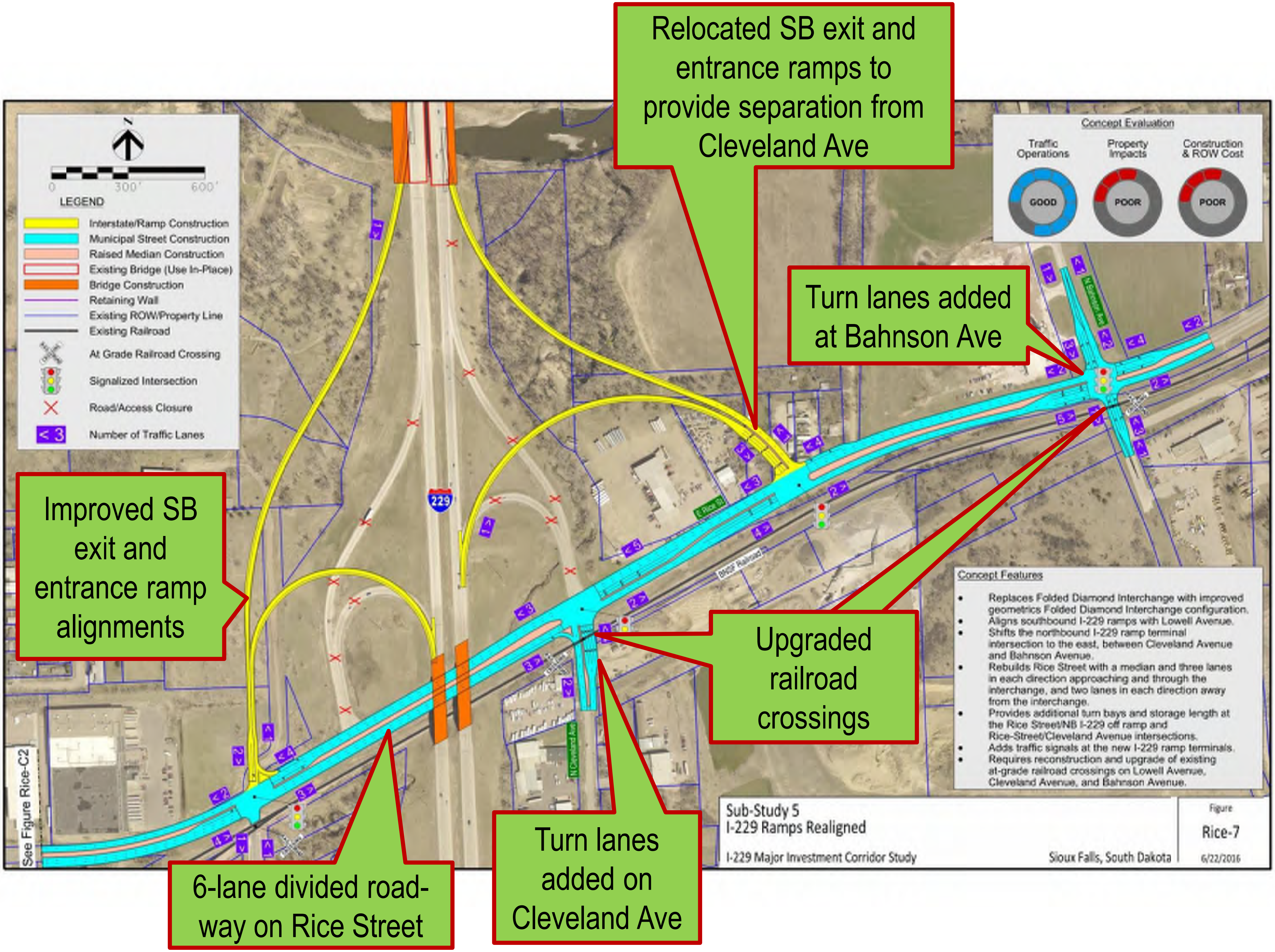


I-229 interchange reconstructed to improve ramp alignments
New grade separated railroad crossing
Turn lanes added at Bahnson Ave
Match Line A-A
Concept Features
Replaces Folded Diamond Interchange with improved geometrics Folded Diamond Interchange configuration.
Aligns southbound I-229 ramps with Lowell Avenue and improves geometrics at northbound I-229 ramps.
Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersection.
Requires reconstruction and upgrade of an existing at-grade railroad crossing on Lowell Avenue.
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
New back access road for properties on north side of Rice St.
Match Line A-A
See Figure Rice-C2
6-lane divided roadway on Rice Street
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
POOR
POOR
Sub-Study 5
4-Lane Divided, Cleveland Realigned to Bahnson, I-229 Ramps Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3c
6/22/2016
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
Bahnson Ave extension to relocated Cleveland Ave

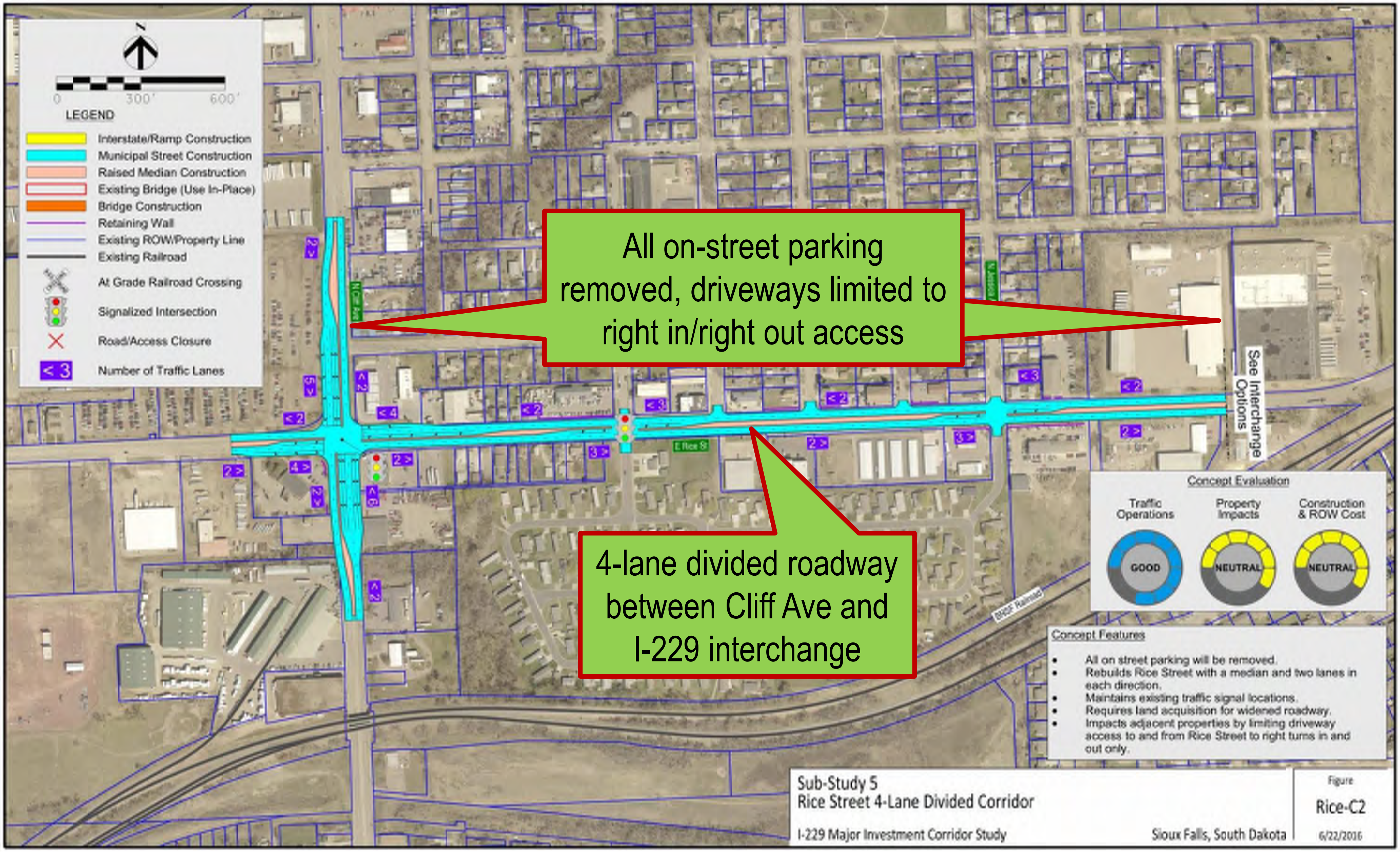

Median U-turns provided to replace crossing movements at NB ramp and Cleveland Ave
Turn lanes added at Bahnson Ave
Upgraded railroad crossings
6-lane divided road-way on Rice Street
Intersection crossing traffic movements restricted
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
< 3
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
N Cleveland Ave
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
NEUTRAL
NEUTRAL
GOOD
Concept Features
• Perpetuates Folded Diamond Interchange configuration.
• Rebuilds Rice Street with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
• Rebuilds Cleveland Avenue with a two-way left turn lane and two lanes in each direction.
• Modifies the northbound Rice Street/Cleveland Avenue/NB I-229 intersection to a Restricted Crossing U-Turn Intersection (RCUT). Right turns only allowed for northbound Cleveland Avenue and the northbound I-229 off ramp. Adds median U-turns along Rice Street.
• Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
Restricted Crossing U-Turns
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-4
6/22/2016



Upgraded railroad crossing
Relocated Rice St. interchange constructed as Single Point Urban Interchange
Concept Features
Replaces Folded Diamond Interchange with Single Point Urban Intersection (SPUI) configuration offset north of the current interchange.
Eliminates existing ramp terminals and creates new collector road to access the interchange north of Rice Street.
Rebuilds Rice Street and Cleveland Avenue with a median and two lanes in each direction.
Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue intersection.
Adds traffic signals at the new intersections with Rice Street and SPUI access road.
Requires reconstruction and upgrade of existing at-grade railroad crossings on Lowell Avenue, Cleveland Avenue, and Bahnson Avenue.
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
POOR
POOR
N Lowell Ave
N Cleveland Ave
229
Match Line B-B
N Bahnson Ave
Turn lanes added at Bahnson Ave
0
300'
600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
Back access road for properties along north side of Rice St.
N Glenwood Cir
Match Line B-B
Sub-Study 5
Offset Interchange - SPUI
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-5
6/22/2016



Relocated SB exit and entrance ramps to provide separation from Cleveland Ave
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
POOR
POOR
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
Turn lanes added at Bahnson Ave
Improved SB exit and entrance ramp alignments
Upgraded railroad crossings
Concept Features
• Replaces Folded Diamond Interchange with improved geometrics Folded Diamond Interchange configuration.
• Aligns southbound I-229 ramps with Lowell Avenue.
• Shifts the northbound I-229 ramp terminal intersection to the east, between Cleveland Avenue and Bahnson Avenue.
• Rebuilds Rice Street with a median and three lanes in each direction approaching and through the interchange, and two lanes in each direction away from the interchange.
• Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice-Street/Cleveland Avenue intersections.
• Adds traffic signals at the new I-229 ramp terminals.
• Requires reconstruction and upgrade of existing at-grade railroad crossings on Lowell Avenue, Cleveland Avenue, and Bahnson Avenue.
See Figure Rice-C2
Sub-Study 5
I-229 Ramps Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-7
6/22/2016
6-lane divided road-way on Rice Street
Turn lanes added on Cleveland Ave



0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
All on-street parking removed, driveways limited to right in/right out access
4-lane divided roadway between Cliff Ave and I-229 interchange
E Rice St
See Interchange Options
BNSF Railroad
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
NEUTRAL
NEUTRAL
Concept Features
• All on street parking will be removed.
• Rebuilds Rice Street with a median and two lanes in each direction.
• Maintains existing traffic signal locations.
• Requires land acquisition for widened roadway.
• Impacts adjacent properties by limiting driveway access to and from Rice Street to right turns in and out only.
Sub-Study 5
Rice Street 4-Lane Divided Corridor
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-C2
6/22/2016

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Dave Meier – HDR Engineering, Inc.
402-399-1068 or Dave.Meier@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study

Exit 7 – Rice Street

Thanks for Attending!!!!!

HDR

CLIFF AVENUE

JUNE 22ND, 2016

- **MEETING NOTES**
- **SIGN-IN SHEETS**
- **COMMENTS**
- **POWERPOINT SLIDES**

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting and Public Meeting– Sub-study 6 – Cliff Avenue Exit 4
Date:	Wednesday, June 22, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 8 Participants

Follow-up discussion items included:

1. What about pedestrian access along Cliff Ave? Response: Providing pedestrian access along both sides of Cliff Ave is being proposed.

2. For Concept Cliff-4, why are property impacts shown described as "neutral"? The impacts look severe along Pam Rd.

3. Resident on Pam Rd – Proposed concepts will add noise to neighborhood.

4. Lincoln High School – Like Concepts Cliff-4 and Cliff-8 that include the 41st St relocation aligned with an entrance to the high school and signalized access to Cliff Ave. About half of the high school related traffic is to and from the south.

5. South 10th/38th St Resident – Parents can't get in to Lincoln High School to pick up children. They park in the neighborhood west of Cliff Ave and the students cross Cliff Ave at random locations.

6. Lincoln High School – Adding a median on Cliff Ave will force school traffic into the school driveway loop. The school bus stop location was moved to 38th & S 10th from its previous location on Cliff Ave in recent years to help direct students to the designated pedestrian crossing on Cliff Ave.

7. Lincoln High School was asked if the existing Cliff Ave pedestrian crossing functions acceptably. The high school responded that some confusion has been noted. Operations are better in the morning peak period than the afternoon peak. It was noted that nearby residents hear vehicle screeching tires at night when the pedestrian crossing is activated. A comment was made that relocating the crossing to 38th St would help. The City noted that Lincoln High School and the City did discuss locating the crossing at the 38th St intersection before the existing midblock location was selected.

8. Will widening Cliff Ave bring more traffic? Response: Traffic volumes on Cliff Ave are approximately 15,000 vehicles/day north of I-229 and about 20,000 vehicles/day between the I-229 ramp terminal intersections. Traffic volumes have been consistent over the last five years.

9. Will it be possible to reduce truck traffic on Cliff Ave? Response: Cliff Ave is a designated truck route and that designation is unlikely to be removed.

10. What is the timeline for completion of the I-229 study? Response: Stakeholder and public comments will be reviewed followed by screening and some refinement of the concepts. A priority plan for potential projects will be the final study step. The study should wrap up in late 2016.

11. Lincoln High School – The high school prefers Concept Cliff-4, but would prefer that the proposed 41st St realignment be modified to stay south of the high school property line.

12. A right turn lane for southbound traffic at the park entrance south of the Cliff Ave bridge over the Big Sioux River is needed.

13. Although Cliff Ave has two southbound through lanes to the East 49th St intersection, drivers treat Cliff Ave as single lane going southbound up the hill toward East 49th. Response: Plans exist to extend a four lane section on Cliff Ave south of East 49th St.

14. Who owns the old railroad right of way? Response: The City owns the former railroad property.

15. Why is the connection from Pam Rd to South 10th Ave shown on Concept Cliff-6? Response: The purpose of the proposed connection is local street continuity and access to properties unaffected by the proposed realignment of East 41st St.

16. Consider using the old railroad right of way for street improvements instead of widening on 41st St. Response: Widening on 41st St is proposed to add lane capacity near Cliff Ave because the existing right of way along 41st St is wider than the former railroad right of way.

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Cliff Avenue Sub-Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Wednesday, June 22, 2016 7:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Christina Bennett	700 E Broadway Ave Pierre	773-4757	christina.bennett@state.sd.us
2	Andy Vandel	Pierre	773-4421	andy.vandel@state.sd.us
3	Pete Longman	Pierre	773-6488	pete.longman@state.sd.us
4	Dean Delashmutt	1207 N Violet PL Sioux Falls		
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CITY OF SIOUX FALLS PUBLIC WORKS
Providing a Better Quality of Life for You!

HDR

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting for Cliff Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Wednesday, June 22, 2016 7:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Steve Gramm	700 E. Broadway Ave	773-6641	steve.gramm@state.sd.us
2	Jason Kjerstad	6700 S. Old Village Pl, SF, SD	977-7740	jason.kjerstad@hdrinc.com
3	Paul Nikolas	5316 W 60th St. N SF, SD	367-5680	paul.nikolas@state.sd.us
4	Rob Leonhardt	2001 Cardinal Dr	231-5074	
5	Courtney & Jerry Helke	3709 S. Slater Park Dr.	376-8286	Helkes@sio.midco.net
6	Evelyn Stalker	905 E. Ram Rd	605-376-2022	evs@sio.midco.net
7	Jerald Peterson	1109 S Lance		
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Comment Card

I-229 Major Investment Corridor Study – Cliff Avenue Sub-Study

Public Open House

PL 0100(87) 3616P, PCN 044K

June 22, 2016

Comments:

CLIFF 8 has The Best Concept Because TRAFFIC STREAM IS DRAWN FURTHER AWAY FROM LINCOLN H.S. The Signal AT The School is A very good idea.

Cancel → Suggestion use ~~RR~~ OLD RR, meeting 41ST, STRAIGHTEN 41ST To ABOUT 9th.

Name: Dean DeLashmutt

Address: 1207 N Violet PL 57103

Phone: 605 496 1108

E-mail:

For your comments to be considered, please return by July 7, 2016.
Comments can also be e-mailed to: sausen@siouxfalls.org

Comment Card

I-229 Major Investment Corridor Study – Cliff Avenue Sub-Study

Public Open House

PL 0100(87) 3616P, PCN 044K

June 22, 2016

Comments:

CLIFF 8 has The Best Concept Because TRAFFIC STREAM is DRAWN FURTHER AWAY FROM LINCOLN H.S. The Signal AT The School is A very good idea.

Cancel → Suggestion use OLD RR, meeting 41ST, STRAIGHTEN 41ST To ABOUT 9Th.

Name: Dean DeLashmutt

Address: 1207 N Violet PL 57103

Phone: 605 496 1108

E-mail:

For your comments to be considered, please return by July 7, 2016.
Comments can also be e-mailed to: sausen@siouxfalls.org

Interstate 229 Major Investment Study

Exit 4 – Cliff Avenue

Public Meeting
June 22nd, 2016
7:00 pm to 8:30 pm

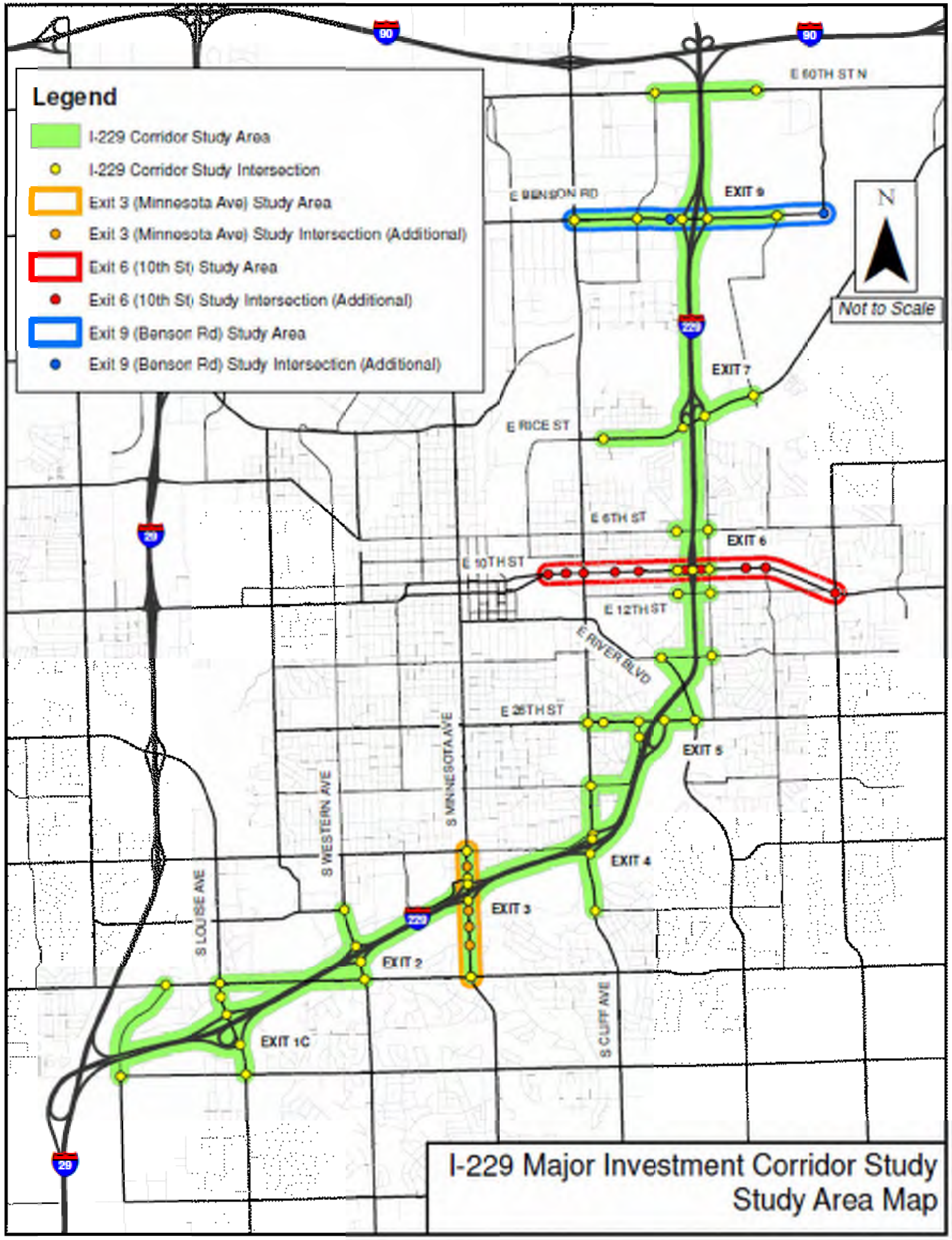
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road
Added Exit 4 – Cliff Avenue
Added Exit 7 – Rice Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

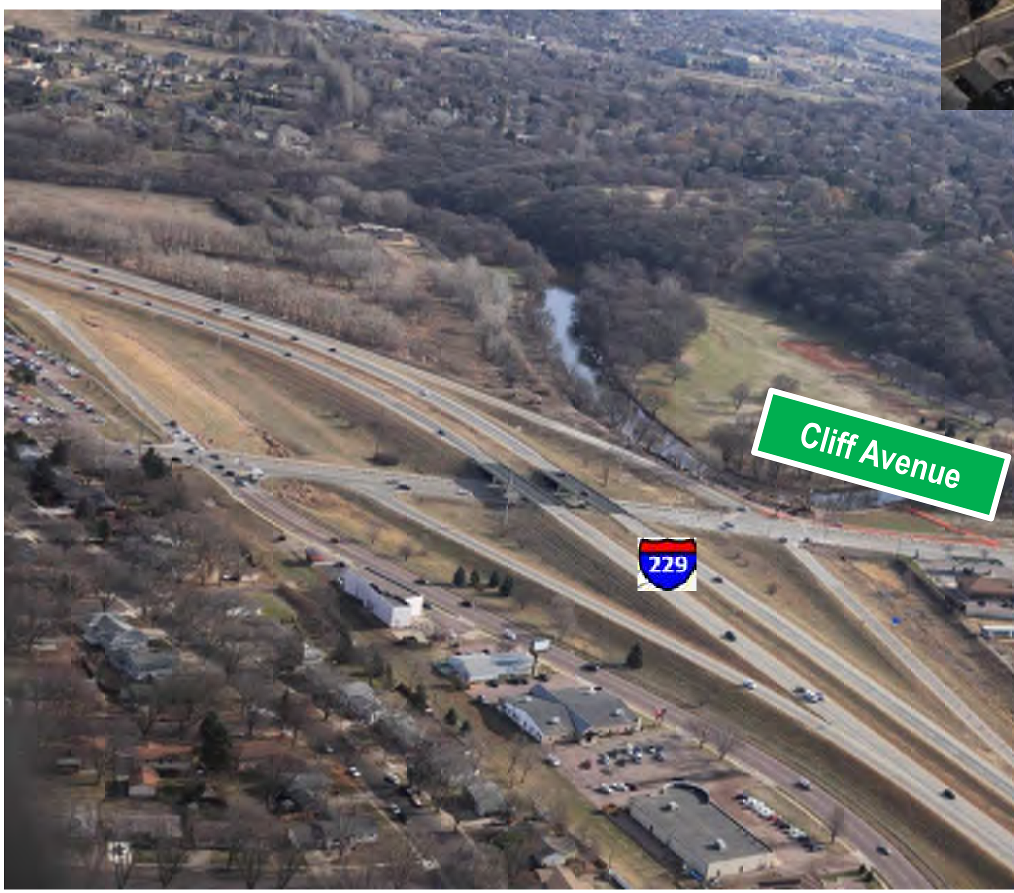
City of Sioux Falls

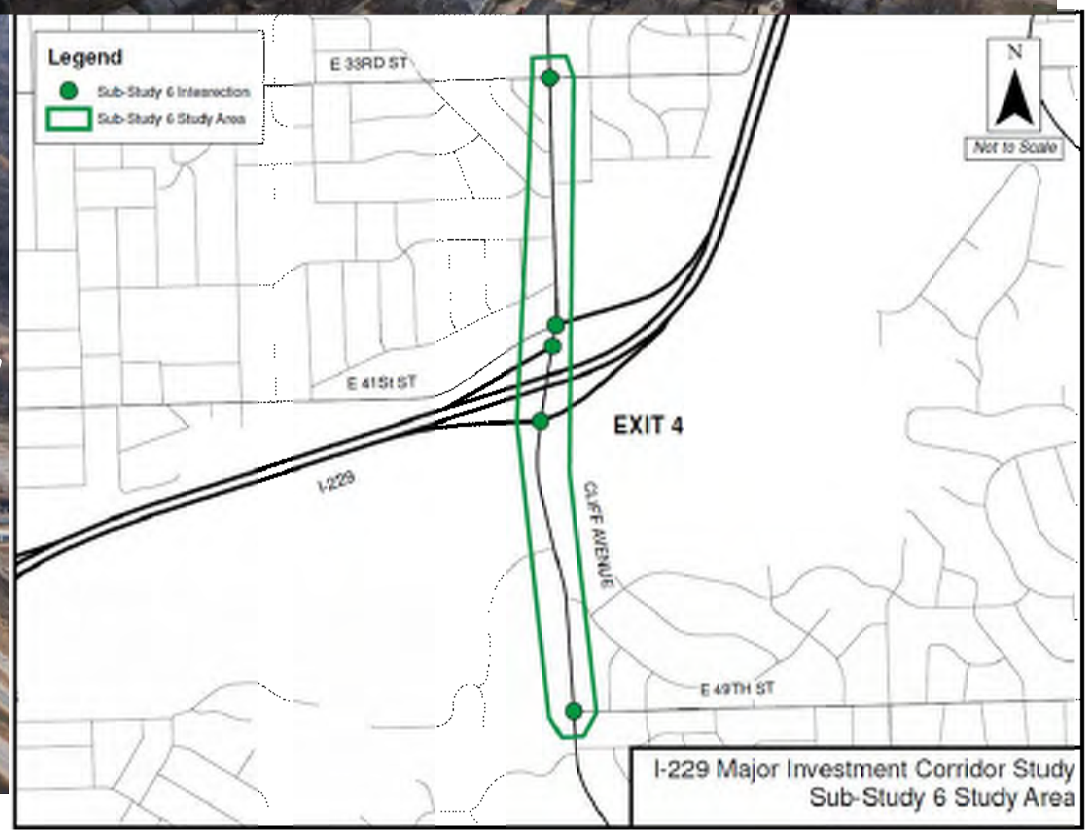
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

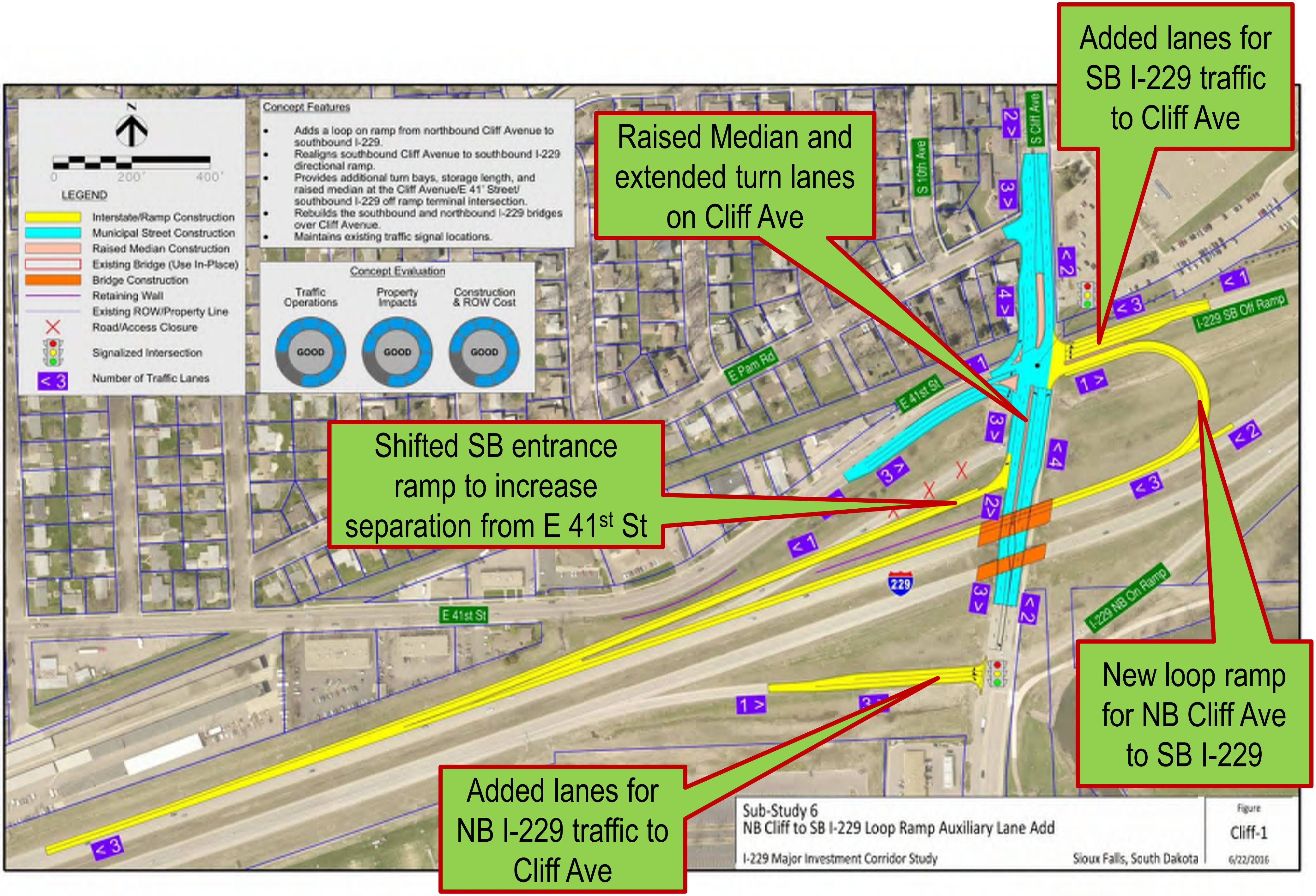
Exit 4 (Cliff Avenue)
Sub - Study Goals

- Reduce traffic congestion
- Develop new geometrics to improve capacity at 41st Street and Interchange
- Improve pedestrian mobility
- Improve safety for corridor users

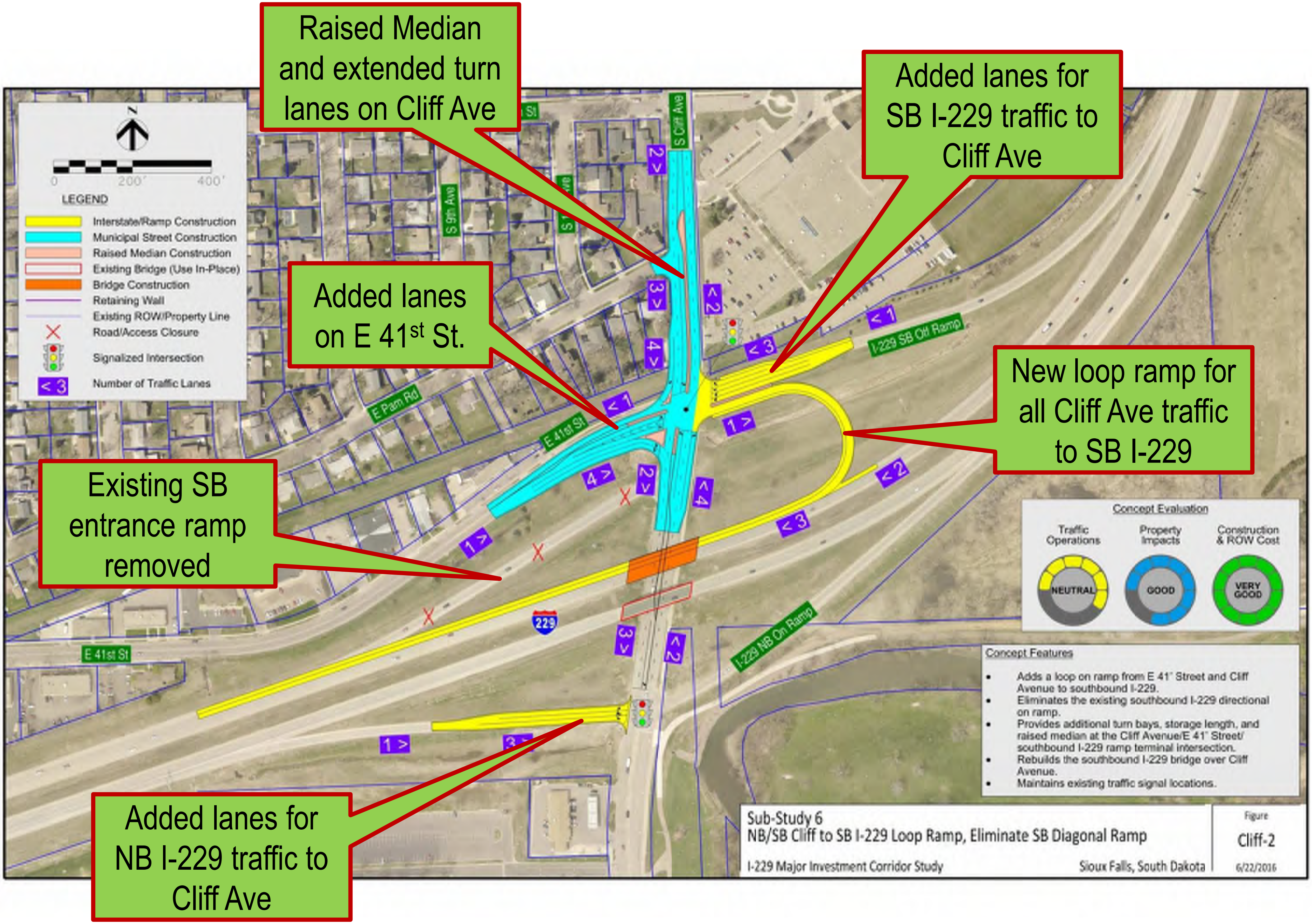




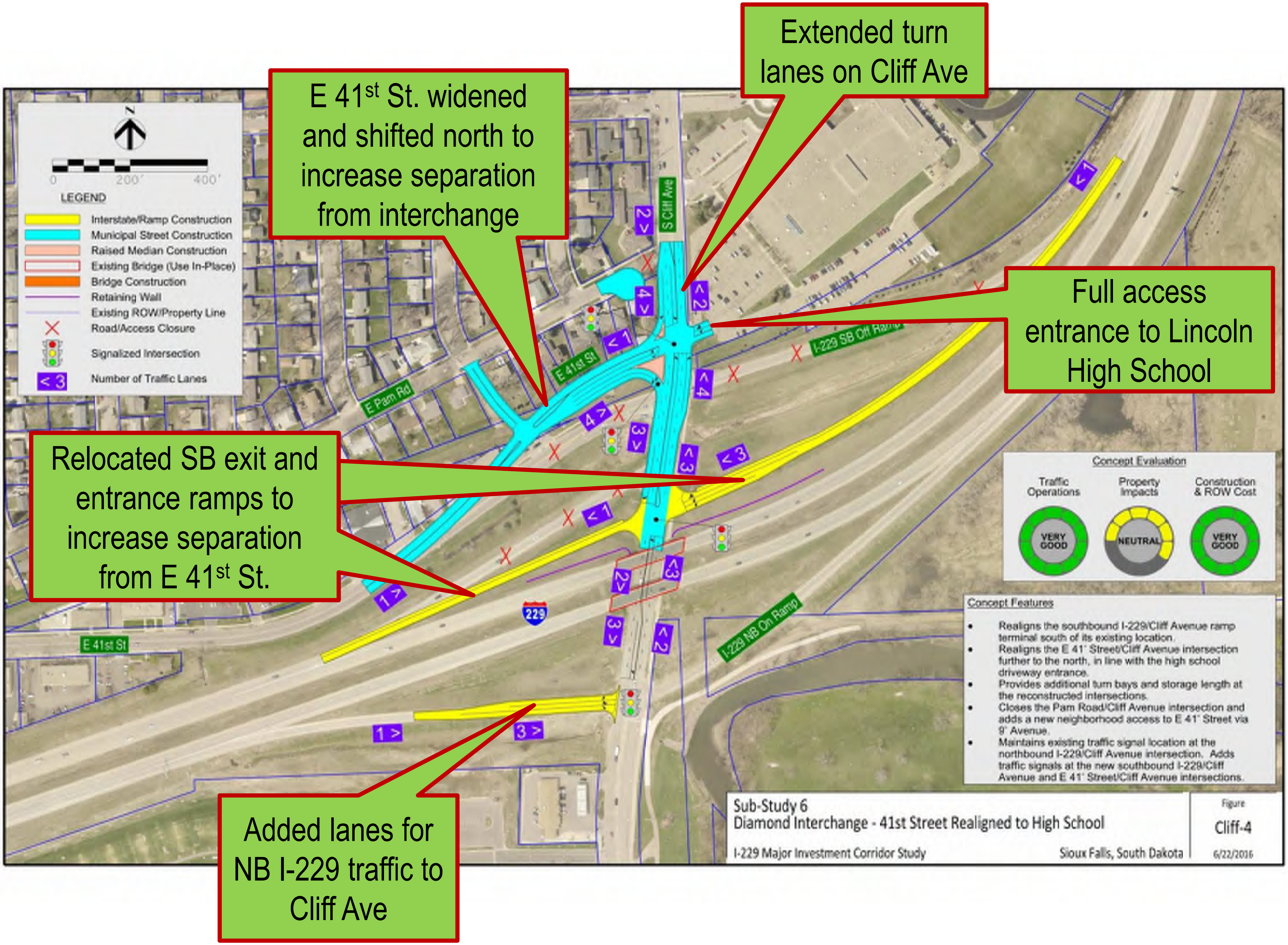

Access to Park close to interchange makes it difficult to exit during peak hour periods
Cliff Avenue
Turn Lane short and few gaps exist to complete left turn movement
229
Cliff Avenue
High Right Turn Volume in the PM Peak Hour
Congestion due to close proximity of 41st Street to I229 SB ON Ramp



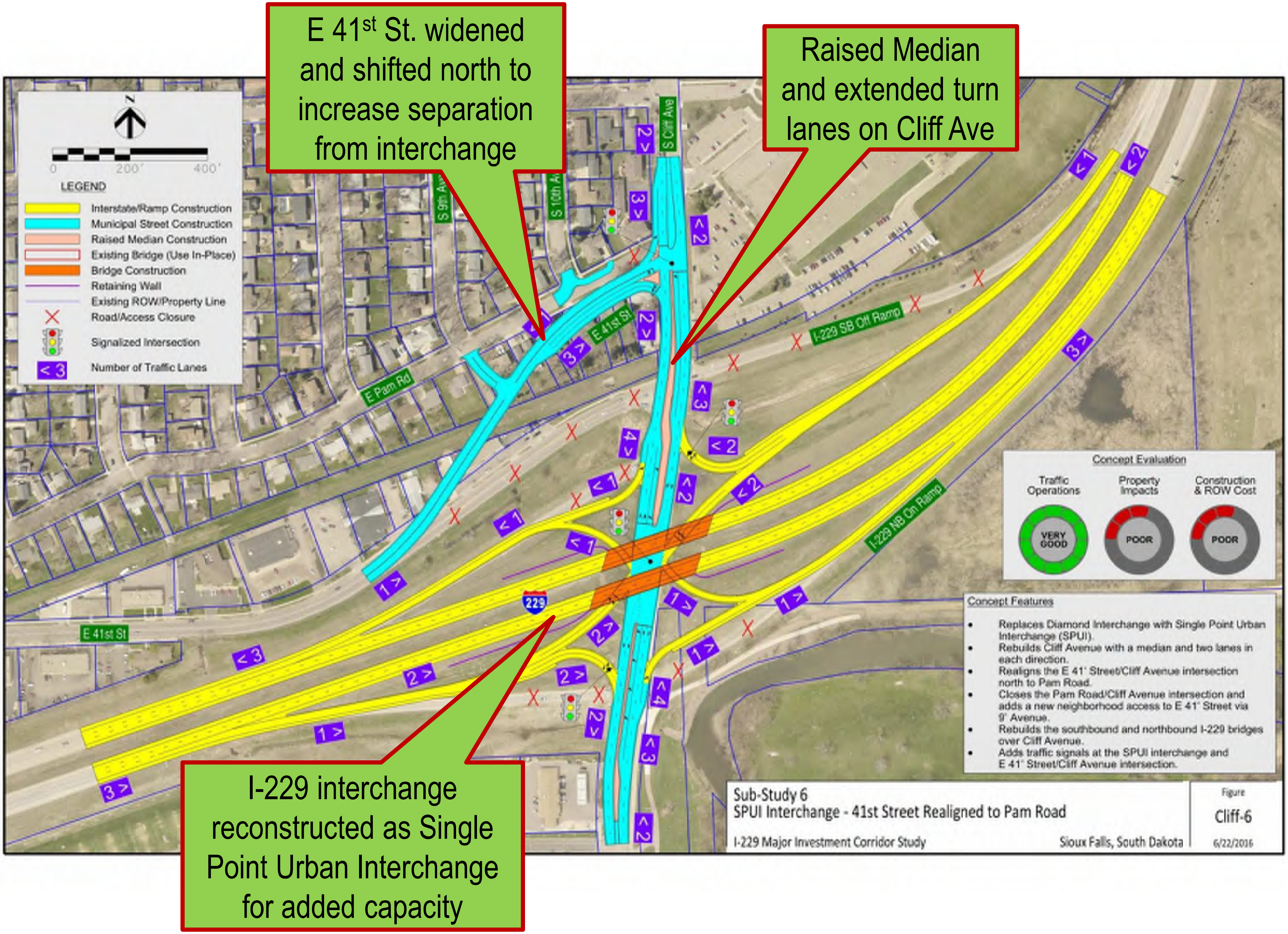
Added lanes for SB I-229 traffic to Cliff Ave
Raised Median and extended turn lanes on Cliff Ave
Shifted SB entrance ramp to increase separation from E 41st St
New loop ramp for NB Cliff Ave to SB I-229
Added lanes for NB I-229 traffic to Cliff Ave
Concept Features
Adds a loop on ramp from northbound Cliff Avenue to southbound I-229.
Realigns southbound Cliff Avenue to southbound I-229 directional ramp.
Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/ southbound I-229 off ramp terminal intersection.
Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
Maintains existing traffic signal locations.
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
GOOD
GOOD
N
0
200'
400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S Cliff Ave
S 10th Ave
E Pam Rd
E 41st St
I-229 SB Off Ramp
I-229 NB On Ramp
229
Sub-Study 6
NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-1
6/22/2016



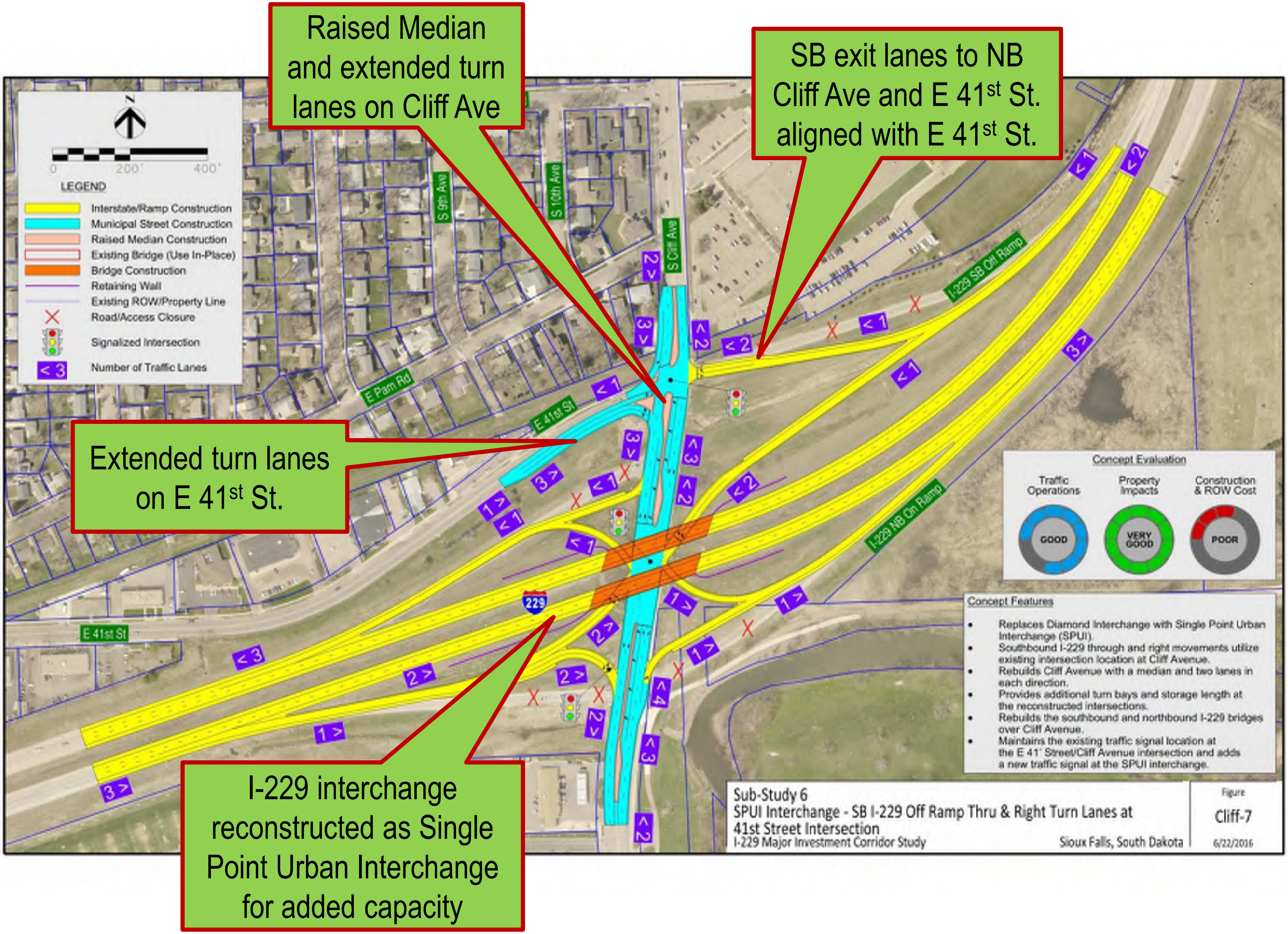
Raised Median and extended turn lanes on Cliff Ave
Added lanes for SB I-229 traffic to Cliff Ave
Added lanes on E 41st St.
New loop ramp for all Cliff Ave traffic to SB I-229
Existing SB entrance ramp removed
Added lanes for NB I-229 traffic to Cliff Ave
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
0 200' 400'
S Cliff Ave
S 9th Ave
E Pam Rd
E 41st St
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
NEUTRAL
GOOD
VERY GOOD
Concept Features
Adds a loop on ramp from E 41st Street and Cliff Avenue to southbound I-229.
Eliminates the existing southbound I-229 directional on ramp.
Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/ southbound I-229 ramp terminal intersection.
Rebuilds the southbound I-229 bridge over Cliff Avenue.
Maintains existing traffic signal locations.
Sub-Study 6
NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-2
6/22/2016



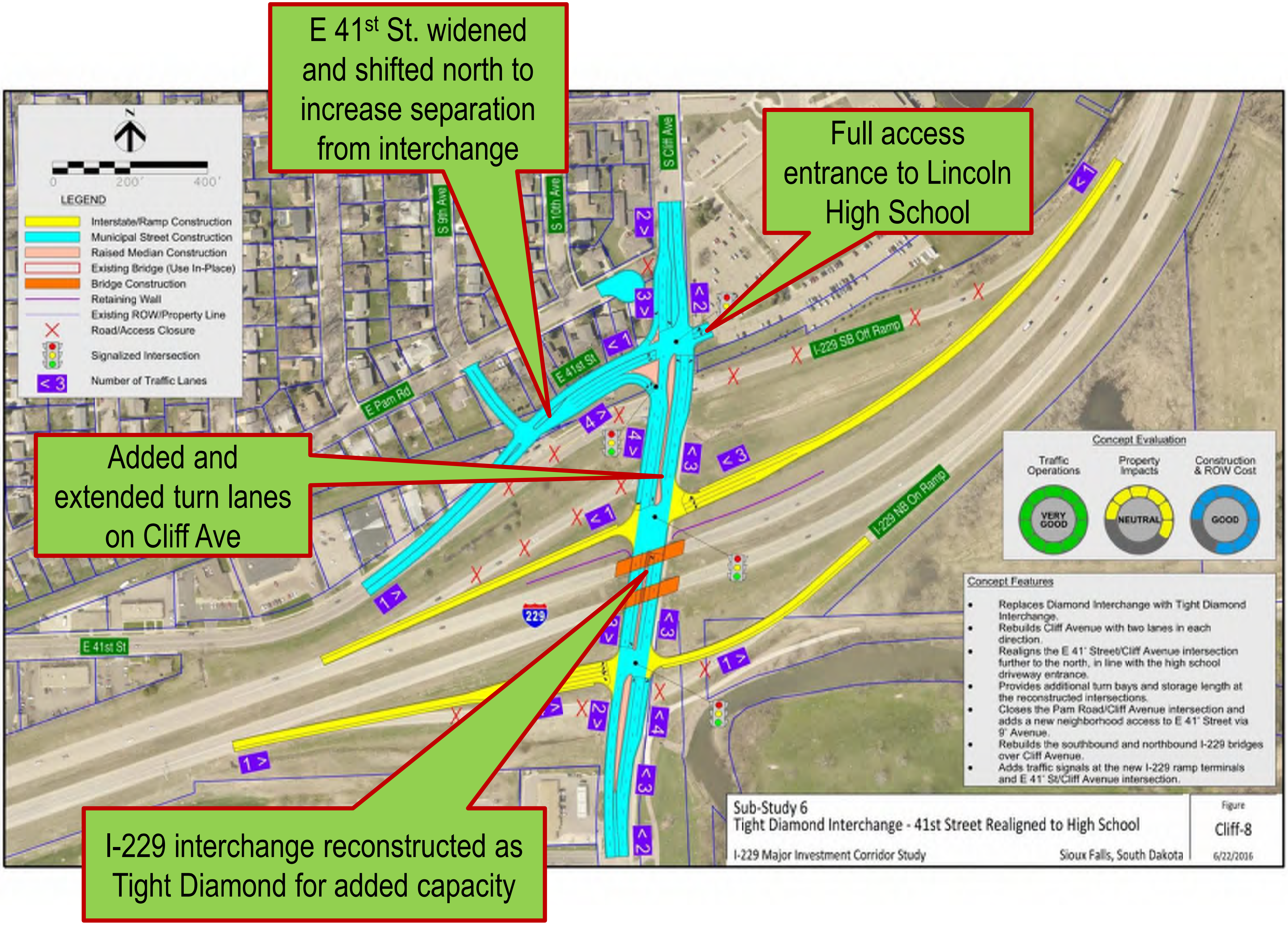
Extended turn lanes on Cliff Ave
E 41st St. widened and shifted north to increase separation from interchange
Full access entrance to Lincoln High School
Relocated SB exit and entrance ramps to increase separation from E 41st St.
Added lanes for NB I-229 traffic to Cliff Ave
N
0 200' 400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
< 3 Number of Traffic Lanes
S Cliff Ave
E 41st St
E Pam Rd
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
NEUTRAL
VERY GOOD
Concept Features
• Realigns the southbound I-229/Cliff Avenue ramp terminal south of its existing location.
• Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
• Provides additional turn bays and storage length at the reconstructed intersections.
• Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
• Maintains existing traffic signal location at the northbound I-229/Cliff Avenue intersection. Adds traffic signals at the new southbound I-229/Cliff Avenue and E 41st Street/Cliff Avenue intersections.
Sub-Study 6
Diamond Interchange - 41st Street Realigned to High School
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-4
6/22/2016



E 41st St. widened and shifted north to increase separation from interchange
Raised Median and extended turn lanes on Cliff Ave
I-229 interchange reconstructed as Single Point Urban Interchange for added capacity
N
0 200' 400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S Cliff Ave
S 9th Ave
S 10th Ave
E 41st St
E Pam Rd
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
VERY GOOD
Property Impacts
POOR
Construction & ROW Cost
POOR
Concept Features
Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
Rebuilds Cliff Avenue with a median and two lanes in each direction.
Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
Adds traffic signals at the SPUI interchange and E 41st Street/Cliff Avenue intersection.
Sub-Study 6
SPUI Interchange - 41st Street Realigned to Pam Road
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-6
6/22/2016



Raised Median and extended turn lanes on Cliff Ave
SB exit lanes to NB Cliff Ave and E 41st St. aligned with E 41st St.
Extended turn lanes on E 41st St.
I-229 interchange reconstructed as Single Point Urban Interchange for added capacity
N
0 200' 400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S 9th Ave
S 10th Ave
S Cliff Ave
E Pam Rd
E 41st St
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
VERY GOOD
POOR
Concept Features
• Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
• Southbound I-229 through and right movements utilize existing intersection location at Cliff Avenue.
• Rebuilds Cliff Avenue with a median and two lanes in each direction.
• Provides additional turn bays and storage length at the reconstructed intersections.
• Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
• Maintains the existing traffic signal location at the E 41st Street/Cliff Avenue intersection and adds a new traffic signal at the SPUI interchange.
Sub-Study 6
SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-7
6/22/2016



E 41st St. widened and shifted north to increase separation from interchange
Full access entrance to Lincoln High School
Added and extended turn lanes on Cliff Ave
I-229 interchange reconstructed as Tight Diamond for added capacity
N
0 200' 400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S Cliff Ave
S 9th Ave
S 10th Ave
E 41st St
E Pam Rd
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
NEUTRAL
GOOD
Concept Features
• Replaces Diamond Interchange with Tight Diamond Interchange.
• Rebuilds Cliff Avenue with two lanes in each direction.
• Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
• Provides additional turn bays and storage length at the reconstructed intersections.
• Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
• Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
• Adds traffic signals at the new I-229 ramp terminals and E 41st St/Cliff Avenue intersection.
Sub-Study 6
Tight Diamond Interchange - 41st Street Realigned to High School
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-8
6/22/2016

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Brian Ray– HDR Engineering, Inc.
402-548-5066 or Brian.Ray@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 4 – Cliff Avenue

Thanks for Attending!!!!!

HDR

APPENDIX -

PUBLIC MEETING #3 – DECEMBER 6TH, 2016

- **SIGN-IN SHEETS**
- **COMMENTS**
- **POWERPOINT SLIDES**
- **MEETING NOTES (SEE STAKEHOLDER MEETINGS #2 APPENDIX)**

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Tuesday, December 6th, 2016 6:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Bruce Wichers	3221 S Sorenson TR	605-254-4375	
2	Lee Miller	905 E 34th St.	605-310-9642	
3	Mark Elrason	101 S Cleveland	605-338-6221	
4	Pete Longman	SDDOT Pierre	773-6488	
5	Joe Boyt	2533 E Harriet Lea	206-484-2698	
6	Jo Wahle		605-351-0658	
7	Luke Henriksen	2200 S [illegible] Ave 57106	605-321-5040	
8	Riley Hosman	Brandon, SD	951-5341	rhos1205@gmail.com
9	Bob Bothm	1116 Cth Ave	605 334 4220	
10	Gerald Teunissen	808 Jane Lane	605-366-1979	gerald@bendenco.com
11	Judy Mickalowski		605-521-6345	
12	Carsen Bower	25225 474th Ave Garretson SD	605-594-6431	
13	Joe Painter	3512 S Alpine SF		
14	Mark Meyer	1504 W. Mooby ST SF	605 275 2667	
15	Travis Krebs	2405 S Glendale Pl	605 254 8651	
16	Sharon Fix	301 N. Marquette Ave 57110	605-335-6001	
17	Jon Smith	941 S Grandview 57103	334-5869	jdsmith@sio.midco.net
18	Allan Kostboth	1205 E. 38th St. 57105	940-2721	kostboth@sio.midco.net
19	Dennis Olsen	2608 E Winston Cir 57108	978-3980	dennis.olsen@medvantx.com
20	DALE Froehlich	West Valley Chateau 6 So Lee SF, SD 57105	201-9810	

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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Tuesday, December 6th, 2016 6:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Steve Gramm	700 E. Broadway Ave.	773-6641	steve.gramm@state.sd.us
2	Dean Delasamutt	7207 N Violet Pl	496 1108	
3	Paul Nikolas	5316 W 60th St. N.	367-5680	Paul.Niklas@state.sd.us
4	Brad Remmich	SDDot – Pierre	773-3093	bradley.remmich@state.sd.us
5	Sarah Schafer	117 E Twin Oaks Pl #53	338-5741	–
6	gary busselman	7201 G Madison ST Sioux Falls SD 57110	605 334 5692	gary@garybuss.com
7	Bruce Card	4815 E [illegible] Dr. S F SD 57110	605-261-1327	bcard@[illegible].com
8	Amber Gibson	500 N Western Ave Ste 100 SFSD 57104	605-367-5390	amber@[illegible]
9	Bart Brost	4800 S Oak Trail Pl SF SD 57108	605-310-8628	brostbart@[illegible].com
10	Lanny Blum	6300 E 26th SF SD 57110	605 332-7391	
11	Kim Blackburn	2708 S 10	940-7908	[illegible]@hot mail.com
12	Mark Skadsen	25952 476th Ave	351-9512	
13	Jason Kjenstad	6300 S. Old Village Pl Suite 100	977-7740	jason.kjenstad@hdrinc.com
14				
15				
16				
17				
18				
19				
20				

DOT

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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Public Meeting
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K
Project No.: 207030
Meeting Date Tuesday, December 6th, 2016 6:00 PM
Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Shannon Ausen	224 W 9th St SF SD	367-8607	sausen@siouxfalls.org
2	Jason Kjenstad	6300 S. Old Village Pl Suite 100 SF SD	977-7740	jason.kjenstad@hdrinc.com
3	Mark Hoines	116 E. Dakota Ave Pierre, SD	776-1010	mark.hoines@dot.gov
4	Steve Painter	4101 S. Western	359-8525	
5	Andy Vandel	SDDOT Pierre	773-4421	andy.vandel@state.sd.us
6	Jeff Hanssen	3101 W. Auburn Hills Ct	310-6280	jeff.hanssen@kneipgroup.com
7	Charlie Kneip	3066 W. Ponsonni Sioux Falls	359-9451	charles.kneip@kneipgroup.com
8	Mitch Brandner	830 E 41st St, SF SD.	605-366-2404	mitch.brandner@gmail.com
9	Josh Larson	2208 S Sheffield SF SD	605-271-1609	joshuadavid@hotmail.com
10	Debi Schafer	2300 S Jefferson SF SD	605 310 2698	–
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before December 22, 2016 to:

Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Very much like improved pedestrian/bike access on all options. Of the 3 current options, Cliff 1 + 7 have less property owner impact (good). Cliff 7 appears to have less impact on affordable housing. Cliff 6 would feed Lincoln HS traffic right onto 41st - Probably not a good idea. Intersection of Cliff + 41st at LHS would be a real mess 7:30-9 am + 3-4:15 pm (Current LHS busiest times. It's already not a favorite time/place for bus + paratransit drivers + commuters.

(optional)
Name: Wendy Butler-Boyesen
Address: 1104 E. Pam Rd.
Phone: 605-906-1203
Email: wbutlerboyesen@gmail.com

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Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Website very useful → advertise on marquee sign please!

Thanks for making considerations for cyclists!

(optional)
Name: Riley Hosman
Address: 1205 Parkview blvd, Brandon
Phone: 951-5391
Email: rhos1205@gmail.com

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Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

DONT INSTALL A DIVIDED Median
ON Benson Prevents Left turns
FROM the SOUTH

(optional)
Name: CHRIS RANS
Address: 3412 N. POTSDAM
Phone: 338-9110
Email: CHRIS@SUNKOTA CONSTRUCTION.com

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Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Divider (median) along Minn from 41st south
makes no sense. Will not improve safety.
Will negatively impact retail business. How will
access be maintained during construction and long
term. NO GOOD ACCESS TO STAPLES / Dollar Tree

(optional)
Name: Dave McElroy
Address: 3310 S Minn Ave
Phone: 605-338-9519
Email: mcelroy.dave@gmail.com

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Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

DO NOT INSTALL A RAISED Median ON BENSON to ELIMINATE LEFT TURNS From the SOUTH

(optional)
Name: CHRIS RAWS
Phone: 338-9110
Address: 3412 N. POTSDAM AVE.
Email: CHRIS@ SUNKOTA CONSTRUCTION AVE.

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6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

Like Mn Ave 2D
" 10 st 2 B/C
" Benson 1A — Suggest doing Southbound Ramp prior to working at North NB Ramp
" Rice 3C — no need to move SB 229 Ramp
" Cliff 1

(optional)
Name: Lanny Bogue
Phone: 332-7391
Address: 6300 E 26th ST
Email: SQDAS@ Sioux Midco.net

Kjenstad, Jason

From: Gary Busselman <gary@garybuss.com>
Sent: Wednesday, December 07, 2016 5:27 PM
To: Kjenstad, Jason
Cc: Nancy Busselman
Subject: I-229 E 10th St Exit COMMENT

I-229 Major Investment Corridor Study
HDR Engineering Inc
ATT: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls SD 57108-2102

Jason.Kjenstad@hdrinc.com

Fax: 605-977-7747

December 7, 2016

RE: 2700 & 2704 E 10th St
Loss of either of the two approaches or the front parking/pass through will amount to a virtual condemnation and will likely result in an inverse condemnation action. Either buy my property or don't damage it so I can't use it as is or sell it to somebody else.

Gary Busselman
STEM LLC
7201 E Madison St
Sioux Falls, SD 57110
605-334-5692
gary@garybuss.com

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...ing South Dakota and the Nation

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HDR Engineering, Inc.
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

I have a tenent in 3508 S. Minesota Ave.
Access off of Minesota Ave & being able to turn
onto 43rd St. when heading S. on Minesota Ave to
access the business is important to the rentability
of these businesses and customer access.

: Jeff Mindt
: 360-6108
Address: 801 E. 38th St. SF, SD 57105
Email: jmindt68@gmail.com

I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before December 22, 2016 to:

Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

No Build -
Keep 43rd Street open to Minnesota Ave for N + S Bound traffic
No median

(optional) Name: Tom Hein

Address:

Phone: 361-8400

Email: theinmail@gmail.com

South Dakota DOT Connecting South Dakota and the Nation

I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

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Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

No Build
Keep 43rd Street open to Minnesota Ave for N + S Bound Traffic
No Median.

(optional)
Name: MARY HEIN
Address:
Phone: 361-8400
Email: theinmail@gmail.com

I-229 Major Investment Corridor Study

www.i229study.com

PL 0100 (87) 3616P, PCN 044K

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Providing a Better Quality of Life for You!

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before December 22, 2016 to:

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ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

December 7, 2016

RE: 2700 & 2704 E 10th St

Loss of either of the two approaches or the front parking/pass through will amount to a virtual condemnation and will likely result in an inverse condemnation action. Either buy my property or don't damage it so I can't use it as is or sell it to somebody else.

(optional)
Name: Gary Busselman
STEM LLC

Address: 7201 E Madison St
Sioux Falls, SD 57110

Phone:

Email: 605-334-5692
gary@garybuss.com

South Dakota DOT
Connecting South Dakota and the Nation

I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

CITY OF SIOUX FALLS PUBLIC WORKS
Providing a Better Quality of Life for You!

WE WANT TO KNOW WHAT YOU THINK! What are your concerns? What issues does the study team need to overcome with this project? What problems do you foresee? Please submit your comments before December 22, 2016 to:

Mail: *HDR Engineering, Inc.*
ATTN: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls, SD 57108-2102

E-mail: *Jason.Kjenstad@hdrinc.com*

Fax: *605-977-7747*

I think your design which hooks up with 49th ST going west makes most sense.

(optional) Name: Mary Montoya
4809 S Twin Ridge Rd
Sioux Falls, SD 57108

Address:

Phone:

Email: mary.montoya@sio.midco.net

Kjenstad, Jason

From:	Robert Reitz <tooferguy007@gmail.com>
Sent:	Monday, December 19, 2016 9:39 AM
To:	Tom Hein; Kjenstad, Jason
Cc:	Shally Rogen; Jeff R. Mindt; Eric & Mary Stormo; Brian Sather
Subject:	Re: I229 and Minnesota Layouts

Please consider access to Minnesota Crossing {3508 S Minnesota Ave} for southbound traffic on Minnesota Ave by narrowing the island to permit a left turn lane for entry to the middle access on the above mentioned property. Otherwise we strongly suggest NO BUILD!

On Tue, Dec 13, 2016 at 8:25 AM, Tom Hein <theinmail@gmail.com> wrote:

Please review DOT options below for destroying our property and access. Be sure to complete the I-229 Major Investment Corridor Study 'We want to know what you think" card and return it to HDR Engineering or Jason.Kjenstad@hdrinc.com with your thoughts. I highly encourage to have a **"No Build"** option which leaves our access points and does not provide a median to prevent our south bound customers from getting into our property.

Please reply.

Thanks,

Tom

---------- Forwarded message ----------
From: **Kjenstad, Jason** <Jason.Kjenstad@hdrinc.com>
Date: Fri, Dec 9, 2016 at 6:04 AM
Subject: Fwd: I229 and Minnesota Layouts
To: Thomas Hein <theinmail@gmail.com>

FYI Tom

Jason Kjenstad 605 360 6595

Begin forwarded message:

> **From:** "Kjenstad, Jason" <Jason.Kjenstad@hdrinc.com>
> **To:** "jmbliss628@aol.com" <jmbliss628@aol.com>
> **Cc:** "Kjenstad, Jason" <Jason.Kjenstad@hdrinc.com>
> **Subject: I229 and Minnesota Layouts**
>
> FYI Rich
>
> **Jason Kjenstad,** PE, LSIT
>
> *Vice President – Dakota's & Wyoming Transportation Operations Manager*
>
> **HDR**
>
> 6300 South Old Village Place
> Suite 100

I-229 Major Investment Corridor Study
HDR Engineering Inc
ATT: Jason Kjenstad
6300 S. Old Village Place, Suite 100
Sioux Falls SD 57108-2102

Jason.Kjenstad@hdrinc.com

Fax: 605-977-7747

December 7, 2016

RE: 2700 & 2704 E 10th St
Loss of either of the two approaches or the front parking/pass through will amount to a virtual condemnation and will likely result in an inverse condemnation action. Either buy my property or don't damage it so I can't use it as is or sell it to somebody else.

Gary Busselman

Gary Busselman
STEM LLC
7201 E Madison St
Sioux Falls, SD 57110
605-334-5692
gary@garybuss.com

Kjenstad, Jason

From: Brian Sather <gdentltd@hotmail.com>
Sent: Monday, December 19, 2016 2:00 PM
To: Kjenstad, Jason; Jeff R. Mindt; Tom Hein; Shally Rogen; Eric & Mary Stormo; Bob Reitz
Subject: I-229 Major Investment Corridor Study

As one of the owners of property at 3508 S. Minnesota Ave.(#108), I recommend a left turn from a turning lane for southbound traffic into the only remaining access opening on the north side. Also, there is no adequate access in these plans to the south of the building for delivery vehicles, trash haulers, and employees. If these concerns can not be corrected, I recommend a "No Build" as the option.

Brian Sather
gdentltd@hotmail.com

Kjenstad, Jason

From: Malmberg, Chris
Sent: Thursday, December 22, 2016 7:40 AM
To: Meier, Dave; Kjenstad, Jason
Subject: FW: Fryn' Pan Family Restaurant

Didn't know if this made it to you.

Chris Malmberg, PE, ENV SP
D 402.399.4959 M 402.212.8136

hdrinc.com/follow-us

From: Stan Mitzel [mailto:smitzel@frynpan.net]
Sent: Wednesday, December 21, 2016 3:50 PM
To: sausen@siouxfalls.org; steve.gramm@state.sd.us; Malmberg, Chris
Cc: Dave Stukel; Rick Weisser
Subject: Fryn' Pan Family Restaurant

Shannon,

I was just looking at the proposed project of the 10 th street corridor as it affects my business at 10th and Cleveland; If we are forced to move because the improvements are causing detrimental effects, I think a good relocation for us would be to take over the old Godfathers building along with the bank lot to the east. This would provide enough parking for us and a suitable location to make our business viable. It seems these lots have been continually vacant the last few years. Just thought I would share my thoughts as this project is very concerning to myself and partners and we would like to know where we stand sooner rather than later.

Thanks for your time,

Stan Mitzel
Fryn' Pan Family Restaurant
3215 S. Carolyn Ave
Sioux Falls, SD 57106
Office: 605.361.7804
Cell: 605.201.5141
Fax: 605.361.7921
smitzel@frynpan.net

INTERSTATE 229 MAJOR INVESTMENT STUDY

Informational Meeting

December 6th, 2016
6:00 pm to 8:00 pm

HRGreen

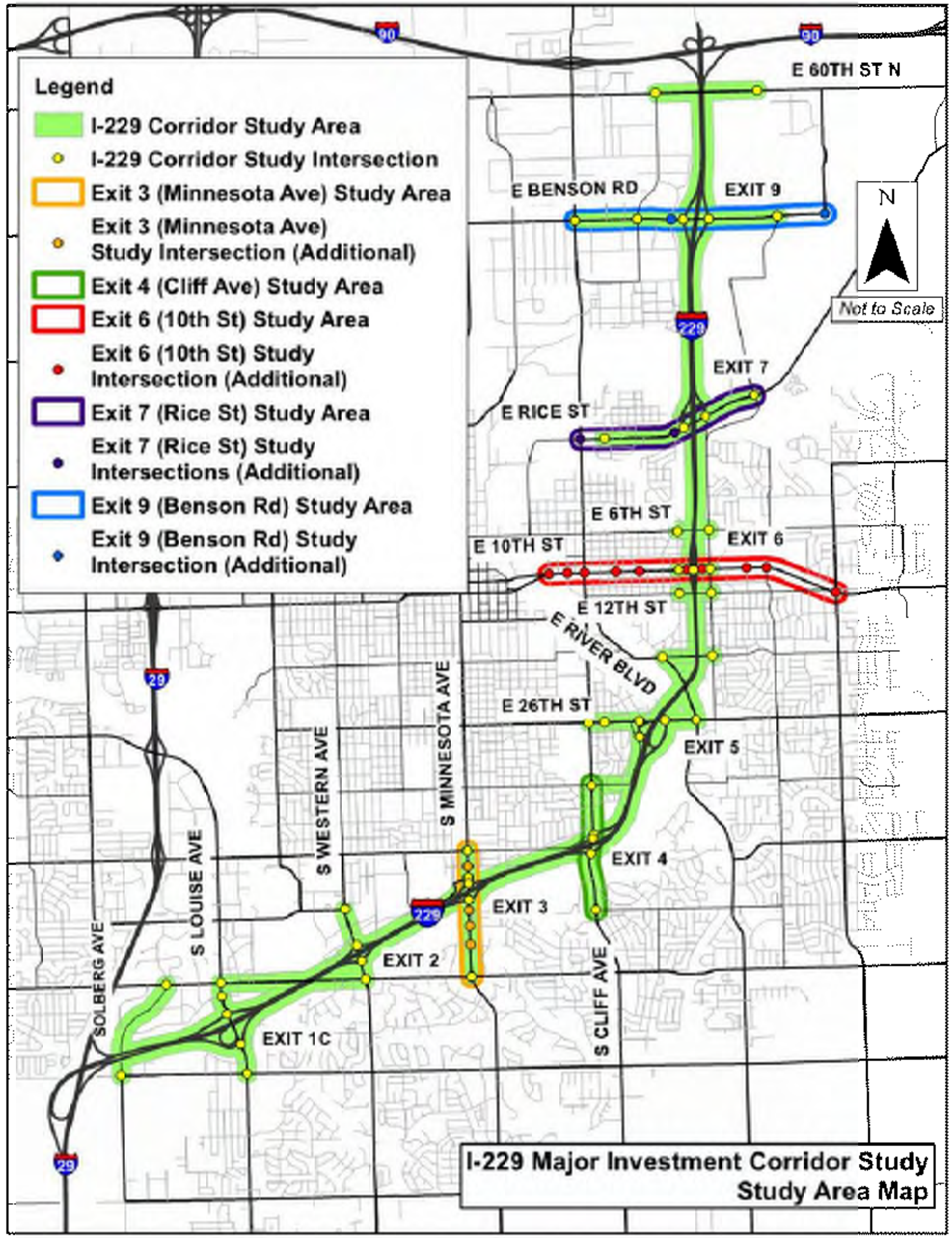
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

- Minnesota Avenue
- Cliff Avenue
- 10th Street
- Rice Street
- Benson Road



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

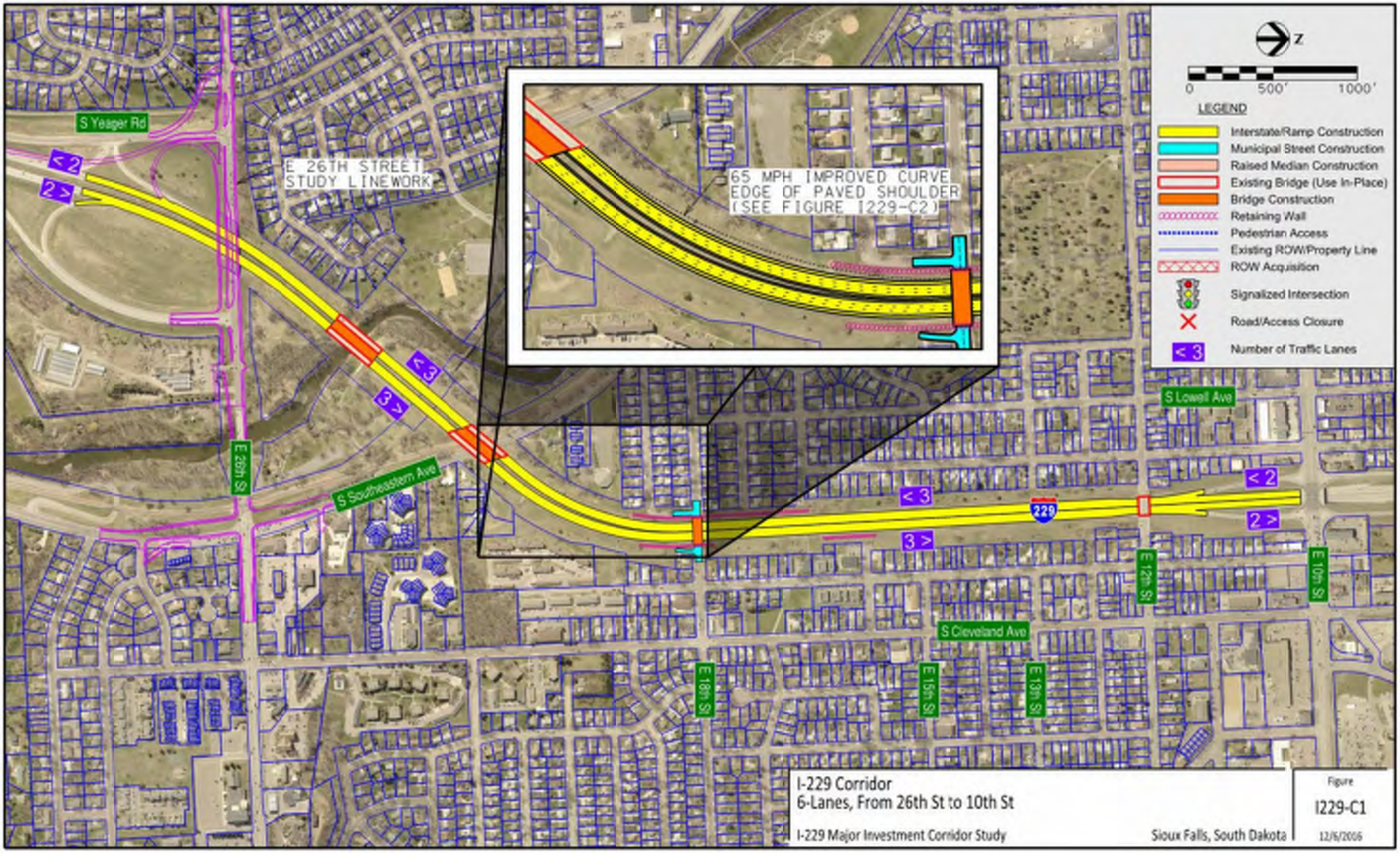
Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Recommended I-229 Corridor Improvement Concepts
- Interchange/Cross Road Sub-studies
  - Concept Evaluation Process
  - Concept Evaluation Results
  - Concepts Recommended for Further Consideration in Future Phases
- Next Steps

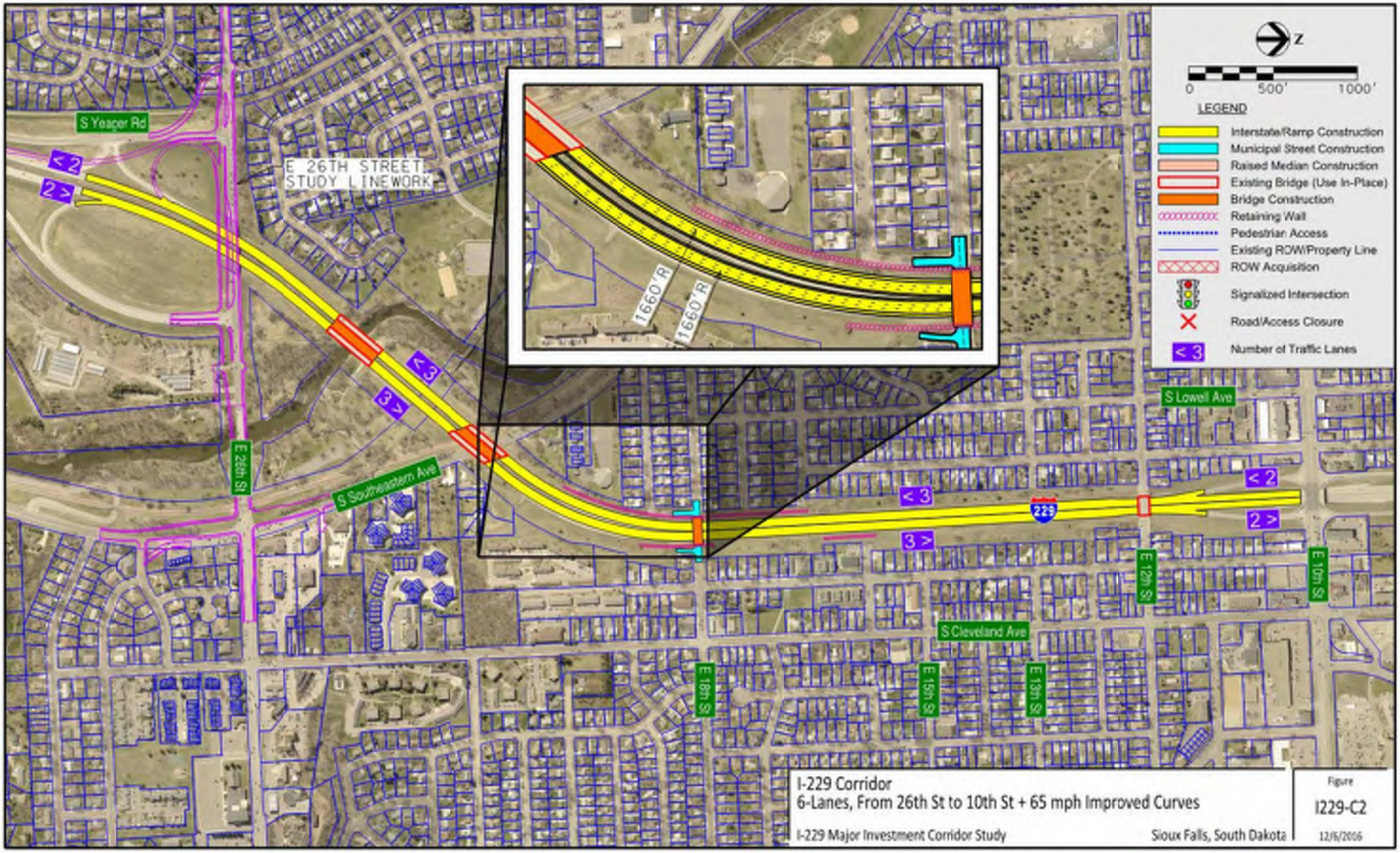
I-229 CORRIDOR IMPROVEMENTS

ADD 3RD LANE EACH DIRECTION
BETWEEN 26TH STREET AND 10TH STREET



I-229 CORRIDOR IMPROVEMENTS

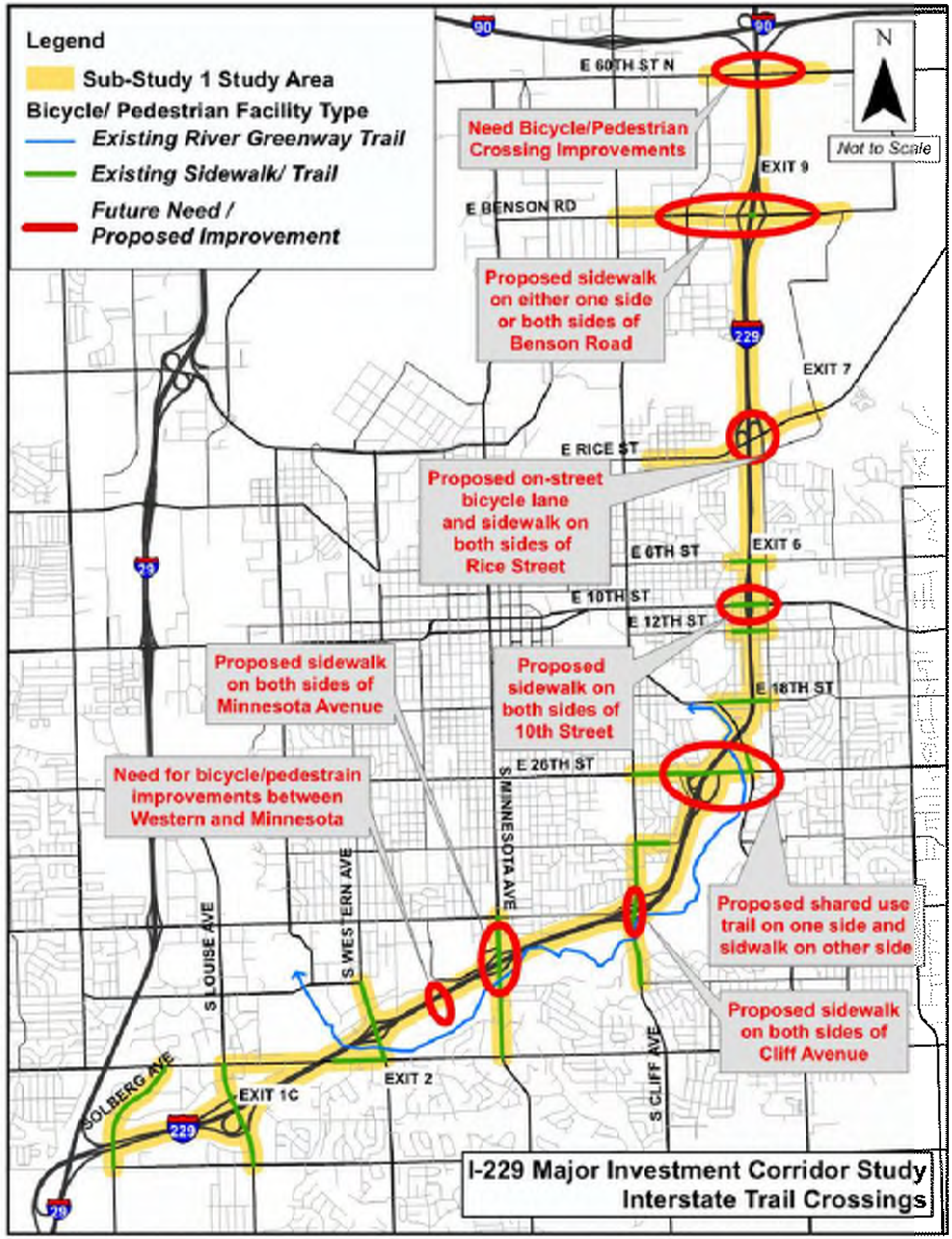
MODIFY CURVE RADIUS BETWEEN SOUTHEASTERN AVE & 18TH ST TO ALLOW 65 MPH DESIGN SPEED



I-229 CORRIDOR IMPROVEMENTS

PEDESTRIAN / BICYCLE CROSSING NEEDS & IMPROVEMENTS

- Sub-study Proposed Improvements
  - Minnesota Avenue
  - Cliff Avenue
  - 10th Street
  - Rice Street
  - Benson Road
- Other Need Locations



I-229 CORRIDOR IMPROVEMENTS

INTELLIGENT TRANSPORTATION SYSTEMS (ITS) CONCEPTS

- Adaptive Signal Control Technologies
- CCTV Cameras
- Dynamic Message Signs
- Dynamic Road Warning Signs
- Traffic Detectors

INTERCHANGE AND CROSS ROAD SUB-STUDIES

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts for Further Consideration in Future Phases

CONCEPT EVALUATION PROCESS

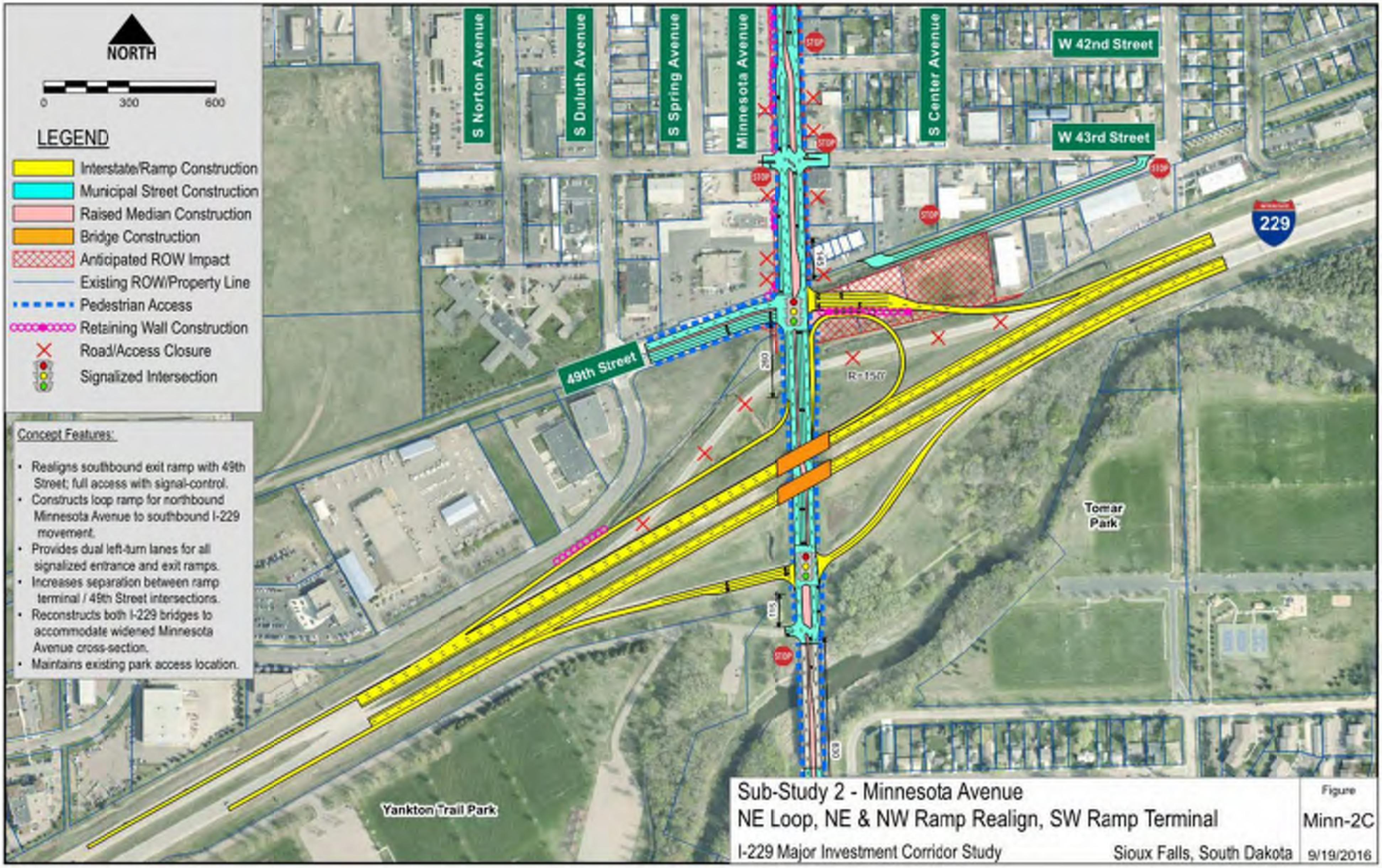
- Evaluation Factors:

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	Advance or Eliminate

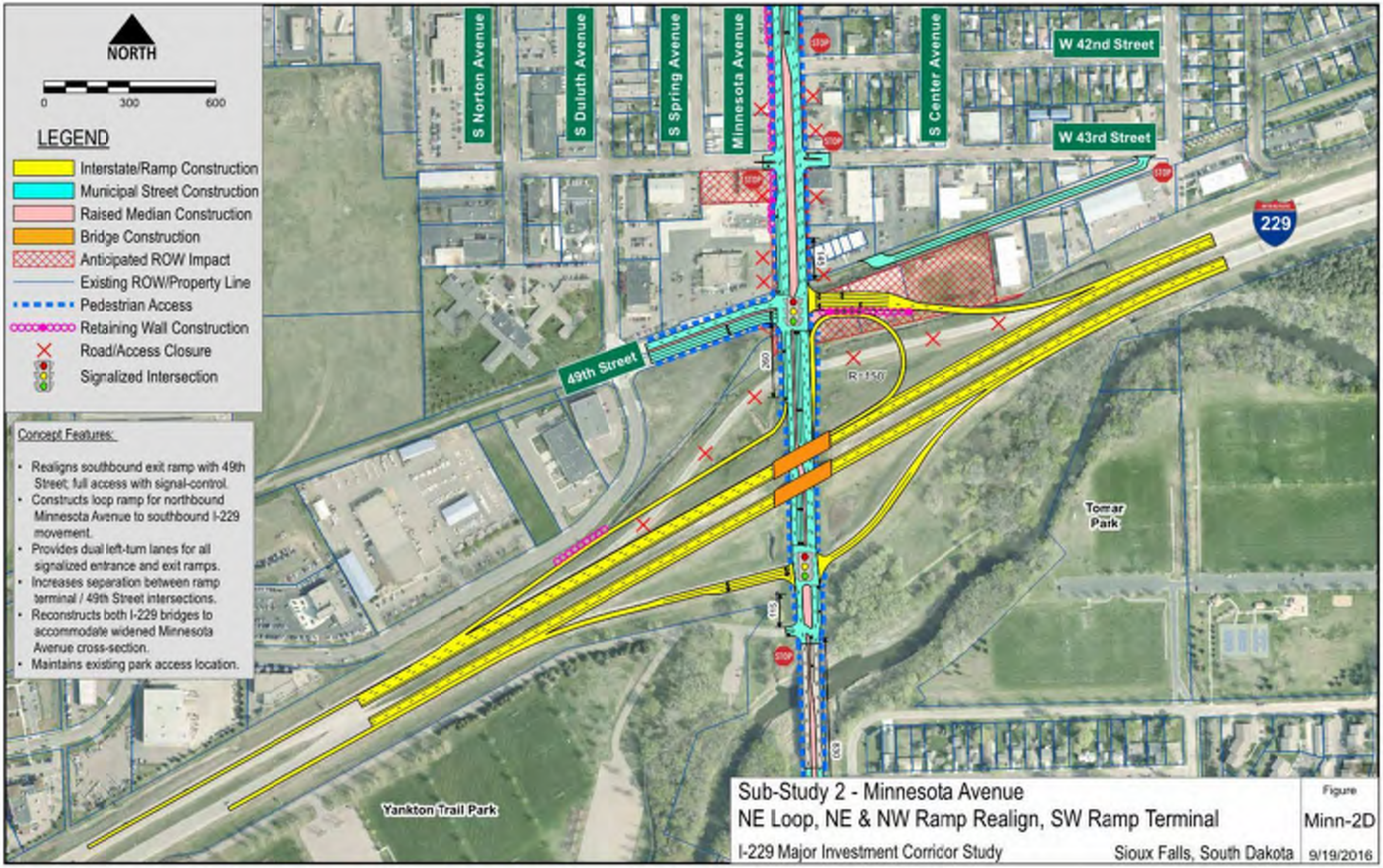
- Recommended Action

CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 2C



CONCEPTS FOR FURTHER CONSIDERATION
MINNESOTA AVENUE – 2D



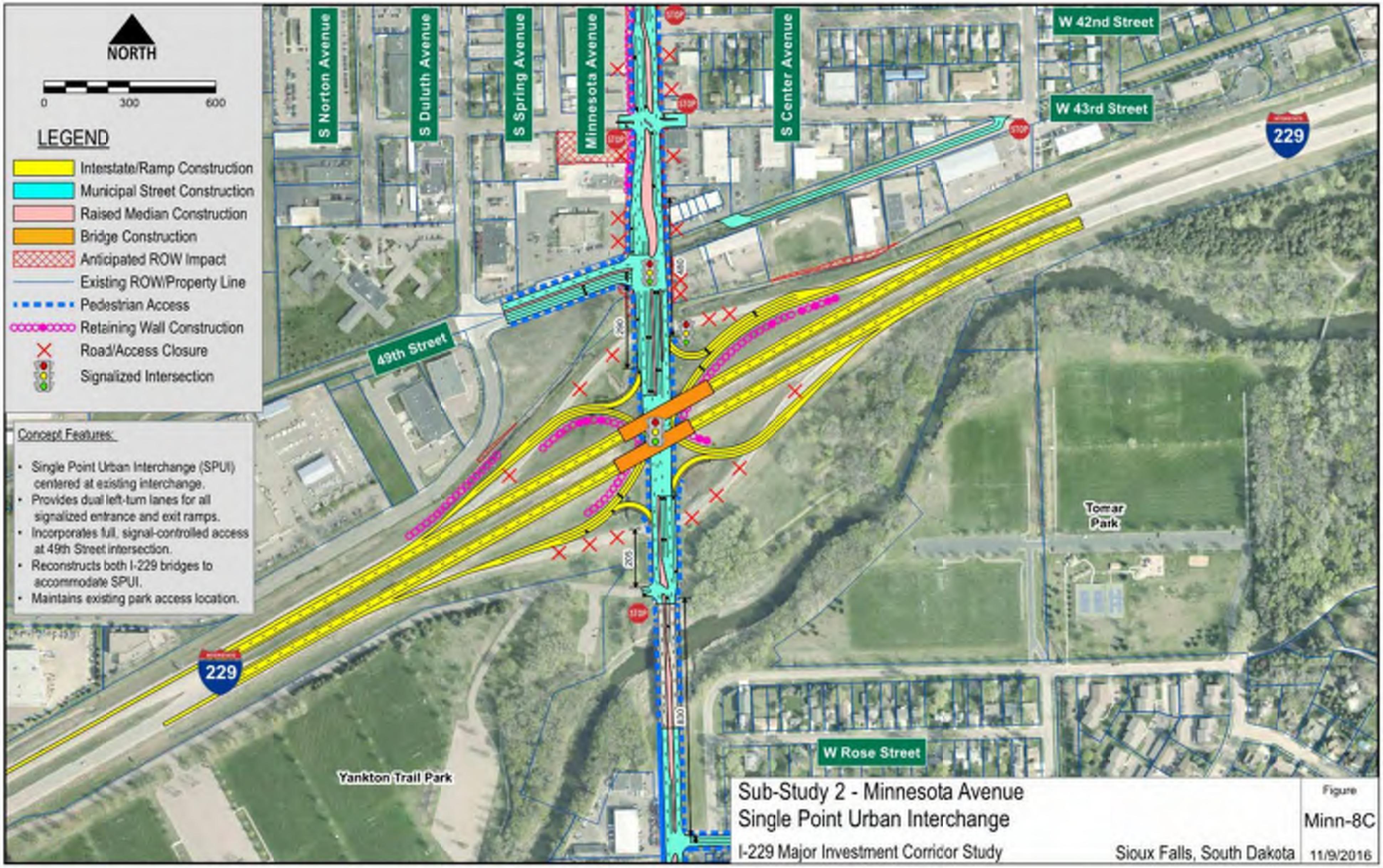
CONCEPT EVALUATION RESULTS

MINNESOTA AVENUE

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
Minn-2C	Diamond with Loop, Direct Connect to 49th St, 5-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	GOOD	Advance
Minn-2D	Diamond with Loop, Direct Connect to 49th St, 6-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	GOOD	Advance
Minn-5D	Diverging Diamond Interchange, 6-Lane Big Sioux River to 41st St, 49th St Right-In Right-Out	GOOD	VERY GOOD	NEUTRAL	GOOD	GOOD	Eliminate Closure of 49th Street Access

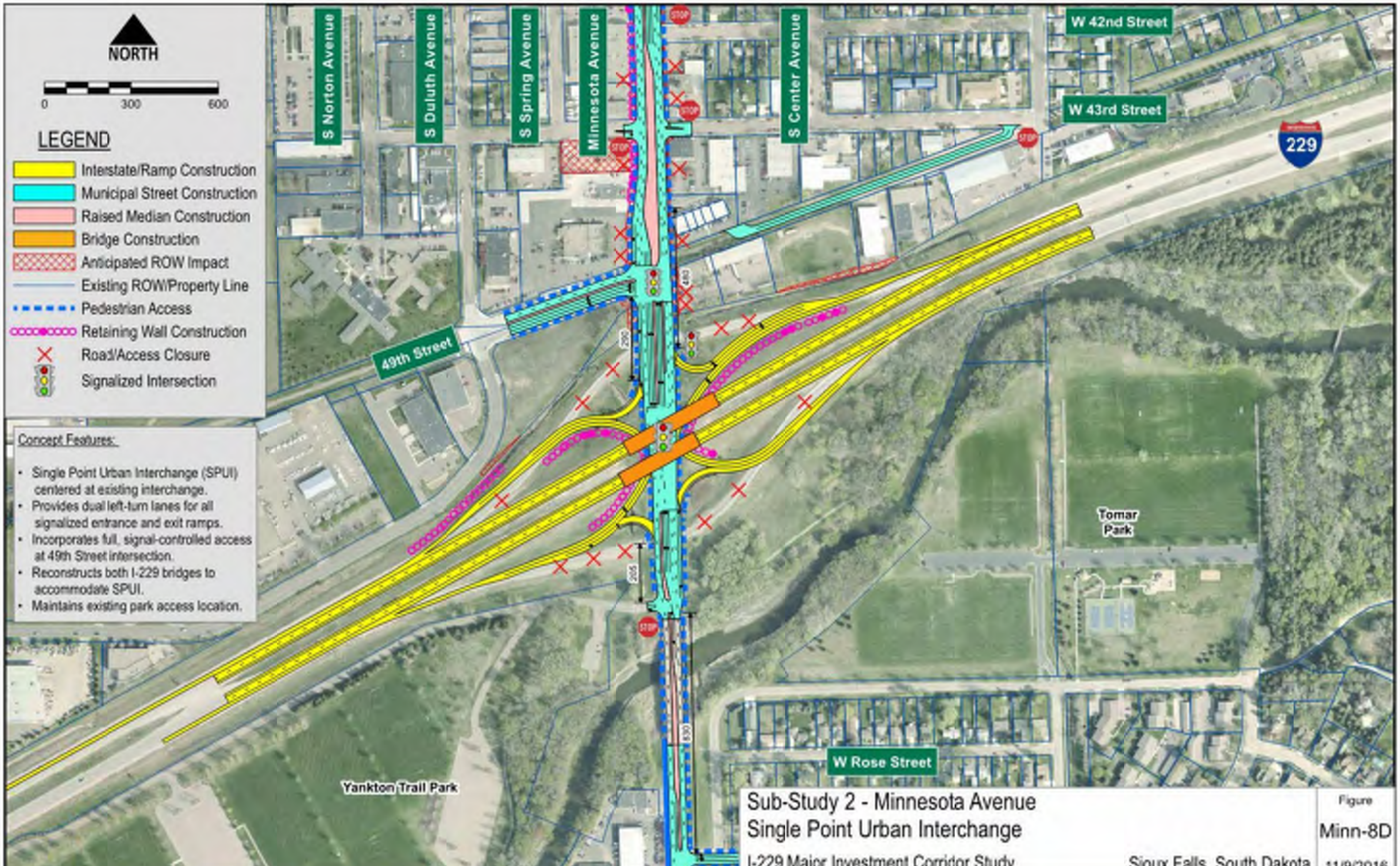
CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 8C



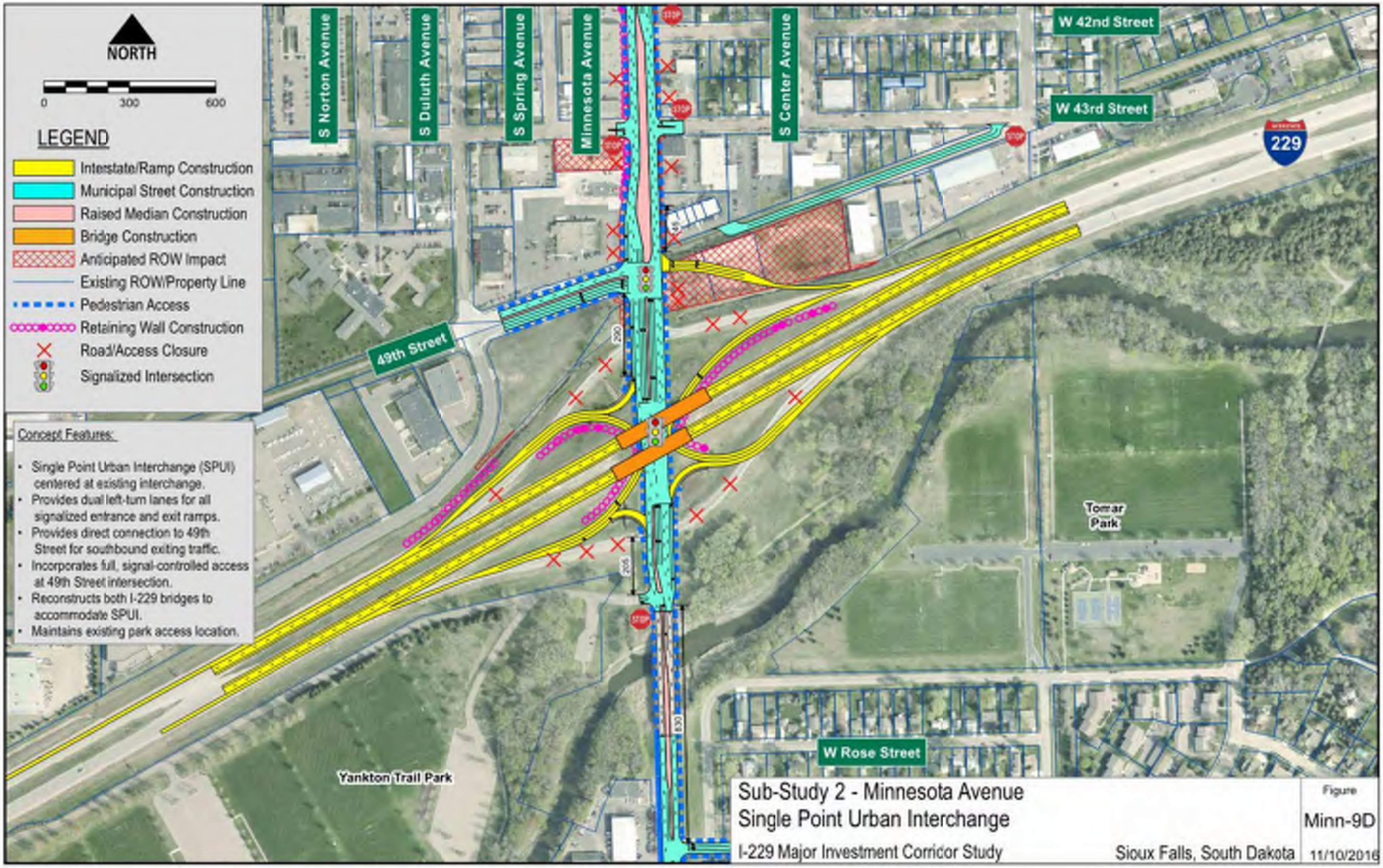
CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 8D



CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 9D



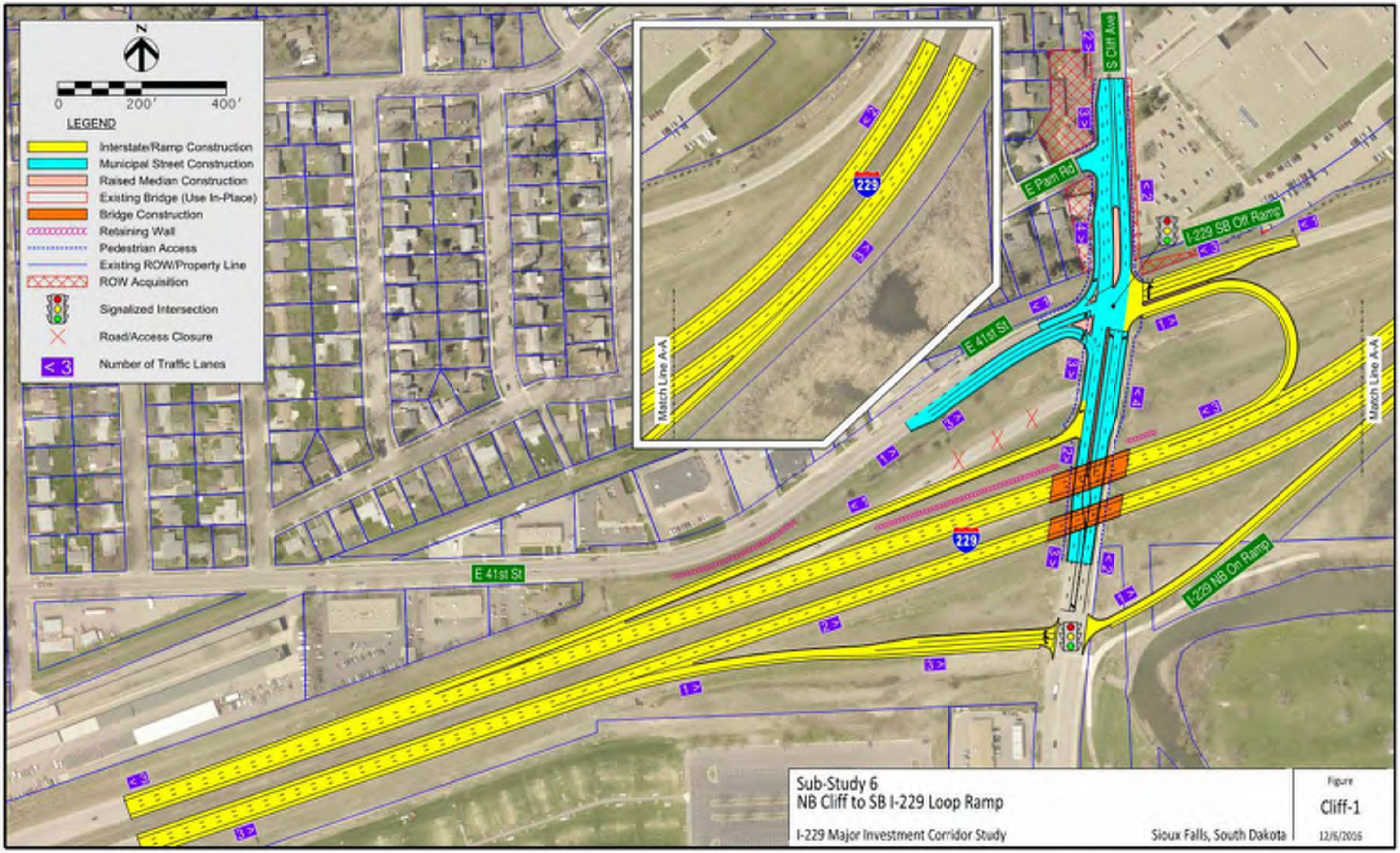
CONCEPT EVALUATION RESULTS

MINNESOTA AVENUE (cont.)

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Minn-8C	Single Point Urban Interchange, 5-Lane Big Sioux River to 41st St, 49th St Full Access	GOOD	GOOD	NEUTRAL	GOOD	NEUTRAL	Advance
Minn-8D	Single Point Urban Interchange, 6-Lane Big Sioux River to 41st St, 49th St Full Access	GOOD	GOOD	NEUTRAL	GOOD	NEUTRAL	Advance
Minn-9	Single Point Urban Interchange, Exit Ramp Connection to 49th St, 5-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	Advance

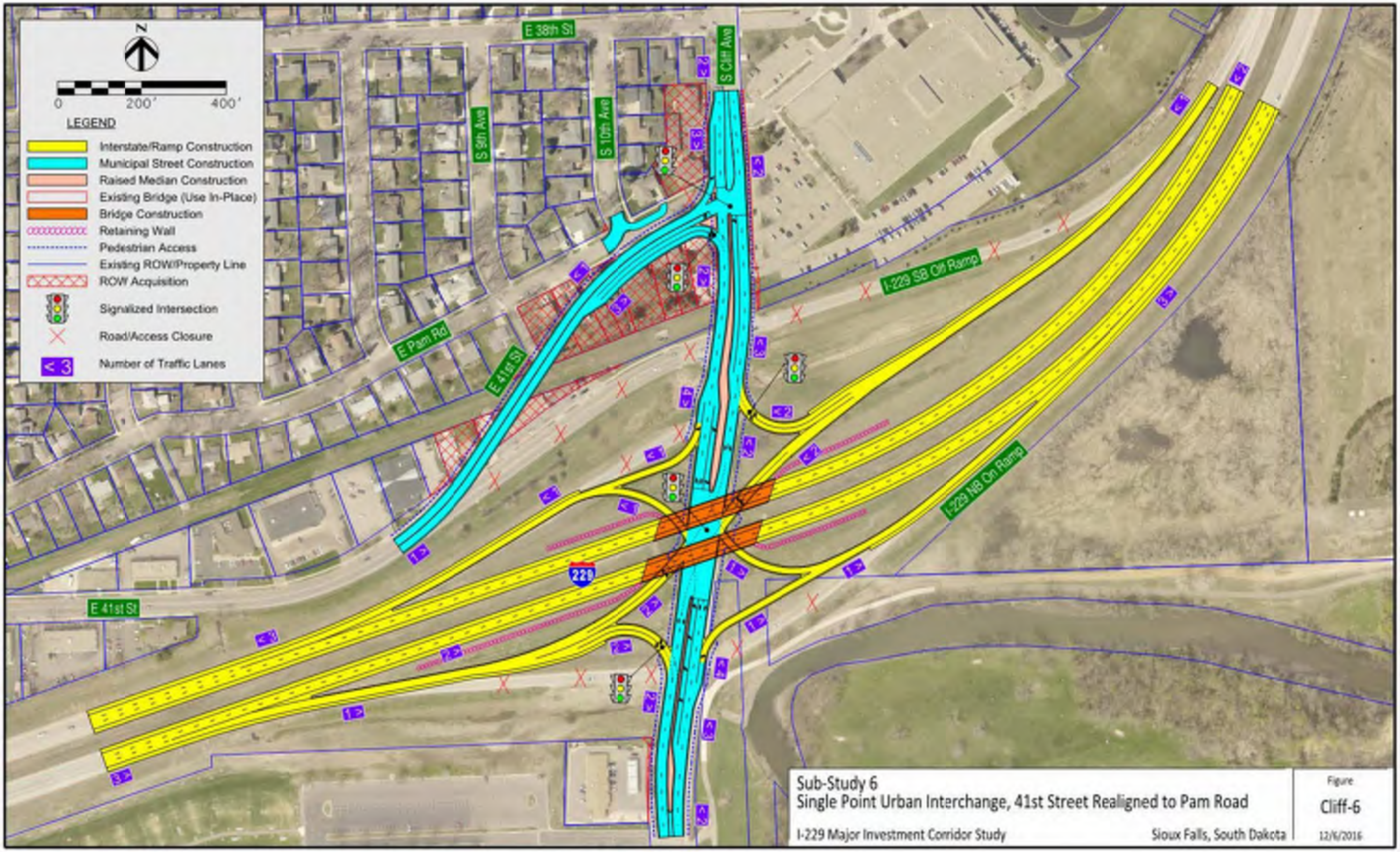
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 1



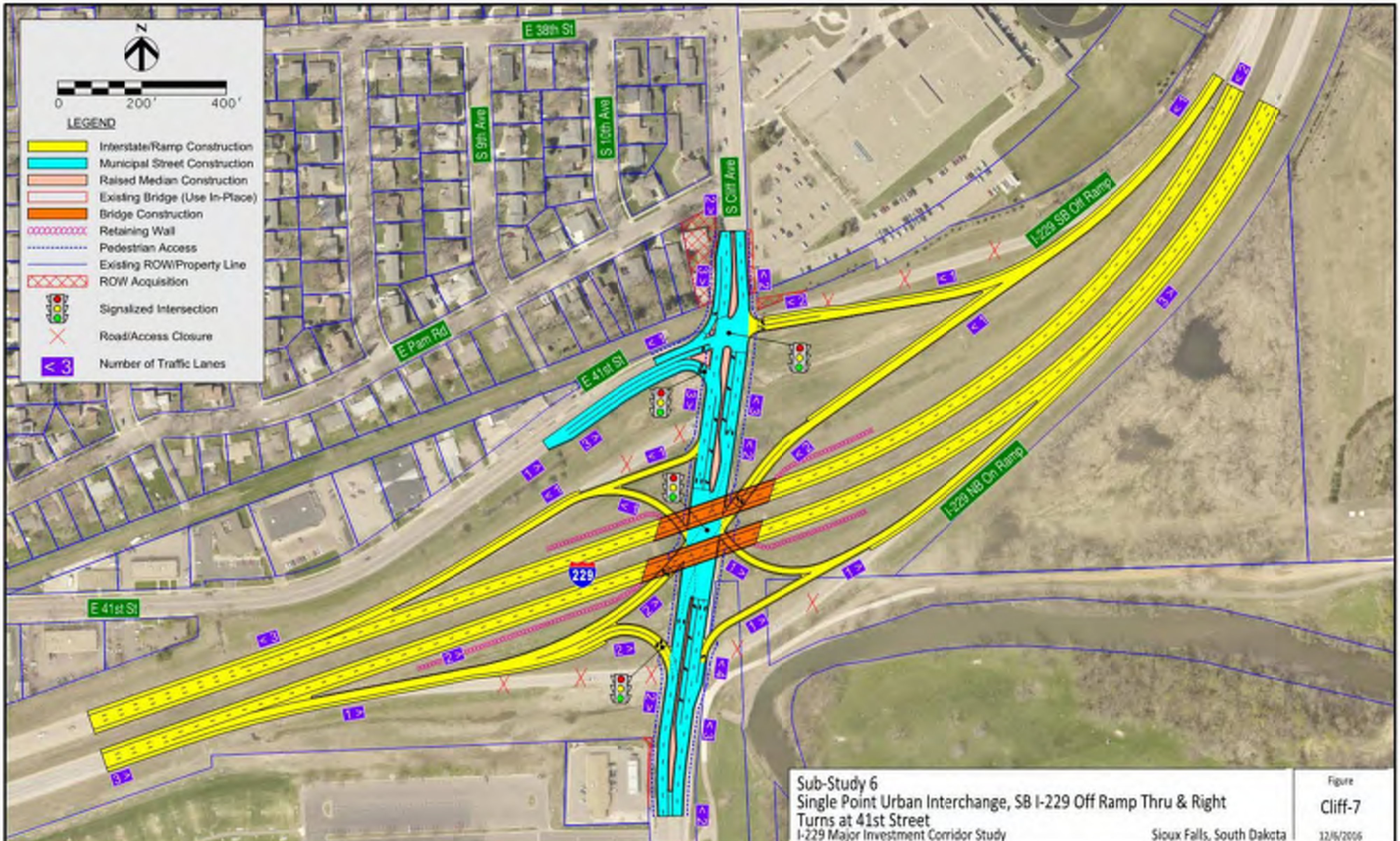
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 6



CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 7



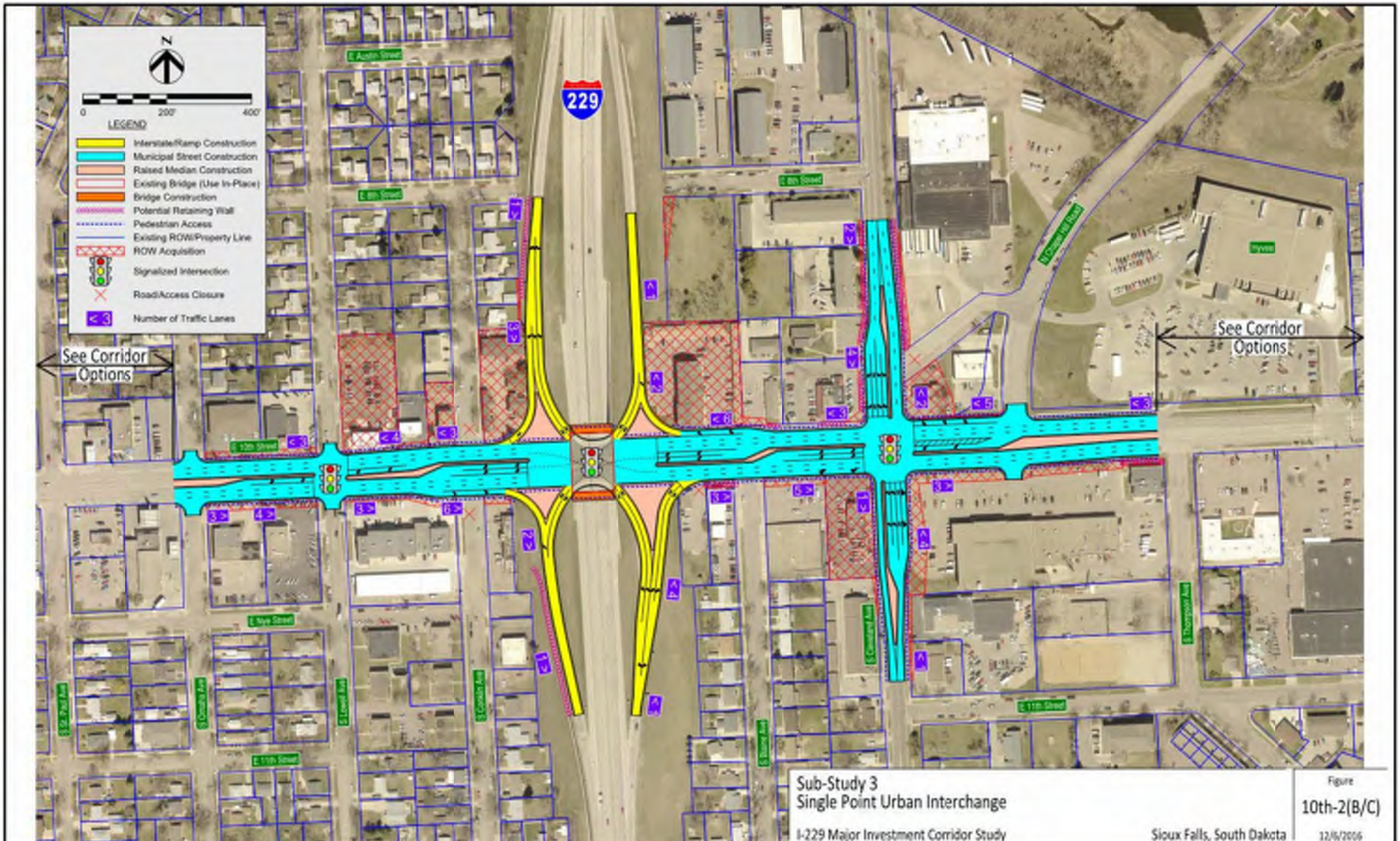
CONCEPT EVALUATION RESULTS

CLIFF AVENUE

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
Cliff-1	NB Cliff to SB I-229 Loop Ramp	GOOD	NEUTRAL	GOOD	GOOD	GOOD	Advance
Cliff-6	Single Point Urban Interchange, 41st St Realigned to Pam Rd	VERY GOOD	GOOD	GOOD	POOR	POOR	Advance
Cliff-7	Single Point Urban Interchange, SB I-229 Off-Ramp Thru & Right Turns at 41st St	GOOD	GOOD	GOOD	VERY GOOD	POOR	Advance

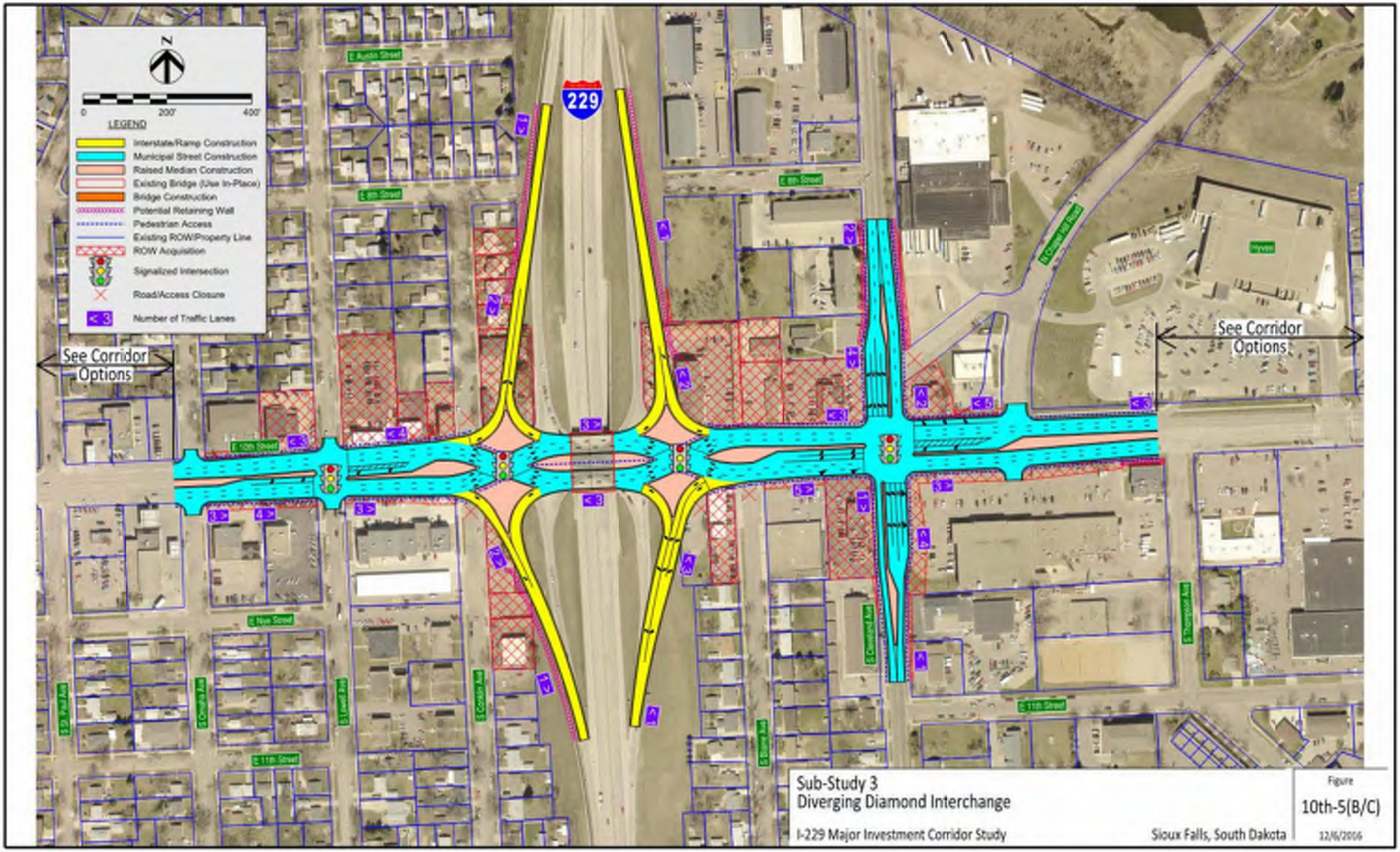
CONCEPTS FOR FURTHER CONSIDERATION

10TH STREET – 2 (B/C)



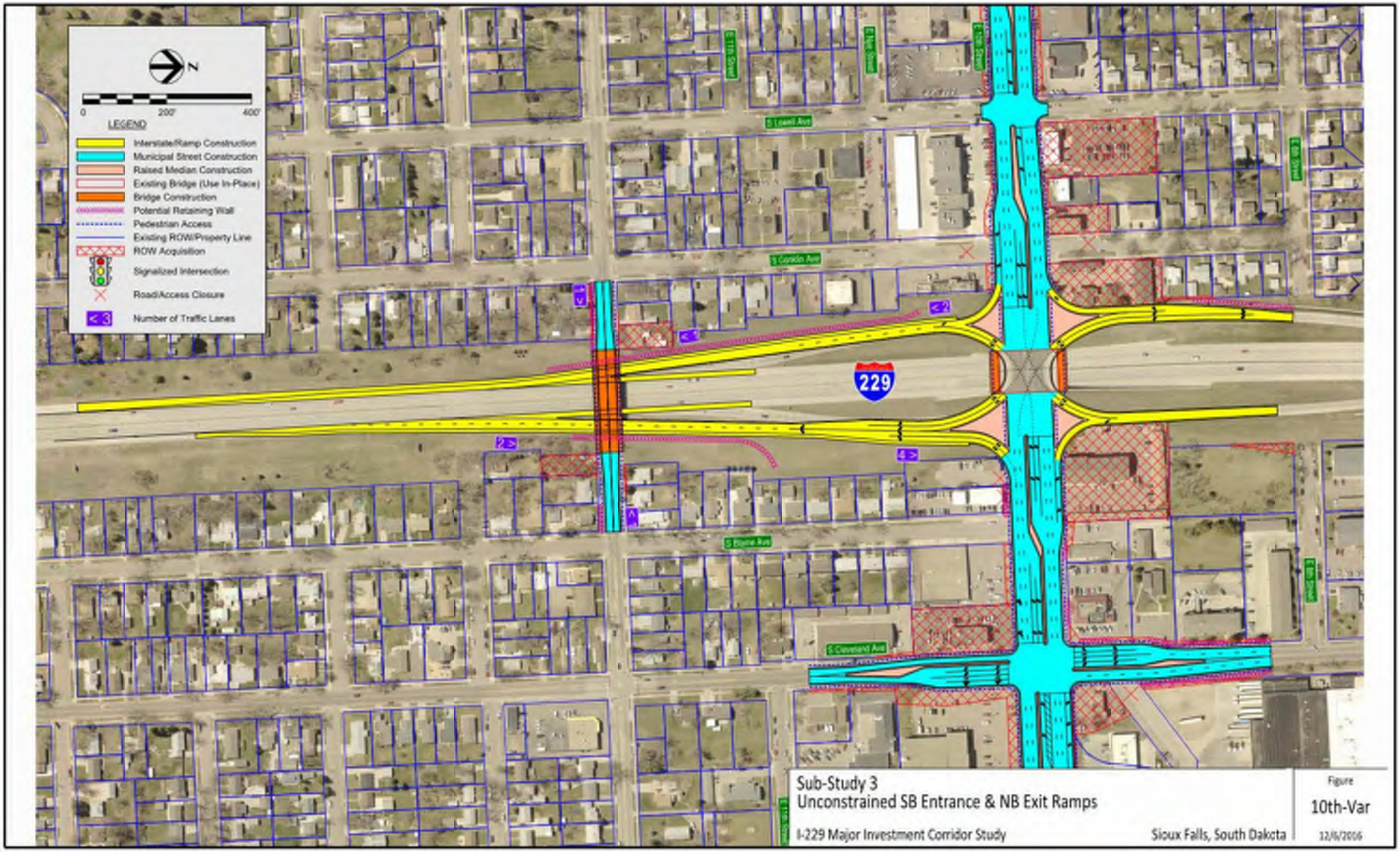
CONCEPTS FOR FURTHER CONSIDERATION

10TH STREET – 5 (B/C)

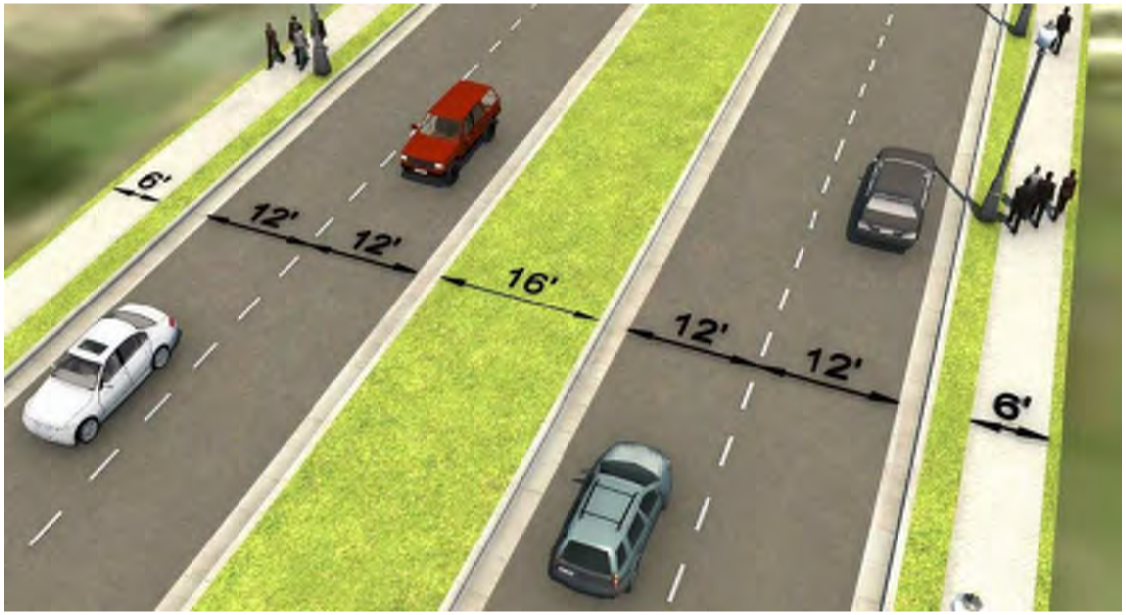


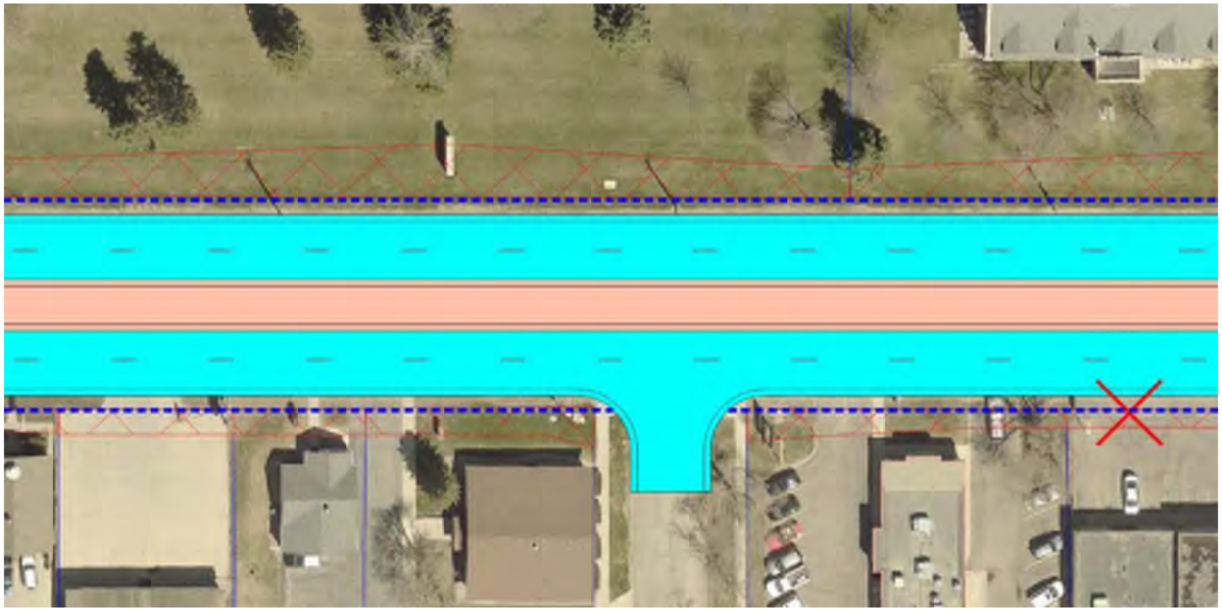
CONCEPTS FOR FURTHER CONSIDERATION

10TH STREET – VAR

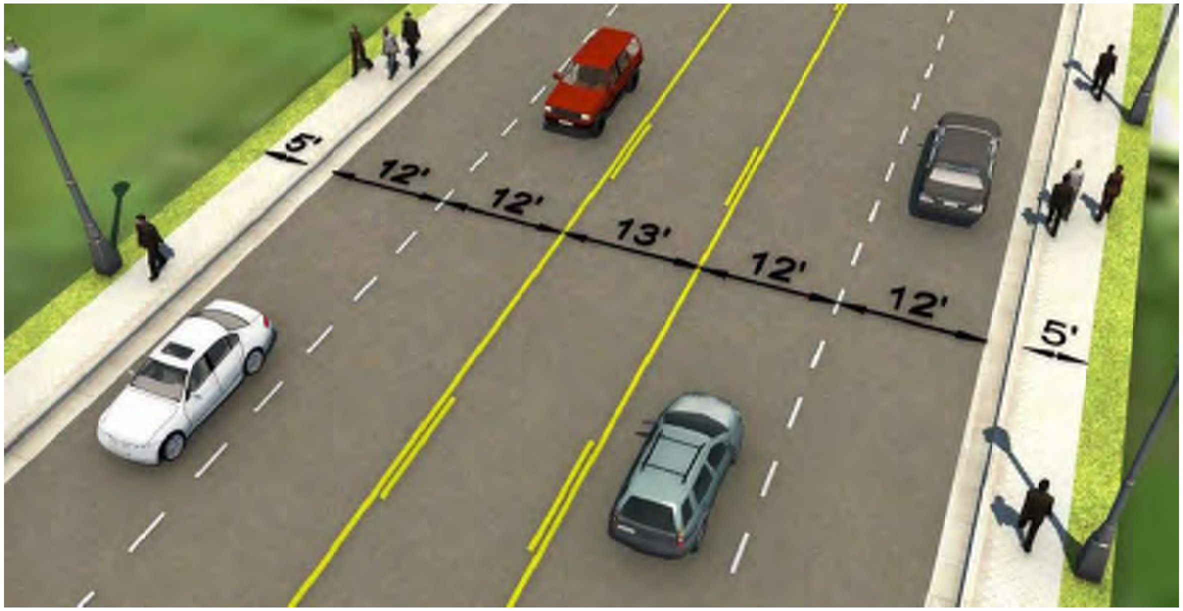


4-Lane Divided Corridor





5-Lane Undivided Corridor



CONCEPT EVALUATION RESULTS

10TH STREET

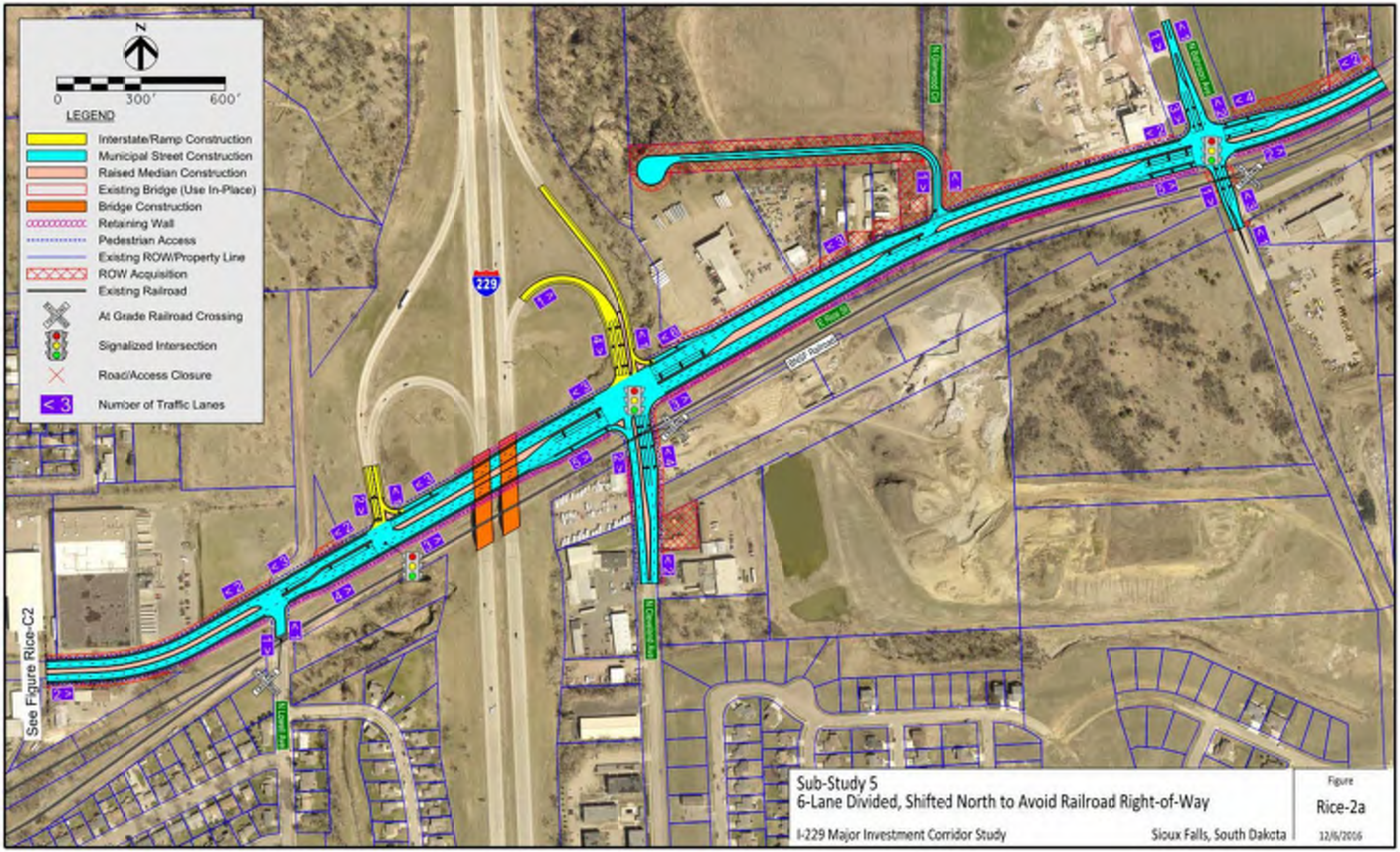
Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
10th-2A	Single Point Urban Interchange, 6-Lane Divided Corridor	VERY GOOD	NEUTRAL	NEUTRAL	POOR	POOR	Eliminate Property impacts, environmental impacts, and cost
10th-2B	Single Point Urban Interchange, 4-Lane Divided Corridor	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL	Advance
10th-2C	Single Point Urban Interchange, 5-Lane Undivided Corridor	GOOD	NEUTRAL	NEUTRAL	GOOD	GOOD	Advance

CONCEPT EVALUATION RESULTS 10TH STREET (cont.)

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
10th-5A	Diverging Diamond Interchange, 6-Lane Divided Corridor	VERY GOOD	GOOD	NEUTRAL	POOR	POOR	**Eliminate** Property impacts, environmental impacts, and cost
10th-5B	Diverging Diamond Interchange, 4-Lane Divided Corridor	GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
10th-5C	Diverging Diamond Interchange, 5-Lane Undivided Corridor	GOOD	GOOD	NEUTRAL	GOOD	GOOD	**Advance**
10th-9A	Tight Split Diamond, 6th St/10th St with 4-Lane Divided Corridor	NEUTRAL	POOR	POOR	NEUTRAL	POOR	**Eliminate** Environmental impacts, cost, and lower traffic & safety benefits
10th-9B	Tight Split Diamond, 6th St/10th St with 5-Lane Undivided Corridor	NEUTRAL	POOR	POOR	GOOD	NEUTRAL	**Eliminate** Environmental impacts and lower traffic & safety benefits
10th-Var							**Advance**

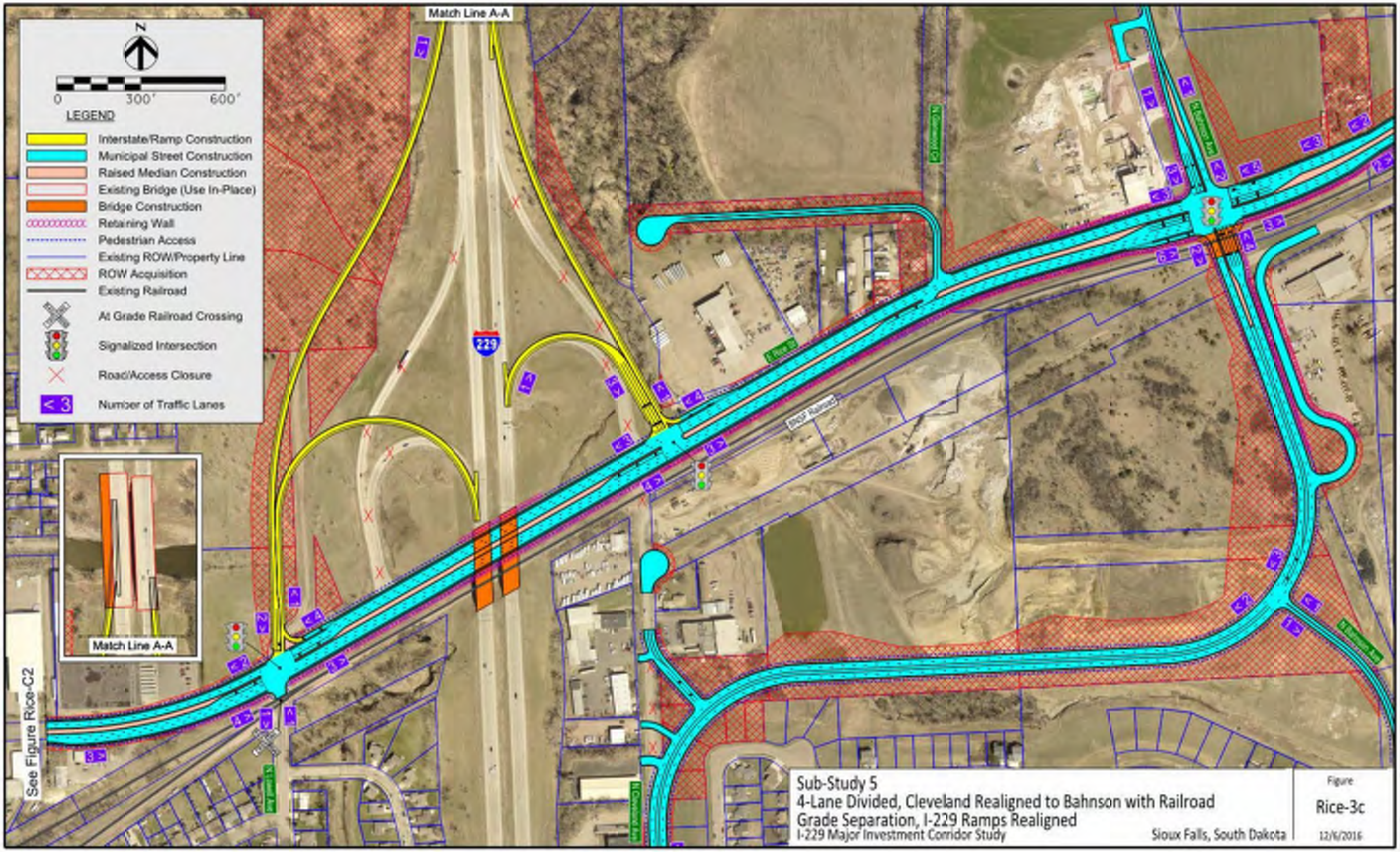
CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – 2A



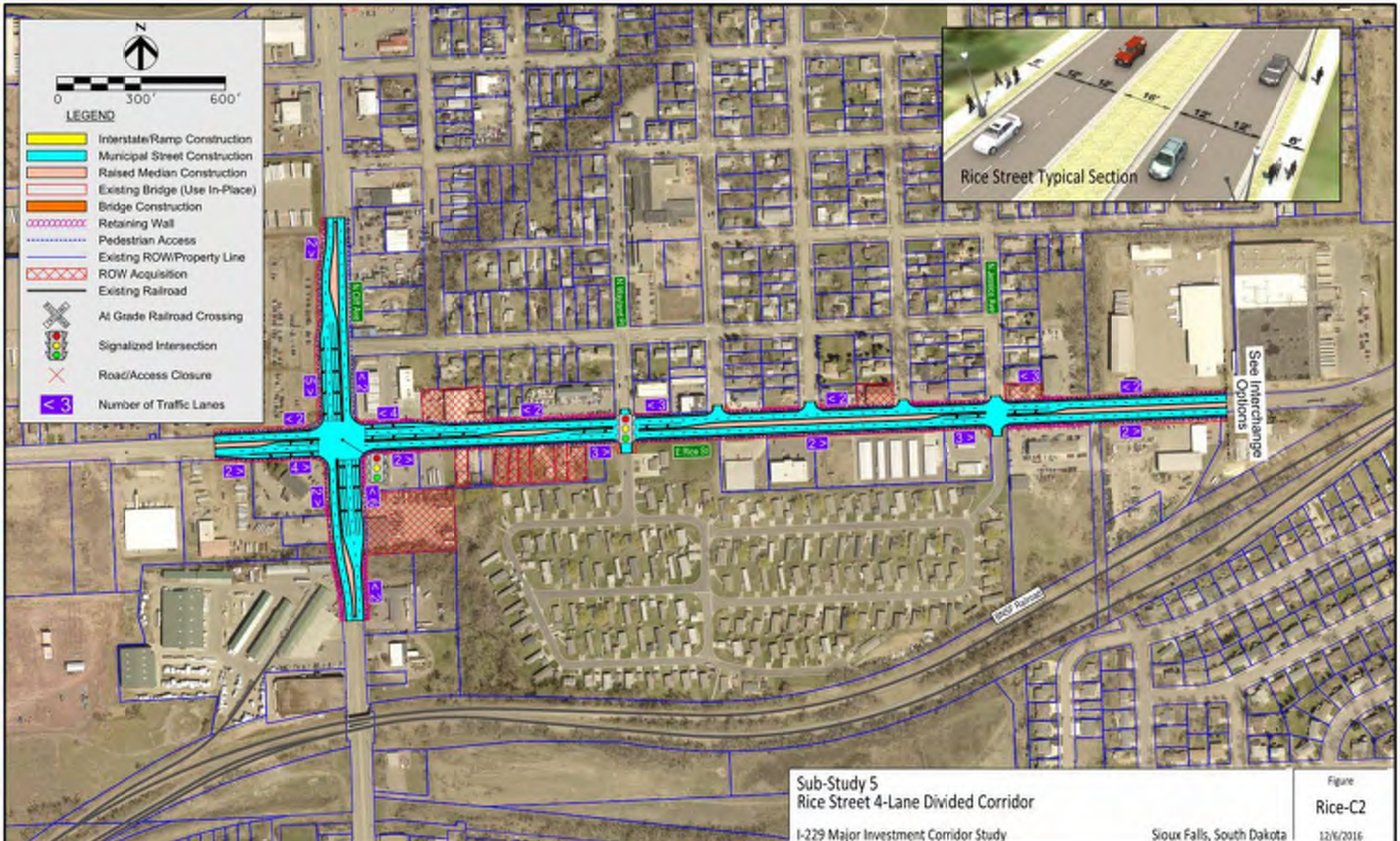
CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – 3C



CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – C2



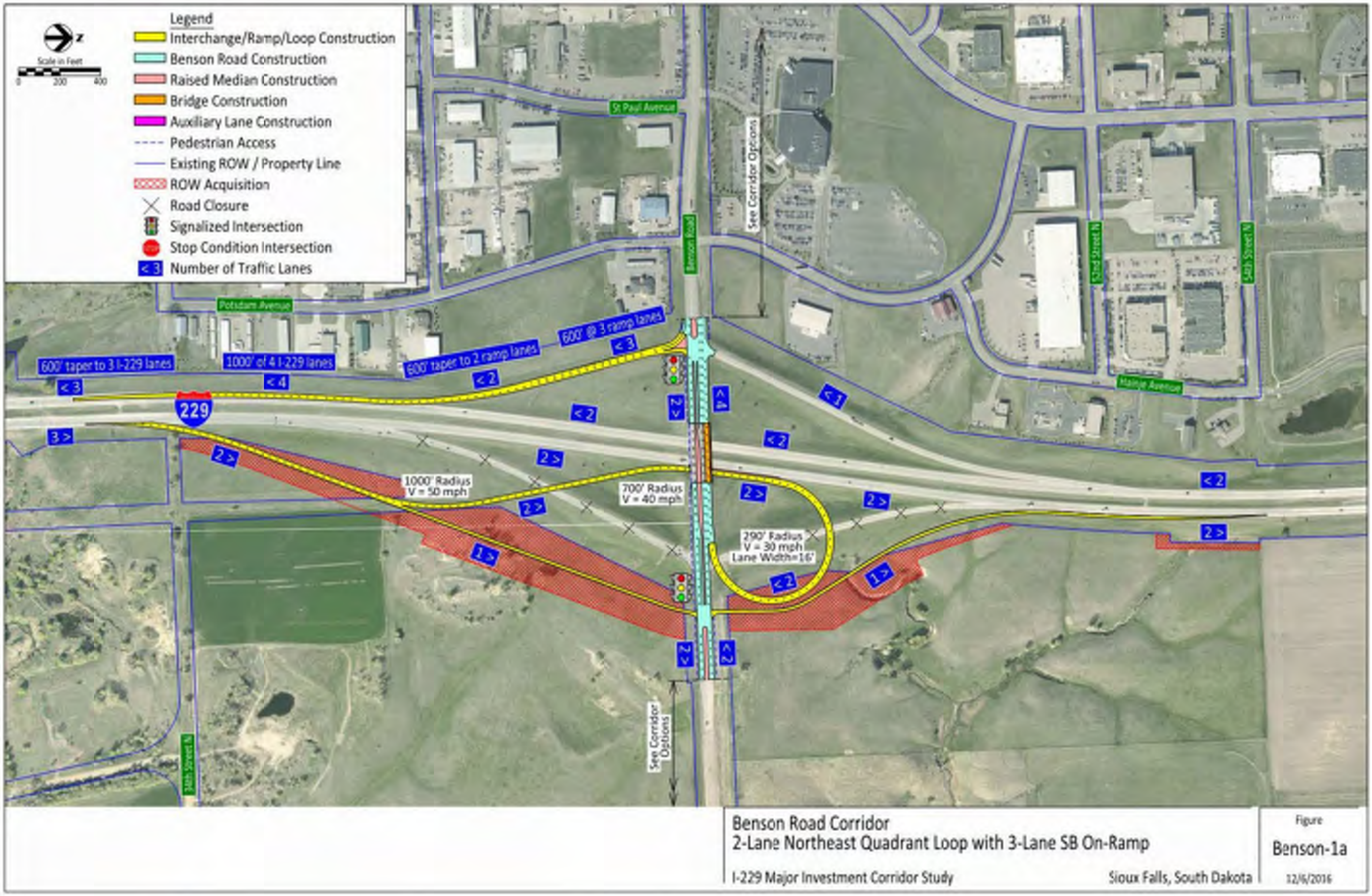
CONCEPT EVALUATION RESULTS

RICE STREET

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
Rice-2	6-Lane Divided	VERY GOOD	GOOD	NEUTRAL	GOOD	GOOD	Advance
Rice-2A	6-Lane Divided, Shifted North to Avoid Railroad Right-of-Way	VERY GOOD	GOOD	NEUTRAL	GOOD	GOOD	Advance
Rice-3C	4-Lane Divided, Cleveland Realigned to Bahnson with Railroad Grade Separation, I-229 Ramps Realigned	VERY GOOD	VERY GOOD	POOR	POOR	POOR	Advance

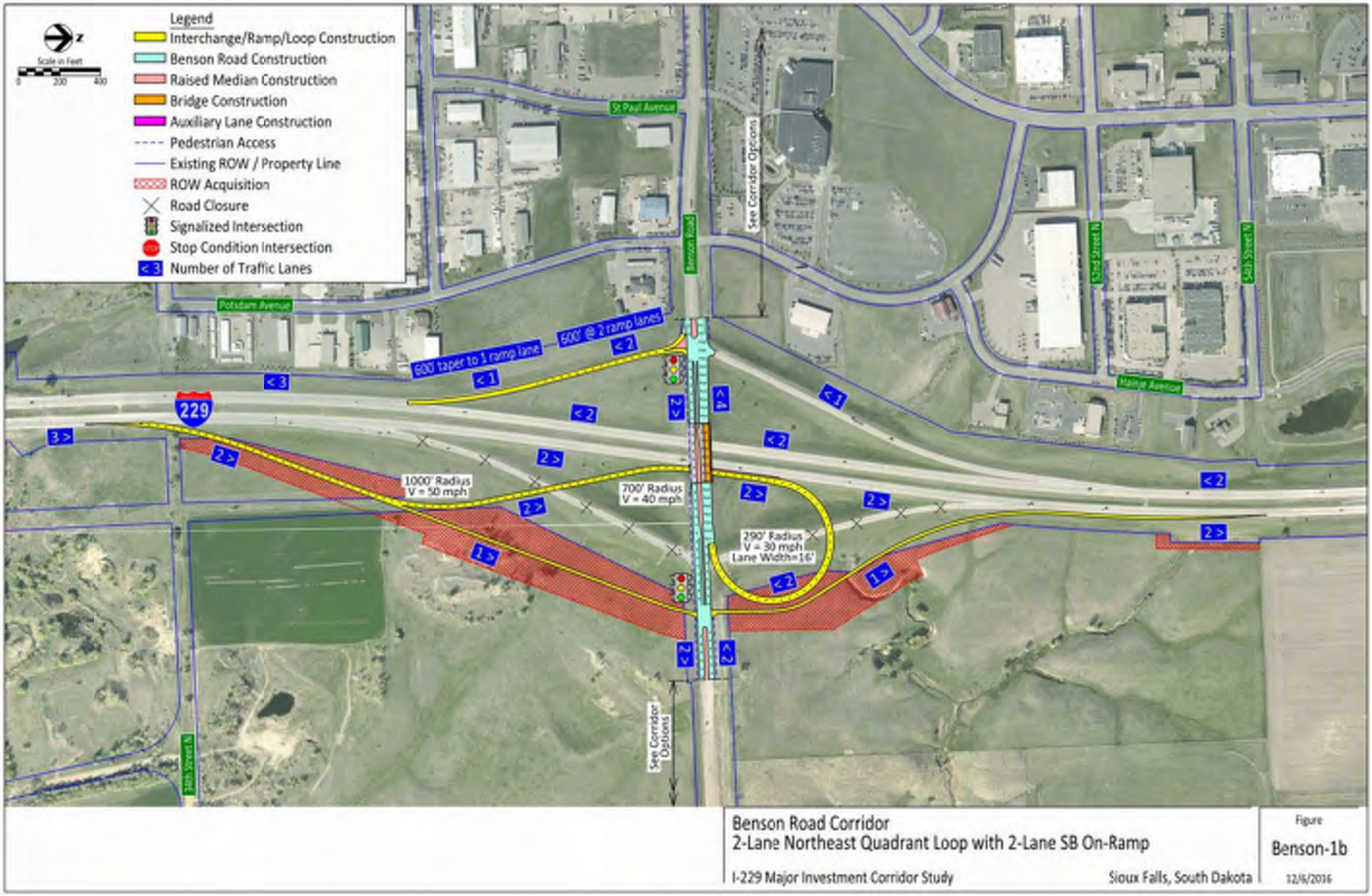
CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 1A



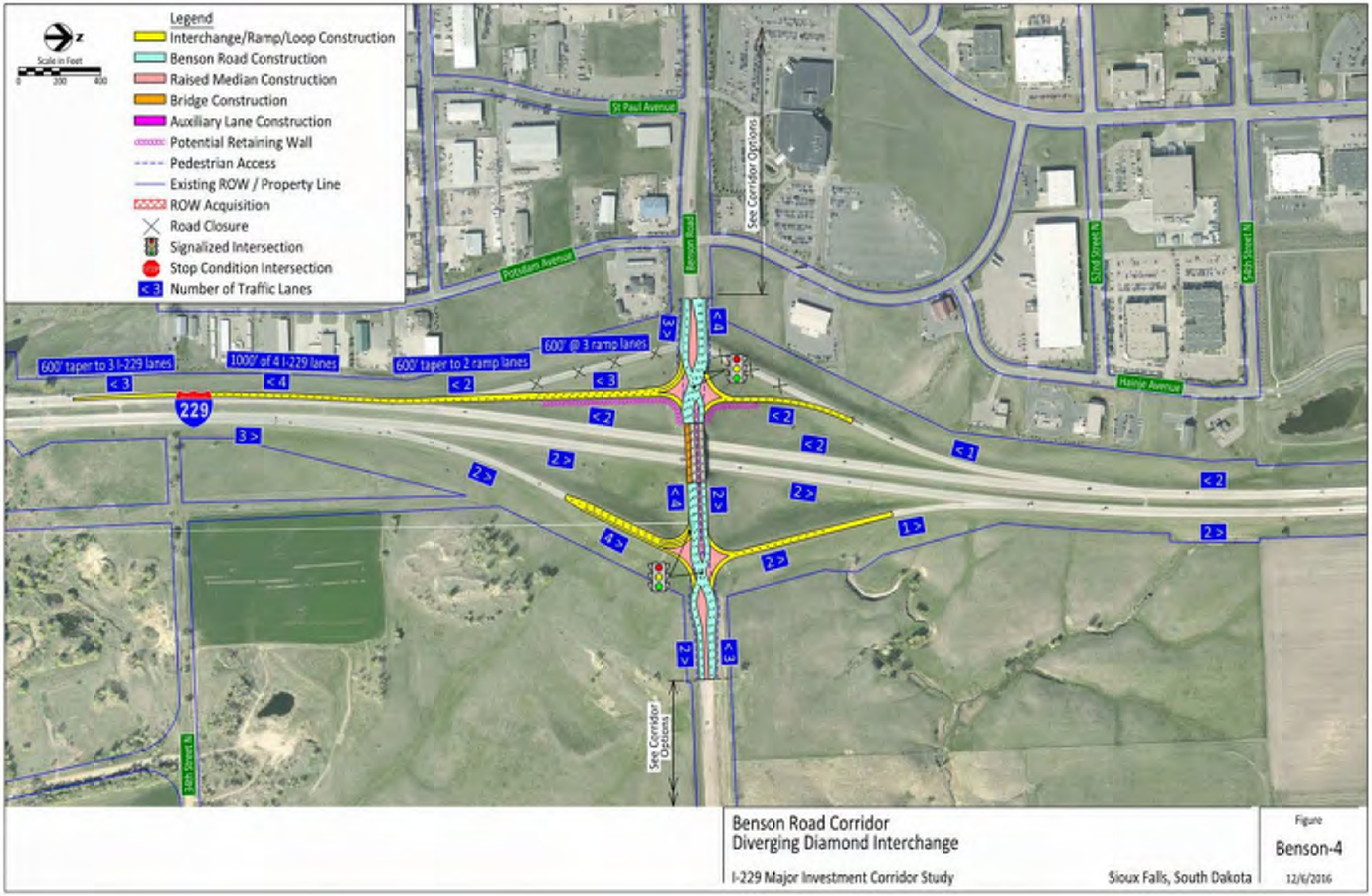
CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 1B



CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 4



CONCEPT EVALUATION RESULTS

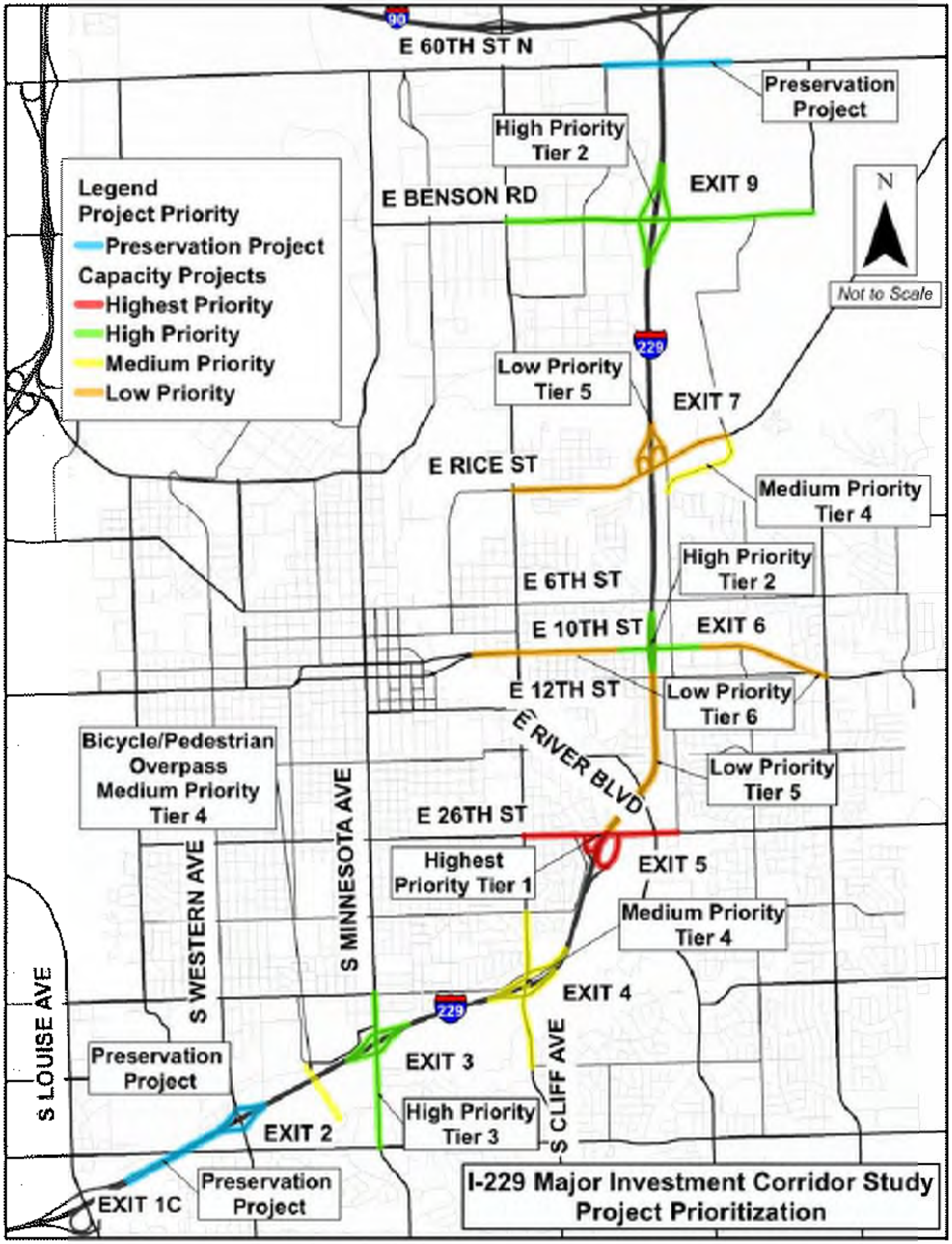
BENSON ROAD

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
Benson-1A	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	VERY GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	Advance
Benson-1B	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp	VERY GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	Advance
Benson-4	Diverging Diamond Interchange	NEUTRAL	VERY GOOD	GOOD	VERY GOOD	NEUTRAL	Advance

FUTURE I-229 CORRIDOR PROJECTS

PRELIMINARY PRIORITIZATION

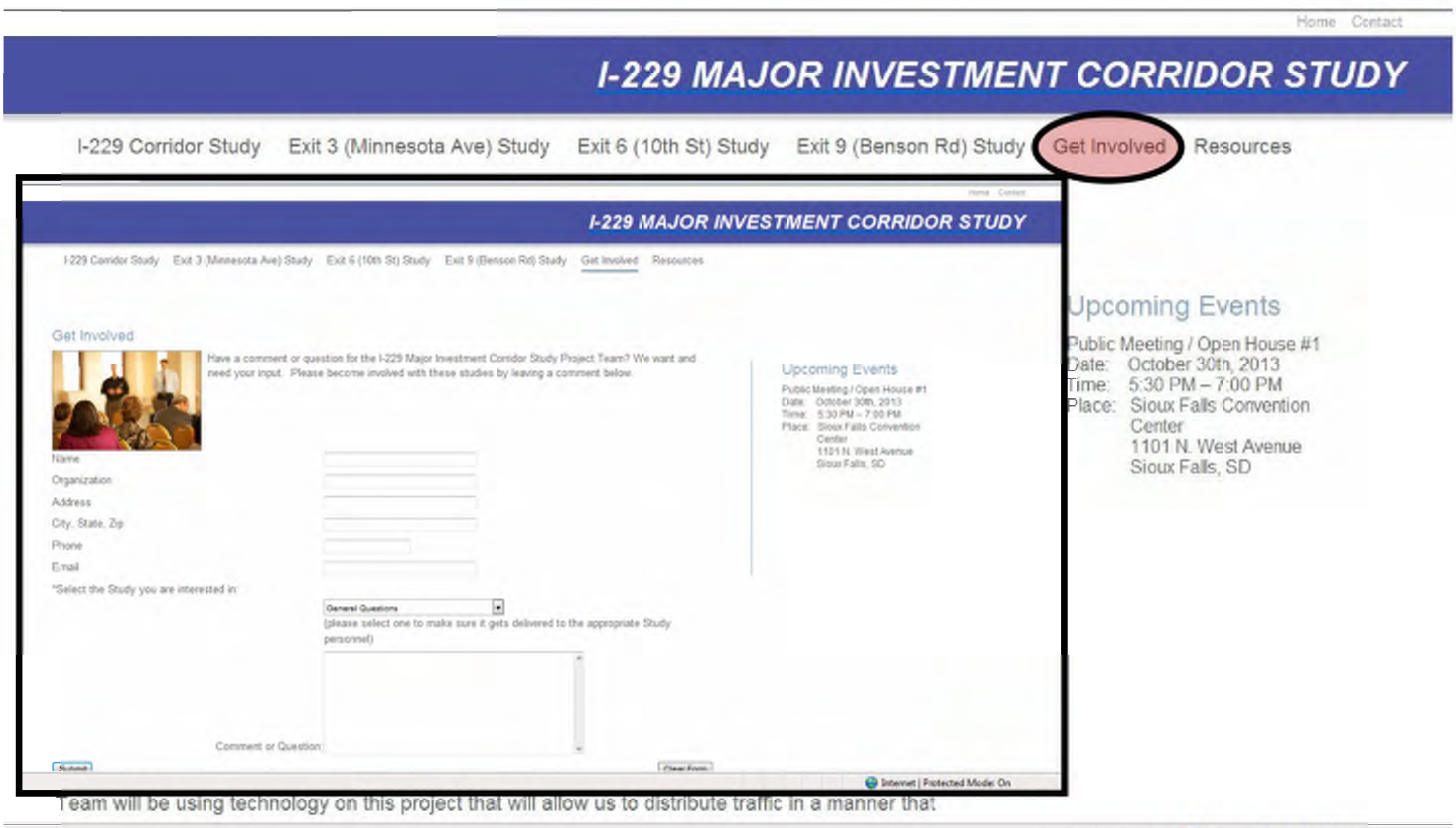
- Minnesota Avenue
- Cliff Avenue
- 10th Street
- Rice Street
- Benson Road
- Other projects list



NEXT STEPS

- Assemble Stakeholder and Public Comments
- SDDOT / City Finalize Project Priorities
- Complete Study Reports
- SDDOT / City Program Projects
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
    - Prepare Interchange Modification Justification Report and Environmental Document
    - Develop Project Design
    - Acquire Right of Way
    - Construction

WWW.I229STUDY.COM



PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Dave Meier – HDR Engineering, Inc.
402-399-1068 or dave.meier@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Thanks for attending!

HRGreen

APPENDIX -

STAKEHOLDER MEETINGS #1 –
DECEMBER 15TH & 16TH, 2014
JUNE 22ND, 2016 (CLIFF AVENUE & RICE STREET)

BENSON ROAD

DECEMBER 15TH, 2014

- **MEETING NOTES**
- **SIGN-IN SHEETS**
- **POWERPOINT SLIDES**

Meeting Minutes

Project:	I-229 Major Investment Corridor Study; PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 4 (Benson Road from Cliff Avenue to Sycamore Avenue)
Date:	Monday, December 15, 2014
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	Paul Nikolas, Travis Dressen (SDDOT) Heath Hoftiezer, (City of Sioux Falls) Russ Robers (First National Bank) Jason Kjenstad, James Unruh (HDR)

Jason Kjenstad covered the PowerPoint slides (attached to meeting notes).

Follow-up discussion items included:

1. Existing Benson Road traffic observations:
   1.1 A.M. peak hour – Westbound traffic on Benson Road west of I-229 is heavy and limits access from the I-229 SB off-ramp and from driveways along Benson Road.
   1.2 P.M. peak hour – Eastbound traffic is heavy but flows reasonably well under normal traffic conditions (if there is no traffic diverted from other areas).
   - The EB to SB movement at the I-229 SB on-ramp is at capacity.
   - There is a high volume of left turning traffic from Potsdam Avenue to Benson Road. It is difficult for this traffic to find gaps in the Benson Road traffic.

   1.3 Off-peak periods – The Lewis Avenue/Benson Road intersection is busy but not congested.

2. Existing I-229 traffic observations
   2.1 Traffic coming from the on-ramps tends to merge into I-229 traffic before getting up to adequate speeds rather than staying in the auxiliary lane. The worst location for this is the 26th Street SB on-ramp where the ramp traffic speeds are slow due to the tight ramp curve. It was noted that the preferred 26th Street interchange configuration will improve this condition.
   2.2 At 10th Street, the trucks turning from the SB off-ramp to EB 10th Street make the turn through the single point intersection slowly and cause the SB off-ramp traffic to back up to I-229 during peak hour traffic. Hoftiezer noted that this is partly due to how the loop detectors sense the truck traffic.

3. Existing geometric constraints
   3.1 The south leg of the Lewis Avenue intersection is too narrow for the trucks that turn onto and off of Benson Road.

4. Benson Road improvement considerations
   4.1 If a 3rd WB lane is added from I-229 to Lewis Avenue, the Potsdam Avenue intersection may need to be right-in/right-out or a ¾ access condition with restriction of left-out movements. Potsdam traffic would re-route to Lewis Avenue. A signalized intersection along Lewis Avenue would be required to accommodate this traffic. Rob suggested that a signal may be most effective at 54th Street.
   4.2 A 3rd EB lane may be necessary from Lewis Avenue to I-229 with free-flow conditions for the SB on-ramp movement. Dual right turns at the SB on-ramp would require signalization and may reduce capacity in comparison to an unrestricted movement.

4.3 The forecast traffic volumes for the MIS project assume that Benson Road will be extended to the east from Sycamore Avenue across the Big Sioux River. The timeframe for this is not known.

5. I-229 improvement considerations
    5.1 60th Street access to/from I-229 would help divert traffic from Benson Road. It was noted the Federal Highway Administration limits the type of access at 60th Street due to the close proximity to I-90 to the north.
    5.2 Benson Road/I-229 ramp terminals will likely need to be signalized.
    5.3 Various interchange configurations are being considered for Benson Road. The configurations will be presented at the next public meeting.

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3610P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 15, 2014 5:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	James Unruh	HDR, Inc. 1300 S. Old Village Pl	605-977-7766	james.unruh@hdrinc.com
2	Jason Kjenstad			
3	Heath Hoftiezer	City of Sioux Falls		
4	Paul Nikolas	SDDOT		
5	Travis Dressen	SDDOT		
6	Russ Robers First Nat'l Bank	1901 E. Benson Rd SF SD 57104	605-782-5801	rerobers@fnbsf.com
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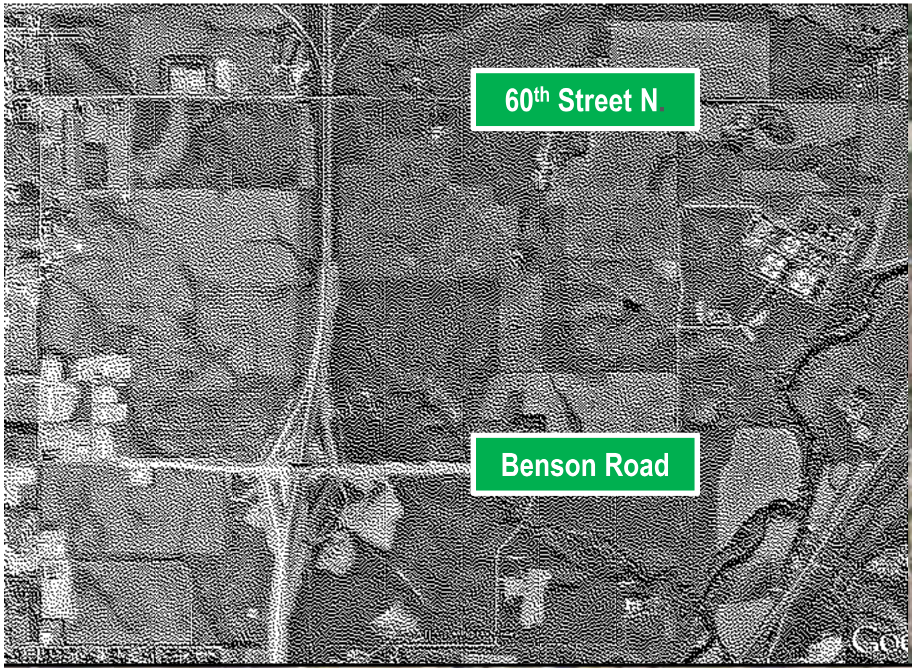


Interstate 229 Major Investment Study

Exit 9 – Benson Rd

Stakeholder Meeting
December 15th, 2014
5:30 pm to 6:30 pm

HDR

HRGreen

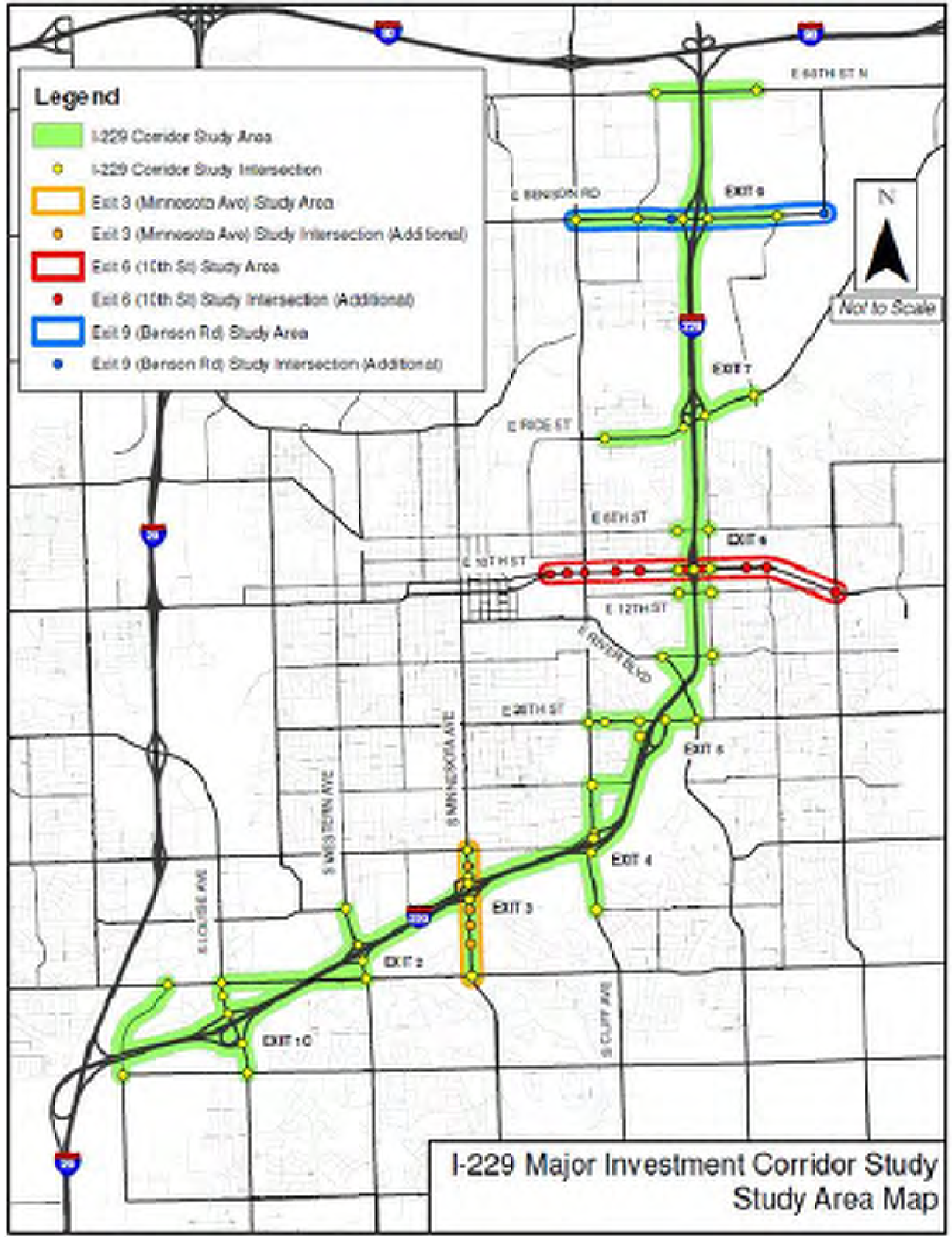
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

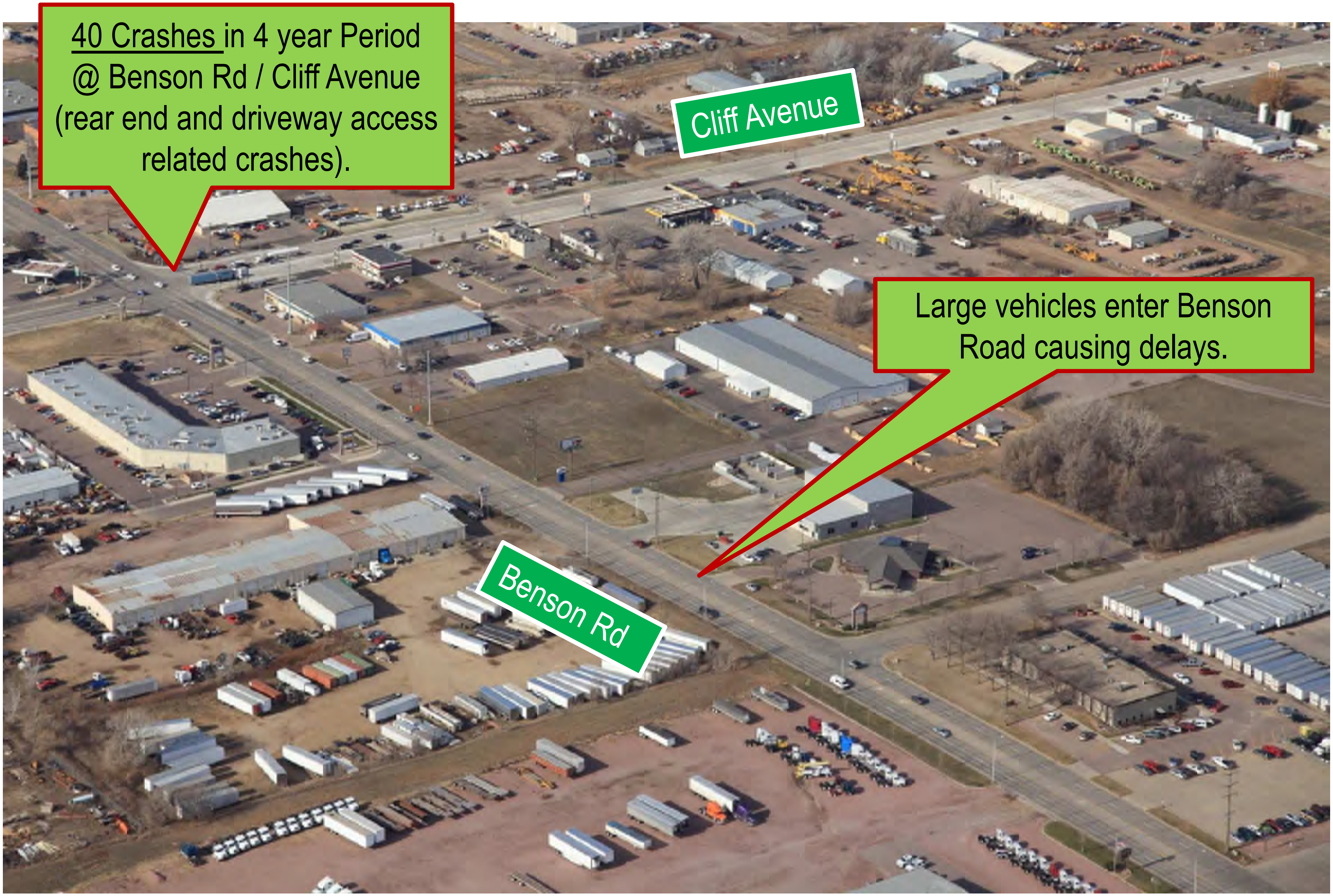
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

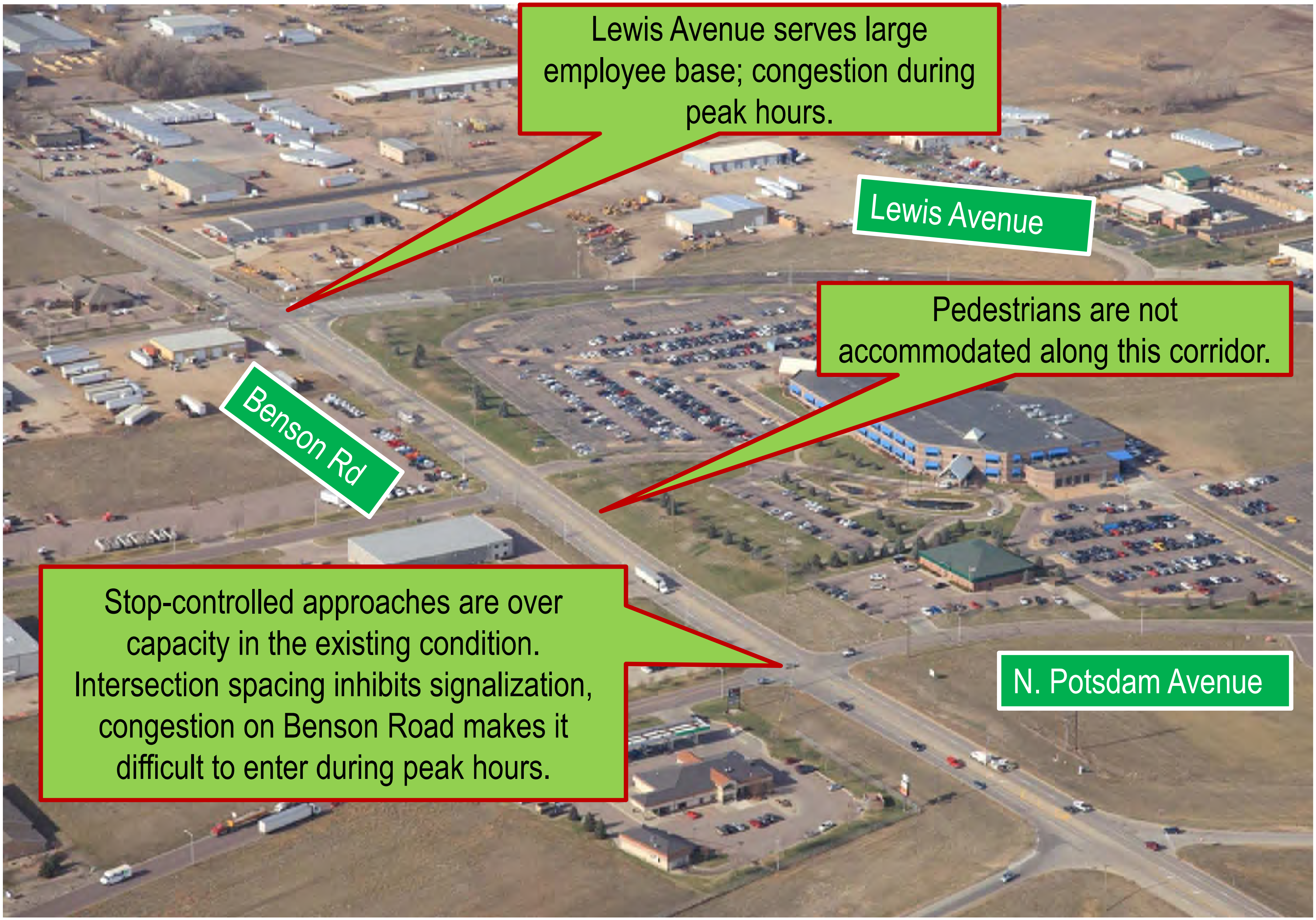
Exit 9 (Benson Road) Crossroad Study Goals

- Reduce traffic congestion at NB on/off interchange ramp terminal
- Develop Corridor Growth Plan to meet traffic demands from development taking place east of I-229
- Improve pedestrian mobility
- Make recommendations to improve corridor intersections
- Develop interchange alternatives to meet future traffic demands

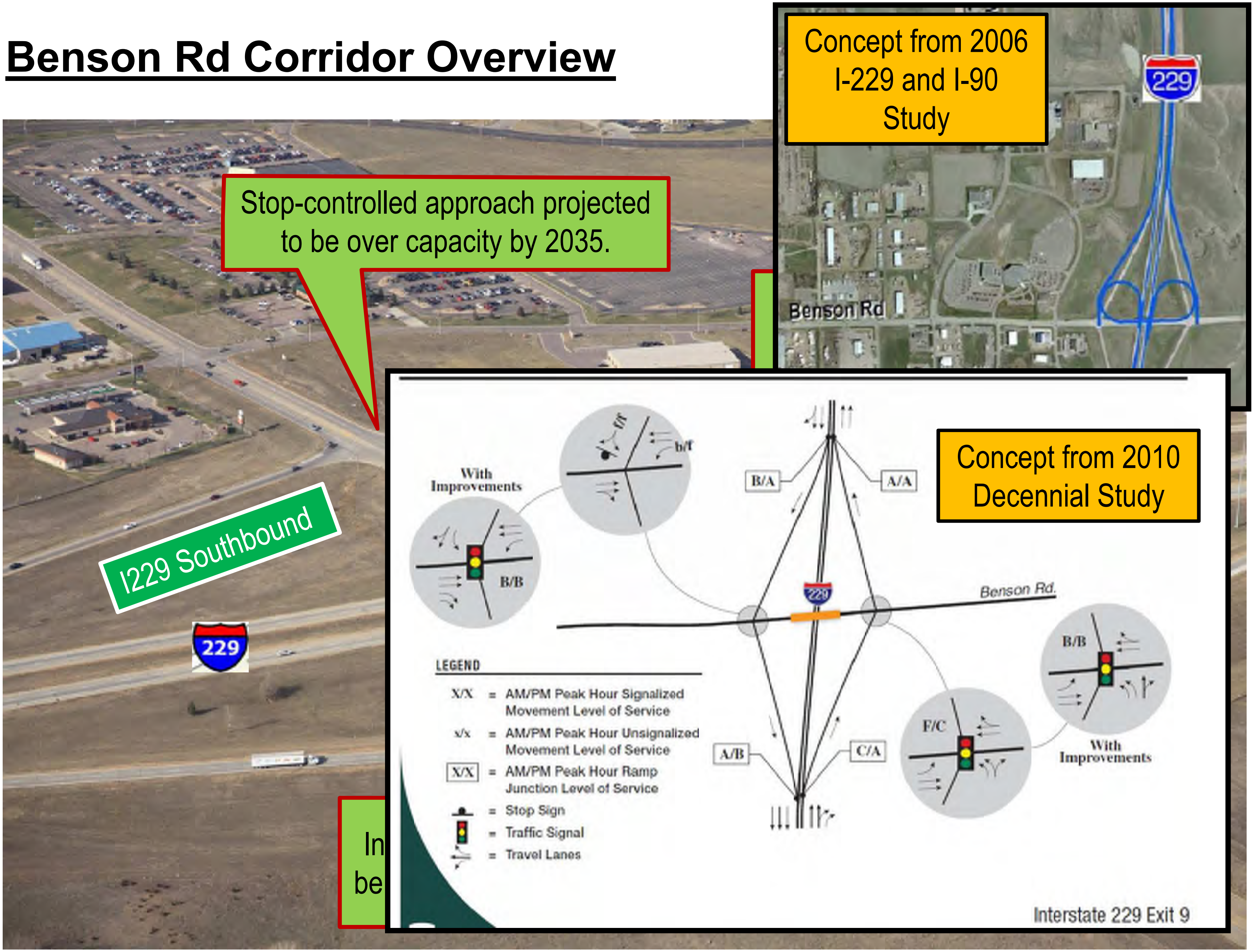
Benson Rd Corridor Overview



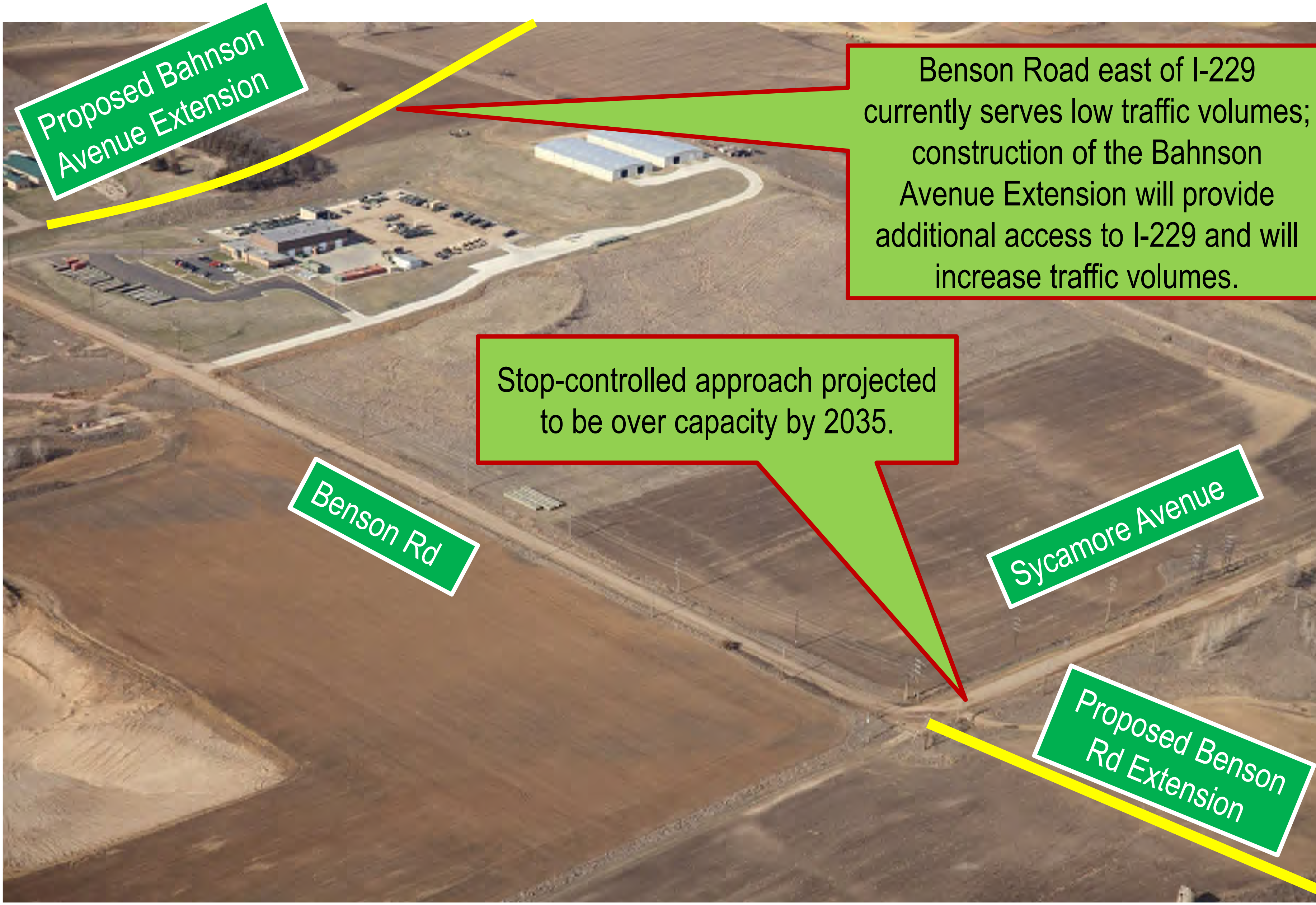
Benson Rd Corridor Overview



Benson Rd Corridor Overview



Benson Rd Corridor Overview



PROJECT CONTACTS:

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James Unruh – HDR Engineering, Inc.
605-977-7740 or james.unruh@hdrinc.com

Shannon Ausen – City of Sioux Falls
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Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 9 – Benson Rd

Thanks for Attending!!!!!

HDR

HRGreen

10TH STREET

DECEMBER 16TH, 2014

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES

Meeting Minutes

Project:	I-229 Major Investment Corridor Study; PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 3 (10th Street from Downtown Viaducts to Sycamore Avenue)
Date:	Tuesday, December 16, 2014
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See attached Sign In sheets

Jason Kjenstad covered the PowerPoint slides (attached to meeting notes).

Follow-up discussion items included:

1. Existing 10th Street traffic observations:
   1.1 A.M. peak hour – Congestion on 10th Street in vicinity of interchange, WB through traffic queues can be obsessive from Cleveland to Hy-Vee.
   1.2 P.M. peak hour – Congestion on 10th Street in vicinity of interchange, WB & EB through traffic queues can be obsessive near I-229. High demand for turning traffic at 10th and Cleveland causes signal coordination issues with the I-229 interchange. Traffic queues on the interchange ramps are a concern.
2. Existing I-229 traffic observations
   2.1 Interchange congestion is noticed during the AM and PM peak hours.
   2.2 Crashes on the NB off ramp at 10th Street a problem, has been better since SDDOT lengthened ramps onto the mainline.
3. Existing geometric constraints
   3.1 The 10th Street and I-229 Single Point Urban Interchange is restricted to single lefts in lieu of dual lefts which is a capacity limitation and leads to additional single lane queuing.
   3.2 Proper queue lengths are not provided at 10th Street and Cleveland causing overlaps with I-229 and 10th Street.
   3.3 10th and Sycamore was a high crash intersection due to the horizontal curvature, 2014 the intersection was reconstructed that changed all the lefts to dual movements that are protected movements. This will remove the crash trends.
4. 10th Street improvement considerations
   4.1 Place a raised median to improve traffic flow by removing conflict locations
   4.2 Possibility widen to 6 lanes to increase capacity
   4.3 Develop interchange alternatives that improve traffic flow a ¼ mile either side of I-229
   4.4 Restrict turning movements at specific intersections to improve traffic flow
5. I-229 improvement considerations
   5.1 Various interchange configurations are being considered for Minnesota Avenue. The configurations will be presented at the next public meeting.
   5.2 Add an additional lane from 26th Street to 10th Street on I-229 to provide increased capacity.

hdrinc.com 6300 S. Old Village Place, Suite 100, Sioux Falls, SD 57108-2102
(605) 977-7740

The following notes were gathered during the discussion with the adjacent landowners and business owners. The statements below are questions asked by the meeting attendees for us to consider as we develop options:

- Biggest problems with 10th St traffic operations are during morning and afternoon peak hours.
- Need to get commuters to use 6th St, 12th St and 18th St to access downtown to relieve 10th St.
- Would raising the posted speed limit on 10th St help traffic flow?
- Why was the traffic signal installed at Lowell?
- 10th St should be widened only at the I-229 interchange.
- Constructing medians slow businesses down.
- If there were ramps from I-229 to 6th and 12th those streets would be viable alternatives to 10th for downtown access. More exists on I-229 would be a cheaper investment than elevated lanes on 10th.
- At Cleveland, traffic from the north is the problem.
- Widening on Cleveland should be done on the east side.
- Relocate Old Home (from the east side of Cleveland).
- A median on Cleveland is not the answer.
- Improvements made at 10th and Sycamore was a good project.
- Relocate the Pizza Hut.
- I-229 should be connected to River Blvd with ramps.
- 6th St should be used instead of 12th St for a split diamond interchange with 10th St.
- Westbound to southbound left turns from 10th St to Cleveland are difficult to make.

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(37) 3616P, PCN 044K — **Project No.:** 207030

Meeting Date Tuesday, December 16, 2014 3:30 PM — **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	HERSIL PATEL	2616 E 10TH STREET SIOUX FALLS SD 57103	605 338 3381	gm@super8siouxfalls.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3516P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 16, 2014 3:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Tami Johnson	Casey's General Store - 1901 East 10th St.	515 571-7184	jajrtpb30@gmail.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3016P, PCN 044K — **Project No.:** 207030

Meeting Date Tuesday, December 16, 2014 3:30 PM — **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Gary Busselman	SF SD 57110 7201 E Madison ST	605 334 5692	gary@garybuss.com
2	CHUCK GUSTAFSON	705 E. RIDGE RD SFSD 57105	332-1000	CGUSTAFSON@mac.com
3	Travis Dressen	SF Area DOT	367 5680	travis.dressen@state.sd.us
4	Lynn Breaty	2520 W. 31st St SF SD 57104	339-1053	lynn.bobprop@midcontinent.net
5	Shannon Ausen	224 [illegible] St	367 7607	sausen@siouxfalls.org
6	Gayle Nelson	2901 S Bahnson 57103	366-5782	DEKDAD@AOL.com
7	Layton Manke	301 S. Blaine	338 2206	
8	Quality Efficiencies Linda Hake	3503 S Norton Ave Sioux Falls, SD 57105	339-3382	[illegible].com
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Interstate 229 Major Investment Study

Exit 6 – 10th Street

Stakeholder Meeting
December 16th, 2014
3:30 pm to 4:30 pm

HRGreen

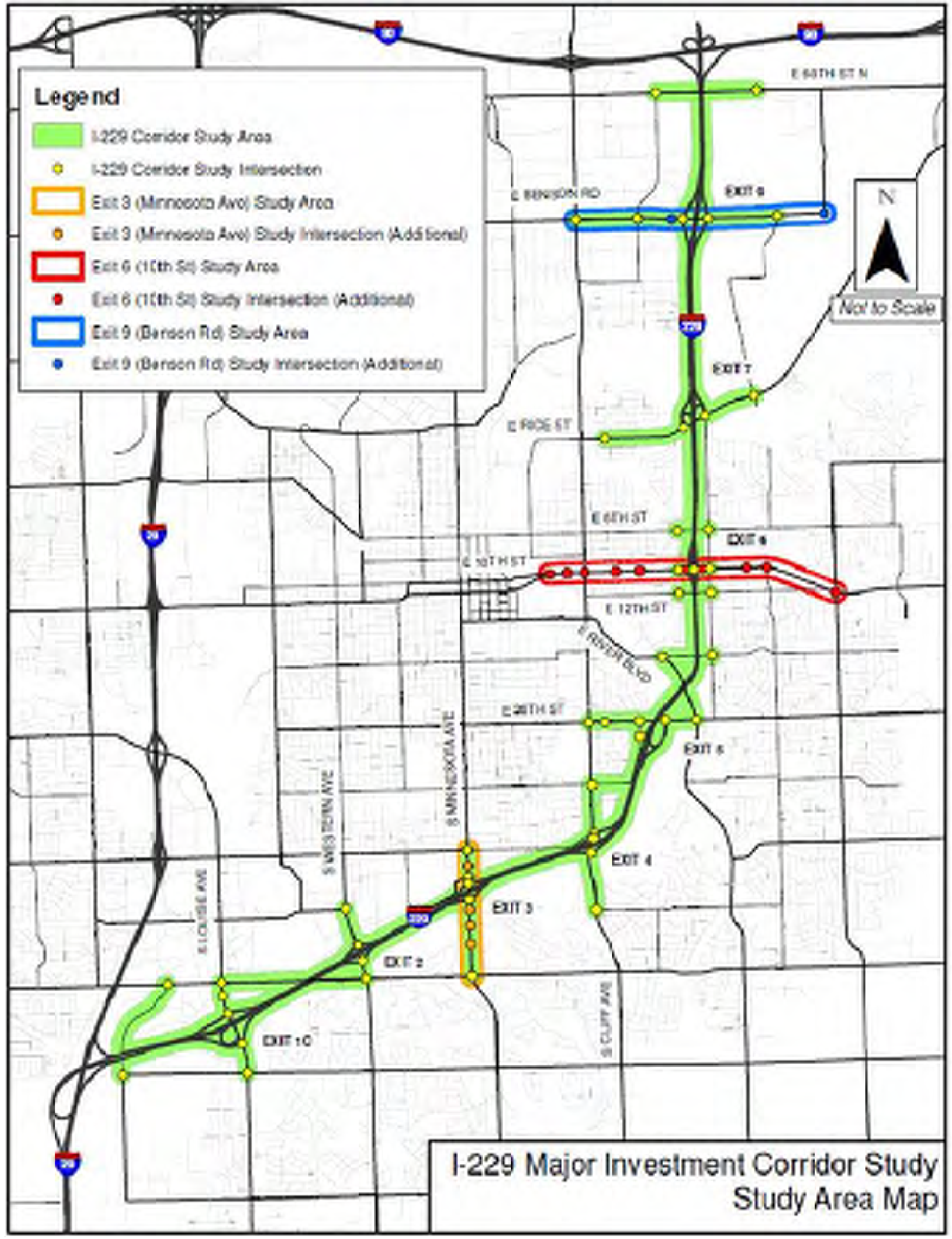
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

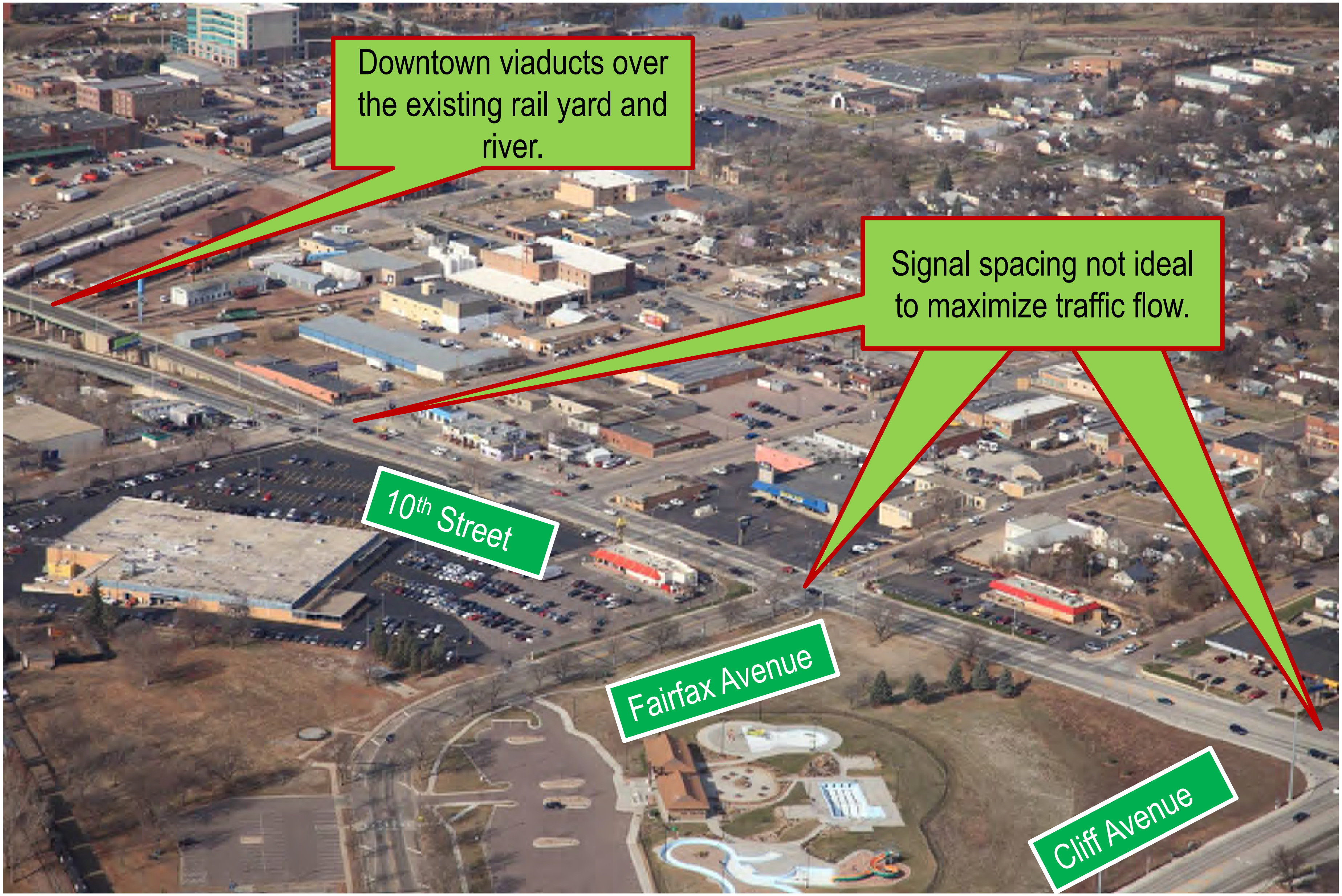
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

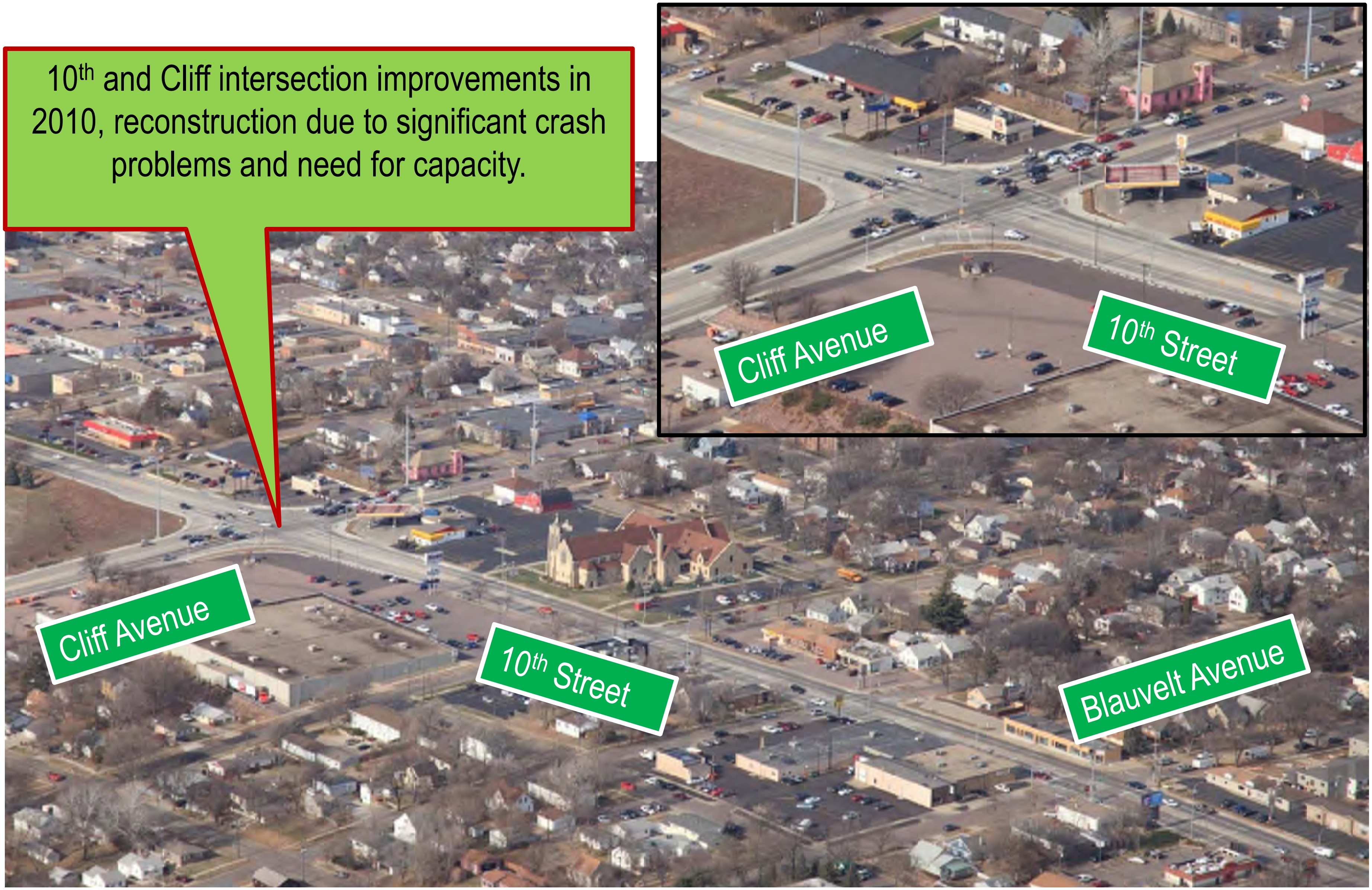
Exit 6 (10th Street) Crossroad Study Goals

- Reduce traffic congestion
- Develop Corridor Growth Plan to meet traffic demands but minimizing impacts to developed properties
- Improve pedestrian mobility
- Improve safety for corridor users
- Identify improvements to the interchange as well as the 10th Street and Cleveland Ave intersection

10th Street Corridor Overview

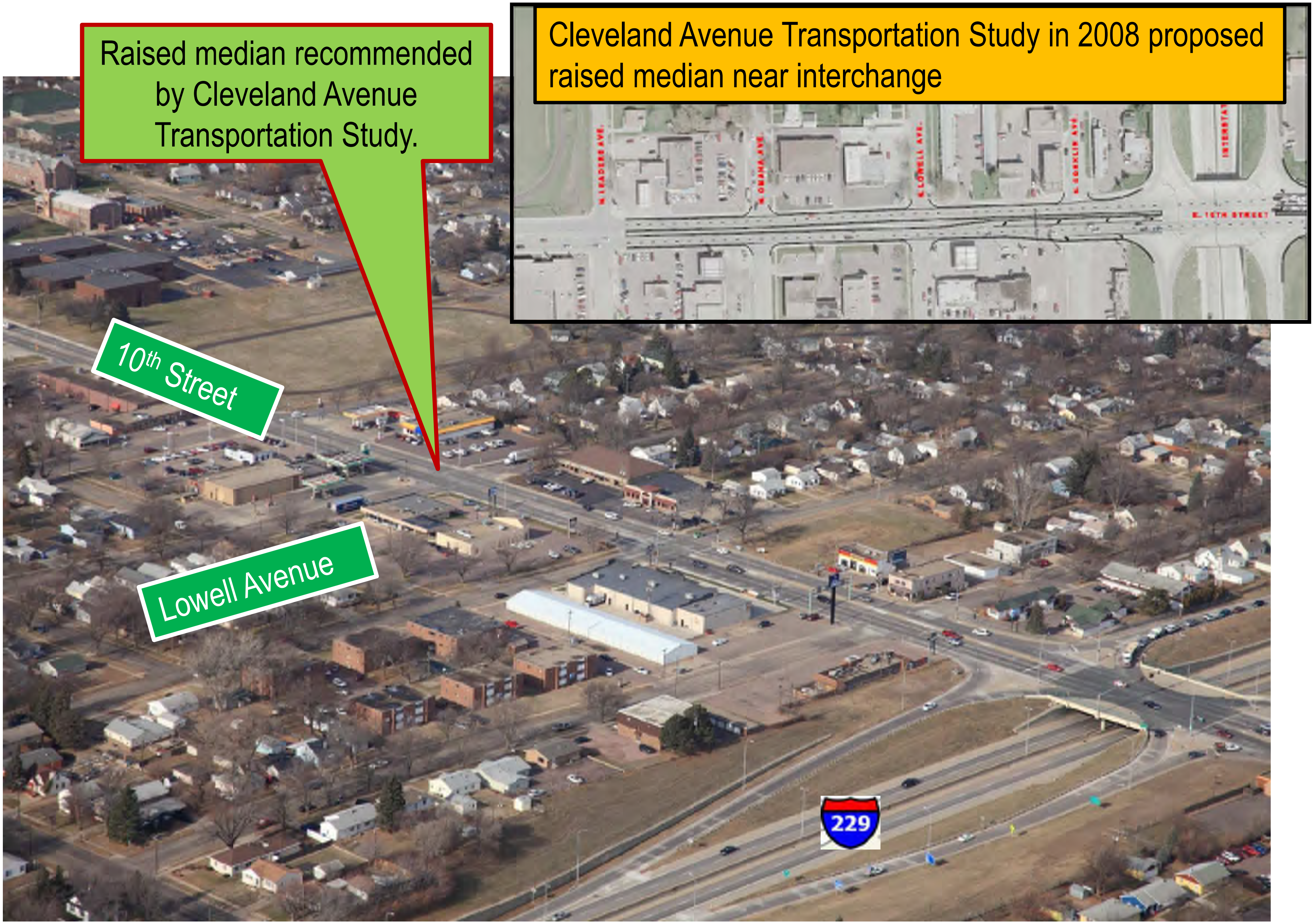


10th Street Corridor Overview

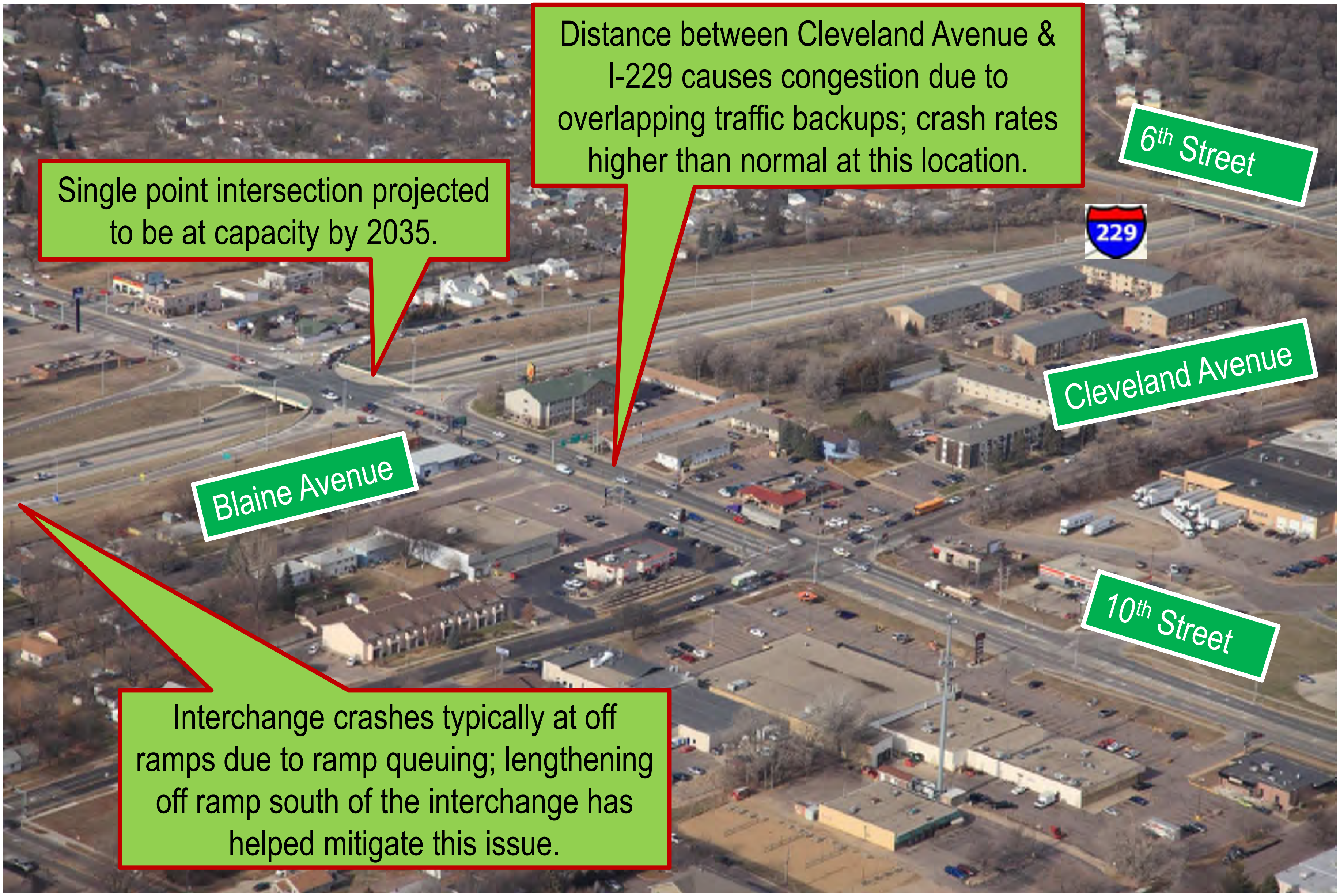


10th Street Corridor Overview

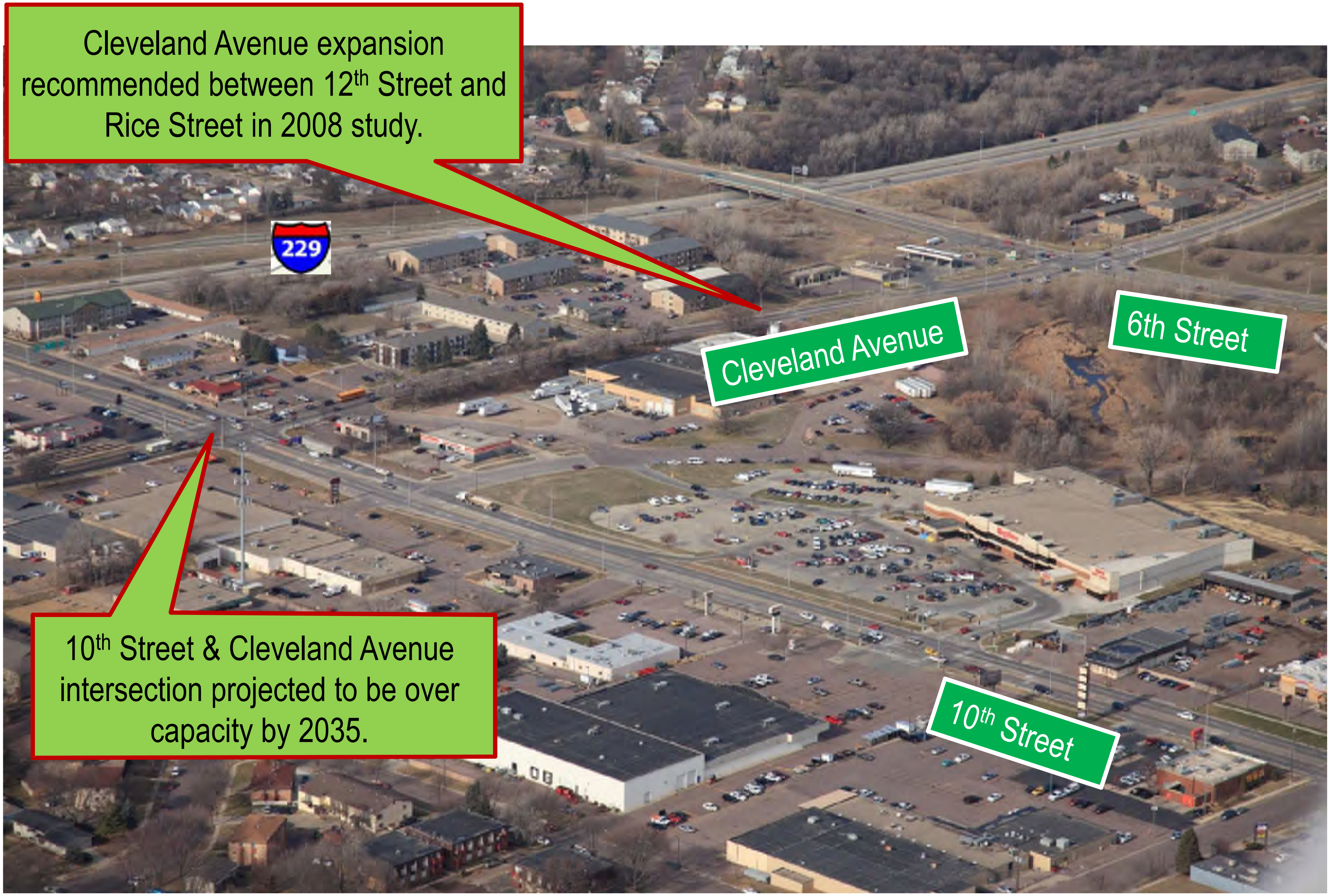
10th Street Corridor Overview



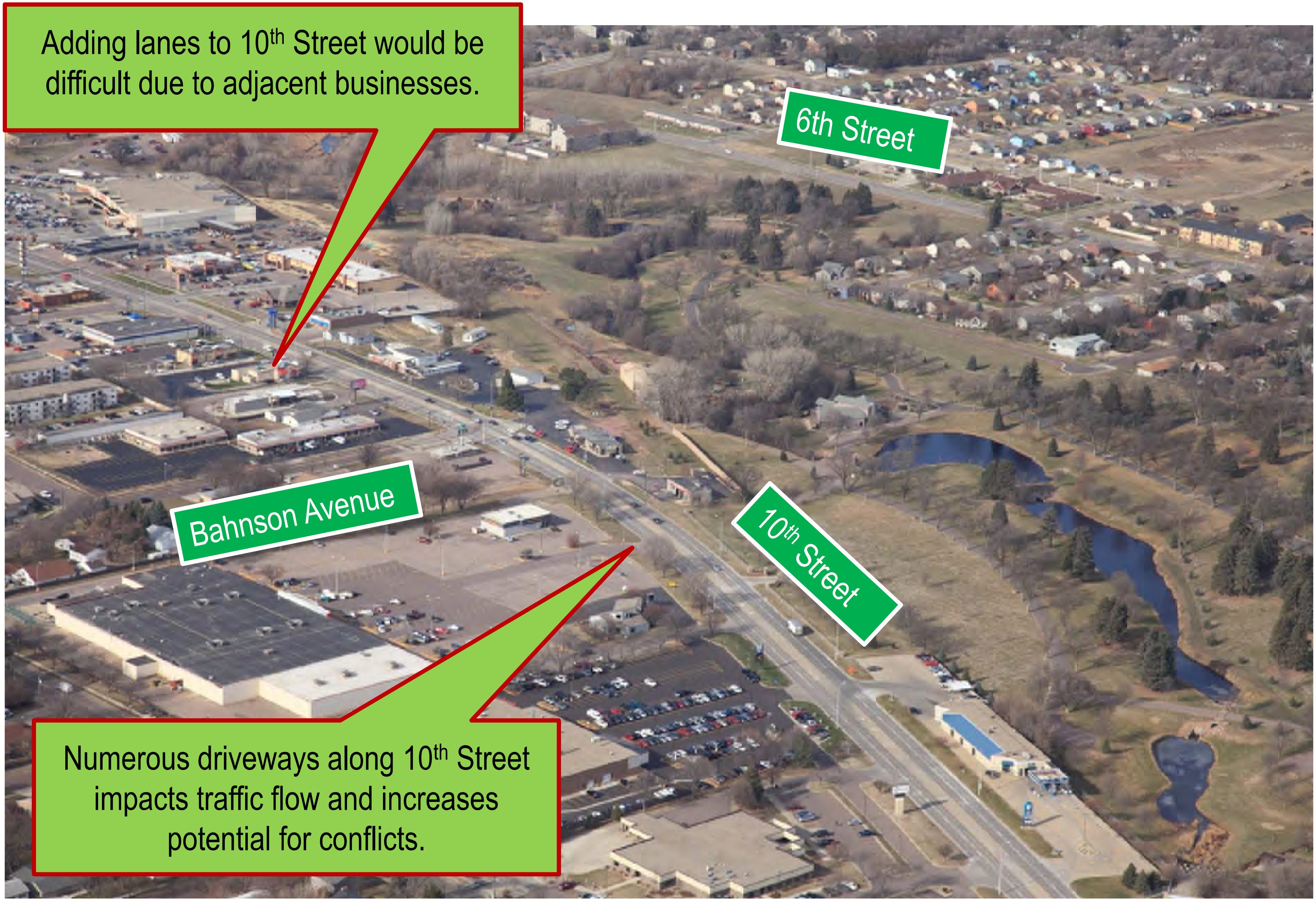
10th Street Corridor Overview



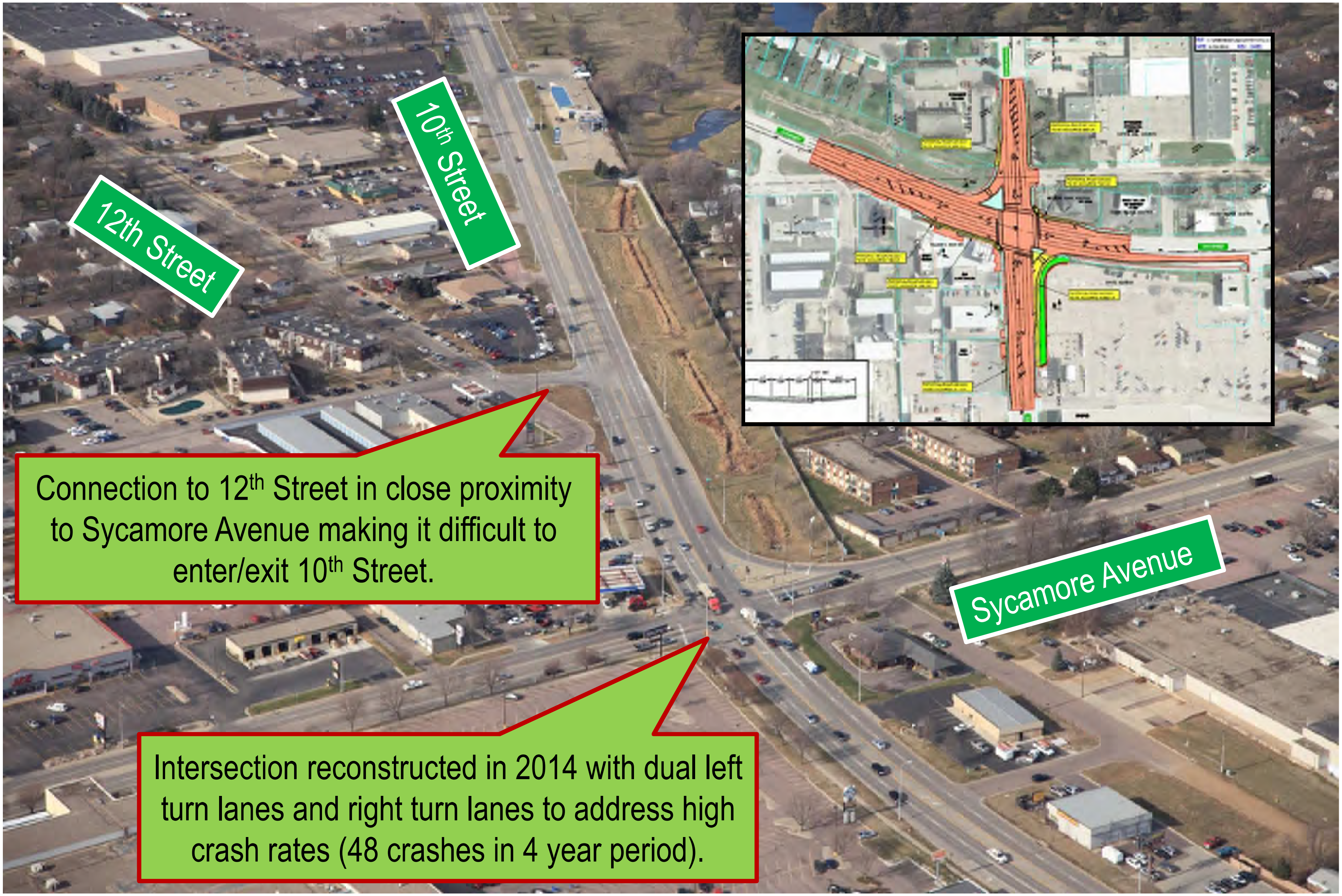
10th Street Corridor Overview



10th Street Corridor Overview

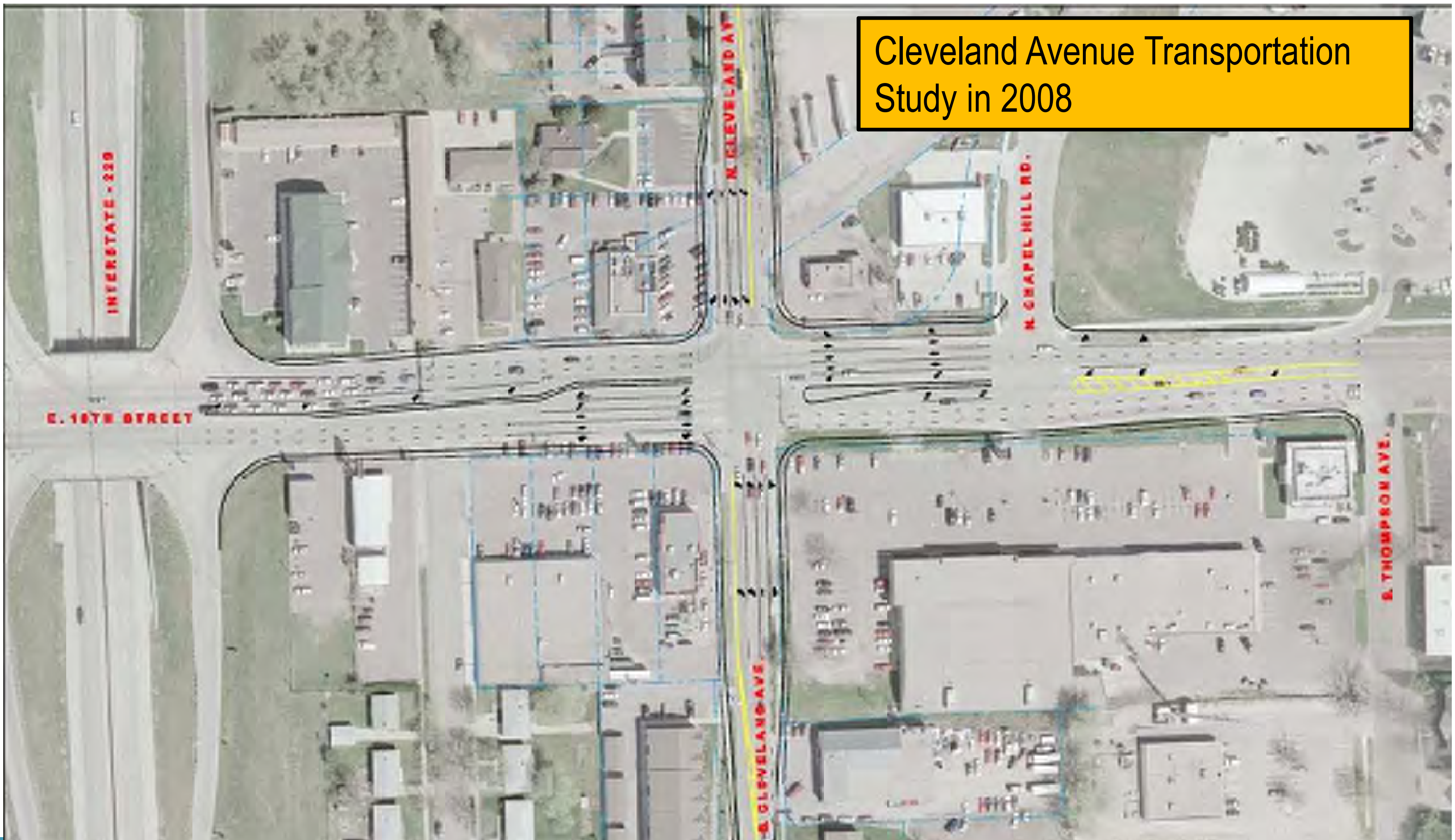


10th Street Corridor Overview



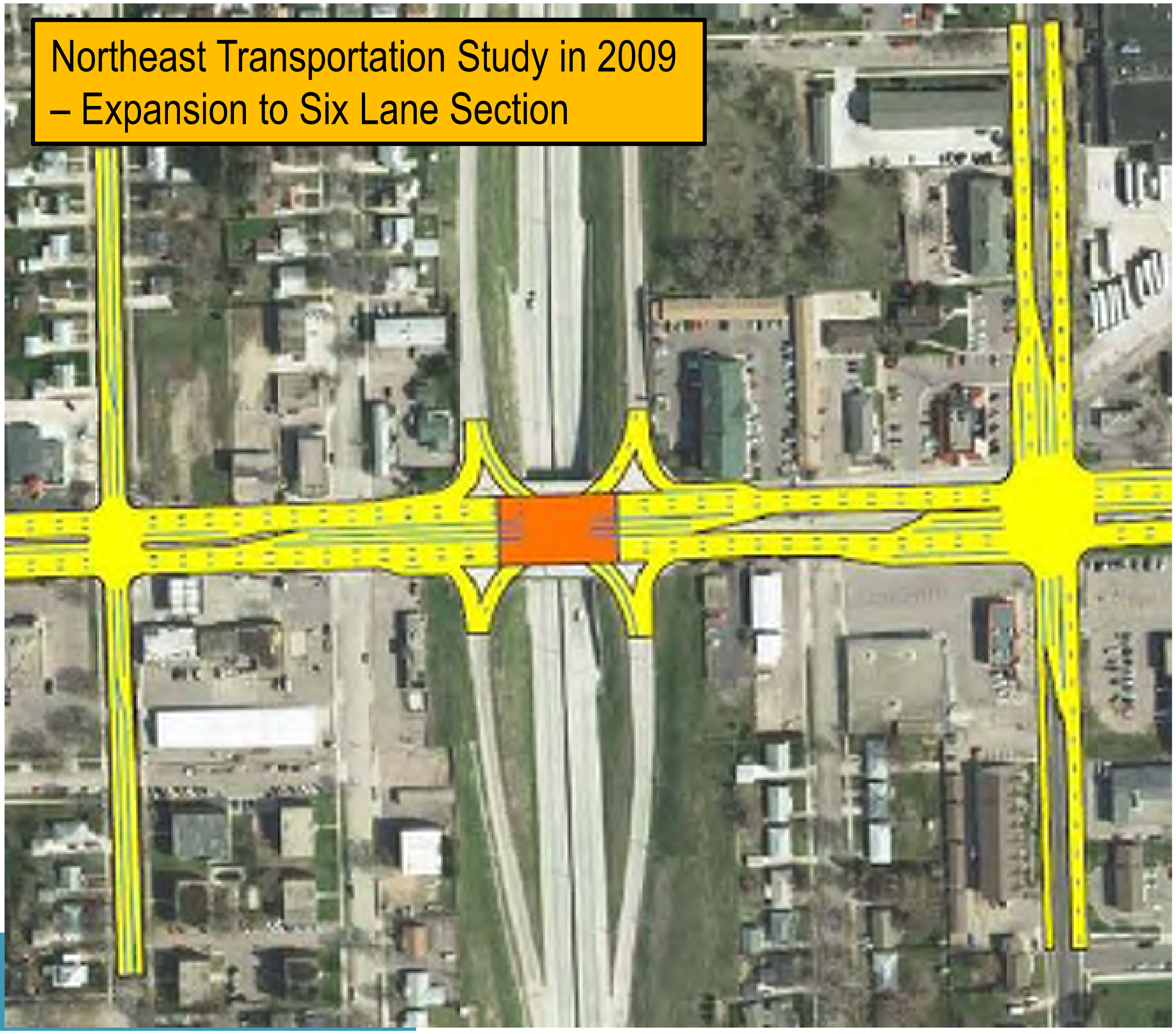
Previous Study Ideas for 10th Street Corridor

- **Cleveland Ave. Transportation Study**



Previous Study Ideas for 10th Street Corridor

- **Northeast Transportation Study**



Previous Study Ideas for 10th Street Corridor

- Northeast Transportation Study

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Chris Malmberg – HDR Engineering, Inc.
402-399-4959 or chris.malmberg@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 6 – 10th Street

Thanks for Attending!!!!!

HRGreen

MINNESOTA AVENUE

DECEMBER 16TH, 2014

- **MEETING NOTES**
- **SIGN-IN SHEETS**
- **POWERPOINT SLIDES**

Meeting Minutes

Project:	I-229 Major Investment Corridor Study; PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 2 (Minnesota Ave from 57th Street to 41st Street)
Date:	Tuesday, December 16, 2014
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See attached Sign In sheets

Jason Kjenstad covered the PowerPoint slides (attached to meeting notes).

Follow-up discussion items included:

1. Existing Minnesota Avenue traffic observations:
   - 1.1 A.M. peak hour – NB traffic on Minnesota Queues at I-229 and 41st Street. 57th Street traffic queues on East approach (WB) at Minnesota Avenue.
   - 1.2 P.M. peak hour – SB traffic on Minnesota is extremely congested between 41st Street and I-229. The 49th Street extension is blocked due to this.
2. Existing I-229 traffic observations
   - 2.1 Traffic queues at the NB off ramp in both AM and PM peak hours and SB off ramp in the AM peak hour.
   - 2.2 Travel Time runs on I-229 indicate capacity is good on the mainline.
   - 2.3 Crashes are highly noticed along the NB off ramp.
3. Existing geometric constraints
   - 3.1 Driveway from Yankton trail park is a concern in relationship to the I-229 ramps
   - 3.2 Proximity of 49th Street extension in relation to interchange.
4. Minnesota Avenue improvement considerations
   - 4.1 Place a raised median to improve traffic flow by removing conflict locations
   - 4.2 Possibility widen to 6 lanes to increase capacity
   - 4.3 Develop interchange alternatives that work with the 49th Street extension location on Minnesota Avenue
   - 4.4 Possibility relocate Yankton Trail Park entrance further south
5. I-229 improvement considerations
   - 5.1 Various interchange configurations are being considered for Minnesota Avenue. The configurations will be presented at the next public meeting.

The following notes were gathered during the discussion with the adjacent landowners and business owners.

- ❖ <u>57th Street and Minnesota:</u> Commenters noted that the angle of the curve in the intersection and the topographic changes create safety concerns – can't see when vehicles are in turning lanes. It was explained that a break in the section line (platting) was the original issue that caused the current misalignment and that it is being slowly corrected each time improvements are made. Angle crashes at the intersection and speed limit changes at the intersection approach were also discussed.

- Lotta Street concerns: (multiple mentions, compiled below) – also see handout provided by Aspen Condominiums representative (attached).
  - Left turning movement safety from Lotta Street at Minnesota Avenue (driver delay and speed of approaching vehicles)
  - Speed on Minnesota Avenue at Lotta Street, particularly northbound (picking up speed heading down the hill)
  - Safety (turning gaps, speed, driveways and pedestrians/bicyclists)
  - Offset drives can lead to some confusion on turning movements
  - Residents at Aspen Condominiums are largely retired and many are elderly.
- Discussion on legal access: Southern building, east of the 49th Street intersection, has separate ownership than the others within the development. If they lose their access to Minnesota Avenue, they would lose their legal access to the property.
- Traffic volumes on 49th: Comment that there has been much more traffic on 49th over last couple years due to new construction and operation of Costco and a new apartment complex.
- Truck Parking West of Minnesota Avenue: A comment was made that Midco trucks park on- streets, creating safety concerns. It was noted that Midco is planning to build a separate facility with off-street parking in the near future, which could potentially alleviate this issue.
- Plans for 49th Street: It was noted the City plans to construct 49th Street beginning in 2017, starting on the west end. Multiple phases will over next several years. The final phase that ties into the existing 49th Street segment would be last, and will be dependent on the committed Minnesota Avenue interchange design.
- New Development Traffic (Walmart, Costco, and Apartments): It was noted that each of these new developments have been accounted for in the travel demand model.
- Safe Access to Minnesota Avenue: A property owner of building immediately adjacent to southbound exit ramp mentioned it was very difficult to turn left out of the property onto Minnesota Avenue.
- Interior cross parcel access: One commenter noted that motorists cut across parking lots west of Minnesota Avenue (North of 49th Street) via cross easements or interior driveways to avoid Minnesota Avenue.

- Center Median Proposed: City of Sioux Falls staff noted that they have begun to look at a median along Minnesota Avenue, starting near the airport and heading south along Minnesota Avenue.

- Bicyclist Safety: A commenter noted that there is a safety issue at the park access driveway with the number/frequency of bicyclists/pedestrians traveling north-south along Minnesota Avenue, across the park driveway. City staff noted they will continue with this study, at bike/ped bridges or overpasses for crossings of I-229.

- Adaptive Traffic Signal Control: City staff noted they plan to implement an adaptive traffic signal control system along Minnesota (from 18th to the southern ramp terminal intersection).

- 41st and Minnesota: City staff mentioned the intent to construct a new eastbound lane at 41st Street, for approximately one to three blocks. This will create an EBL, EBL, EBT, and EBR lane configuration at the Minnesota intersection. Looking at construction as early as 2016. The City plans to replace the existing 5-section heads at Minnesota to remove the Dallas phasing, thereby replacing it with the flashing yellow signal head.

Sign In Sheet

Subject I-229 Major Investment Corridor Study - Stakeholder Meetings for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87), 3616P, PCN 044K

Project No.: 207030

Meeting Date Tuesday December 16, 2014 1:30 PM

Meeting Location: Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Shannon Ausen	224 W. 9th ST SF SD	367-8607	sausen@siouxfalls.org
2	Bob Bottin	3600 S. Duluth Ave	334-4220	robert.[illegible]@[illegible]abilities.org
3	Pam Taylor	5000 S. Sunnymede Cir Sioux Falls	332-6509	pam.jansa@gmail.com
4	Steve Sherman	3800 S. Grange	359-7857	ssherman@jackhenry.com
5	Cindy Strawsburg	4300 S. Pine Cone Place	3671871	[illegible]@AOL.com
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DOT | CITY OF SIOUX FALLS PUBLIC WORKS | HDR

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(37) 3815P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 16, 2014 1:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Dianne Metli	4304 S. Minn Ave	339-2864	metli@sio.midco.net
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3	Paul Nikolas	5316 W. 60th St. N.	367-5680	Paul.Nikolas@state.sd.us
4	Ann Kelley	4601 S. Minn Ave.	341-2838	
5	Nemmadhe Hai	4600 W. 12th.	605-366-3233	[illegible]
6	BRIAN SATHER	3308 S. Minn. #108 Bus; 6000 E AUTUMN LN	338-3205	[illegible]
7	John Hart	1309 W. 51st	444-6320	jhart@uca-dakotas.org
8	MARK KOZEL	4040 S. GRANGE AVE	336-0860	mkozel@kuperyards.com
9	Richard Elmen	3501 S. Minnesota	366 0252	relmen@rentall-inc.com
10	Kelly Vis	404 S. Grange Ave	336-6860	kvis@kuperlumber.com
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Interstate 229 Major Investment Study

Exit 3 – Minnesota Avenue

Stakeholder Meeting
December 16th, 2014
1:30 pm to 2:30 pm

HDR

HRGreen

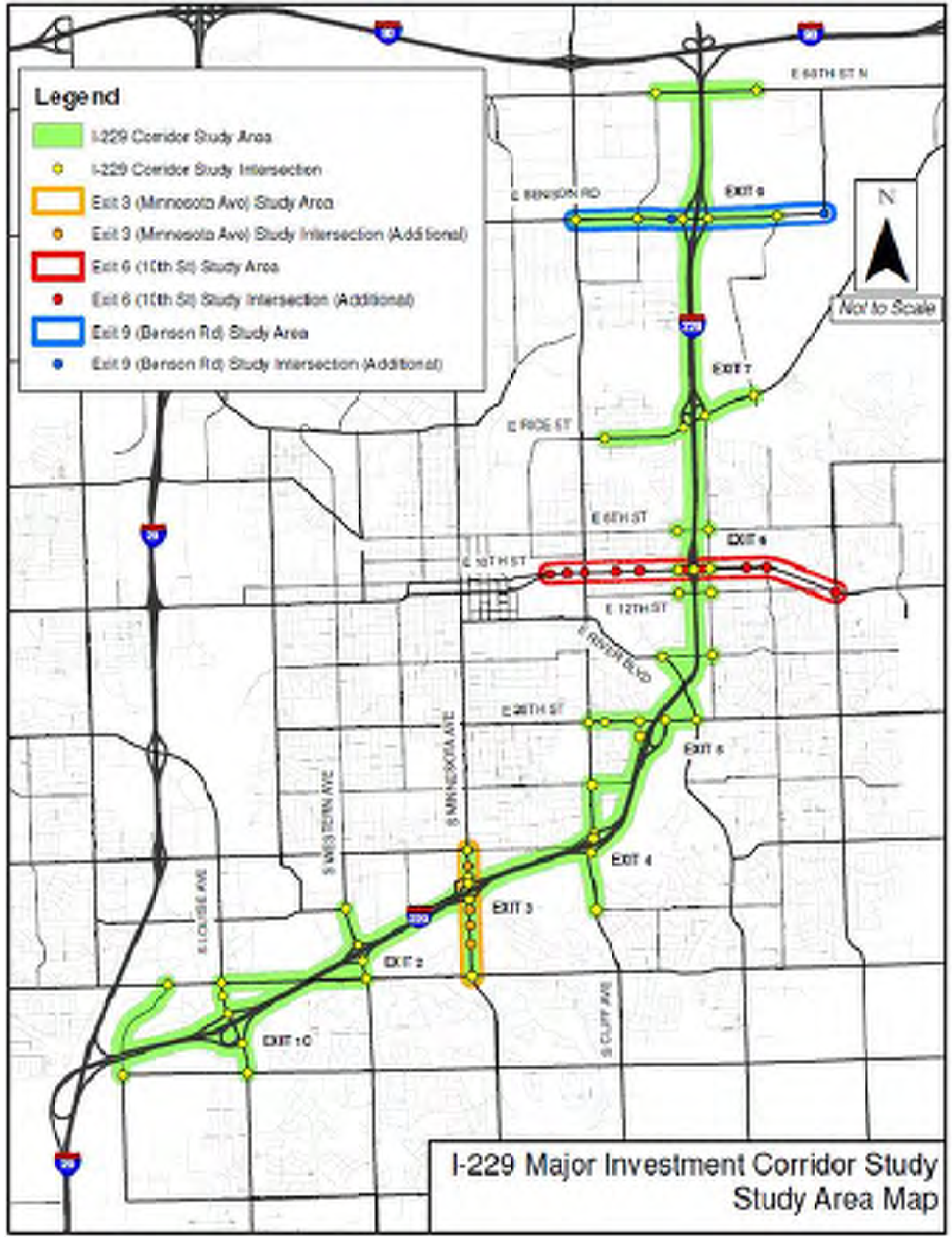
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

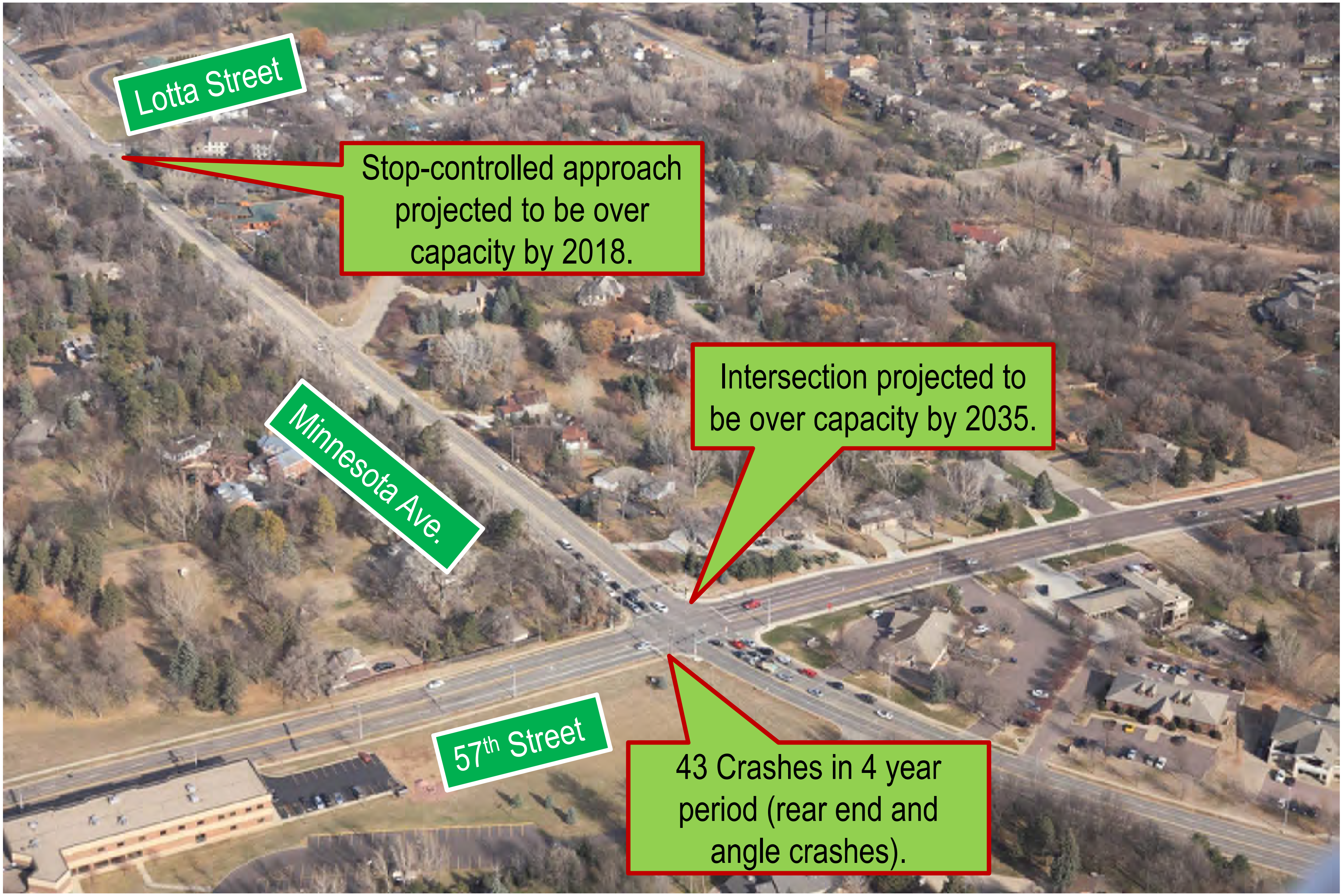
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

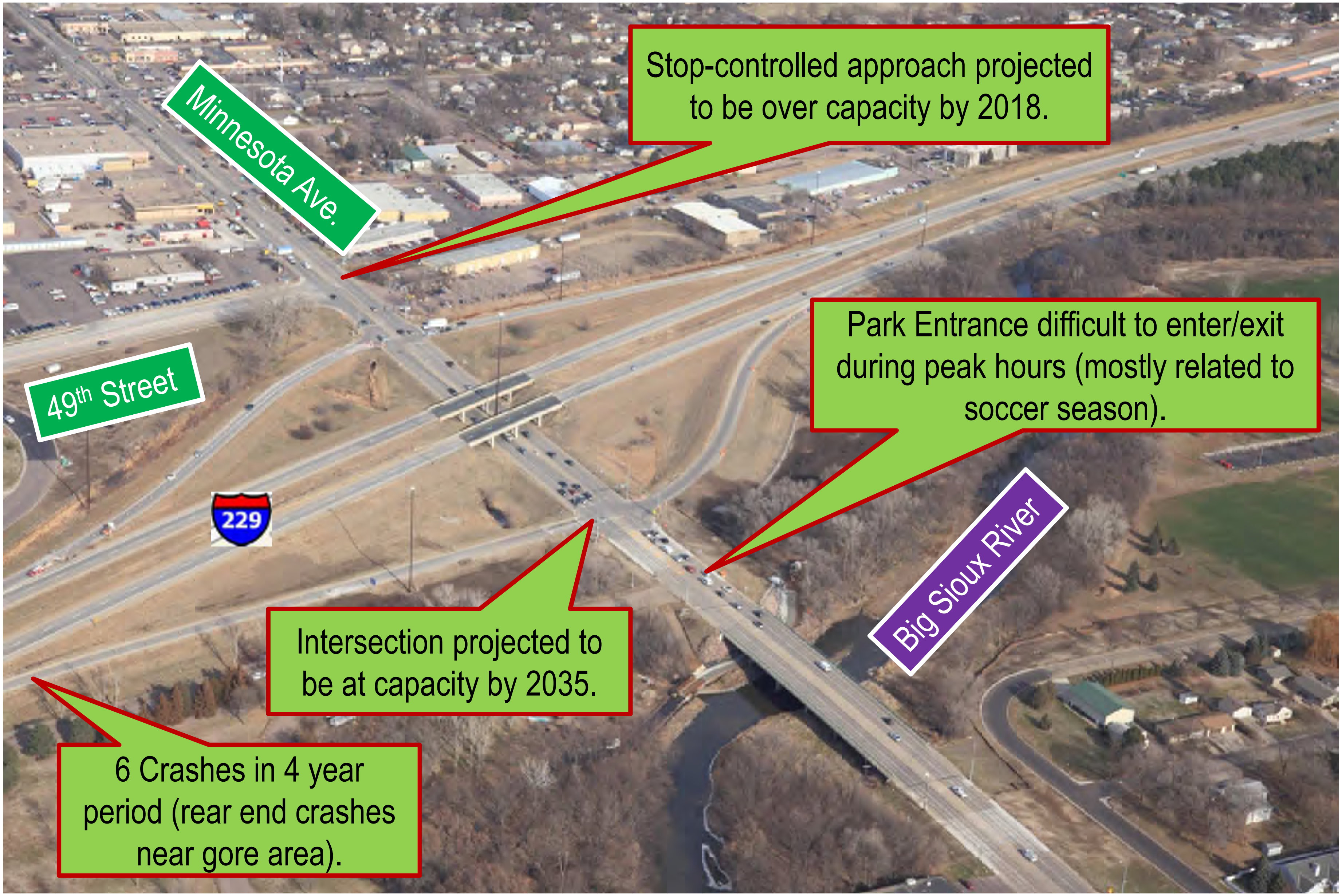
Exit 3 (Minnesota Avenue) Crossroad Study Goals

- Reduce traffic congestion
- Evaluate interchange options
- Integrate plans for the 49th Street Extension with the interchange options developed
- Improve pedestrian and bike access to the Big Sioux River Pathway
- Improve safety for corridor users
- Improve vehicle safety to Yankton Trail Park

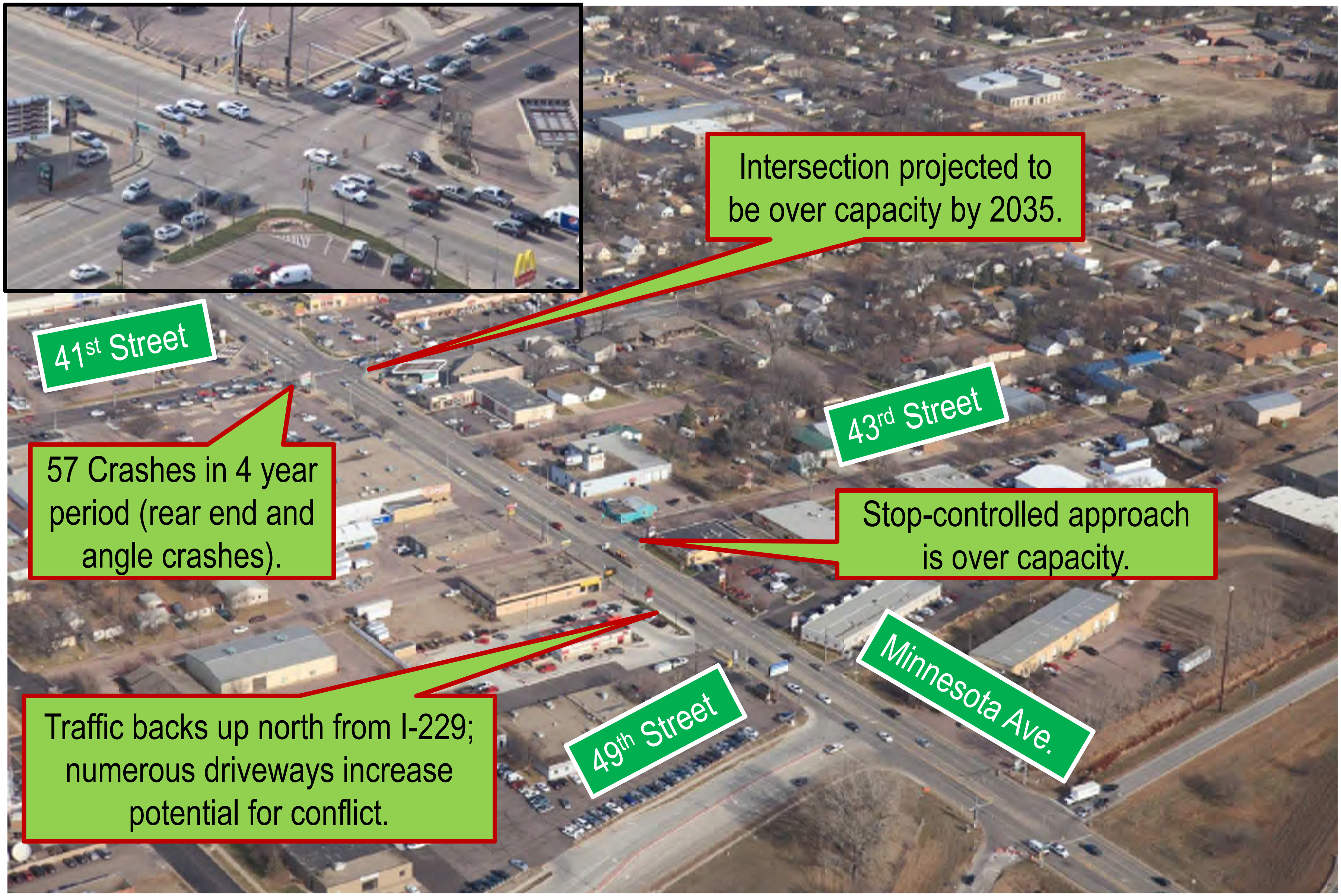
Minnesota Avenue Corridor Overview



Minnesota Avenue Corridor Overview



Minnesota Avenue Corridor Overview



Relevant Previous Studies

Preliminary local street extensions, interchange concepts, and traffic impact analyses in the vicinity of I-229 & Minnesota Avenue were identified in the following studies:

- **41st Street Corridor Study**
- **Sioux Falls Major Street and Access Management Plan**
- **2000 and 2010 Decennial Interstate Corridor Studies**
- **49th Street Extension Study**
- **Traffic Impact Studies – Costco, Scheels, and Walmart**

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Ross Harris– HR Green, Inc.
515-657-5263 or rharris@hrgreen.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study

Exit 3 – Minnesota Avenue

Thanks for Attending!!!!!

HRGreen

RICE STREET

JUNE 22ND, 2016

- SIGN-IN SHEETS
- POWERPOINT SLIDES
- MEETING NOTES (SEE CLIFF AVENUE AND RICE STREET PUBLIC MEETINGS APPENDIX)
- COMMENTS (SEE CLIFF AVENUE AND RICE STREET PUBLIC MEETINGS APPENDIX)

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Rice Street Sub-Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Wednesday, June 22, 2016 1:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Patty Nohr Myr-Kelly's Paving	1300 N. Bahnson Ave	334-3204	Patty.n@ Mkrpaving.com
2	Darrel Hoyer	1300 N Bahnson Ave SFSD	334-3204	darrel.hoyer@myrkelly paving.com
3	Milt Nussbaum	2900 East Rice St S/SD	605-338-0053	[illegible]
4	Dan Kearney	47046 259 ST SFSD	351-5705	[illegible] @ Aol.com
5	[illegible]	1509 E 39 St N	366 3139	
6	James St Clair	1409/1413 E Rice	605 359-0005	jensenport@ hotmail.com
7	Peggy Jensen	" "	605 310-0740	"
8	Jason Kjenstad	6300 S. Old Village Pl	605-977-7740	jason.kjenstad@hdrinc.com
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Interstate 229 Major Investment Study

Exit 7 – Rice Street

Stakeholder Meeting
June 22nd, 2016
1:00 pm to 2:00 pm

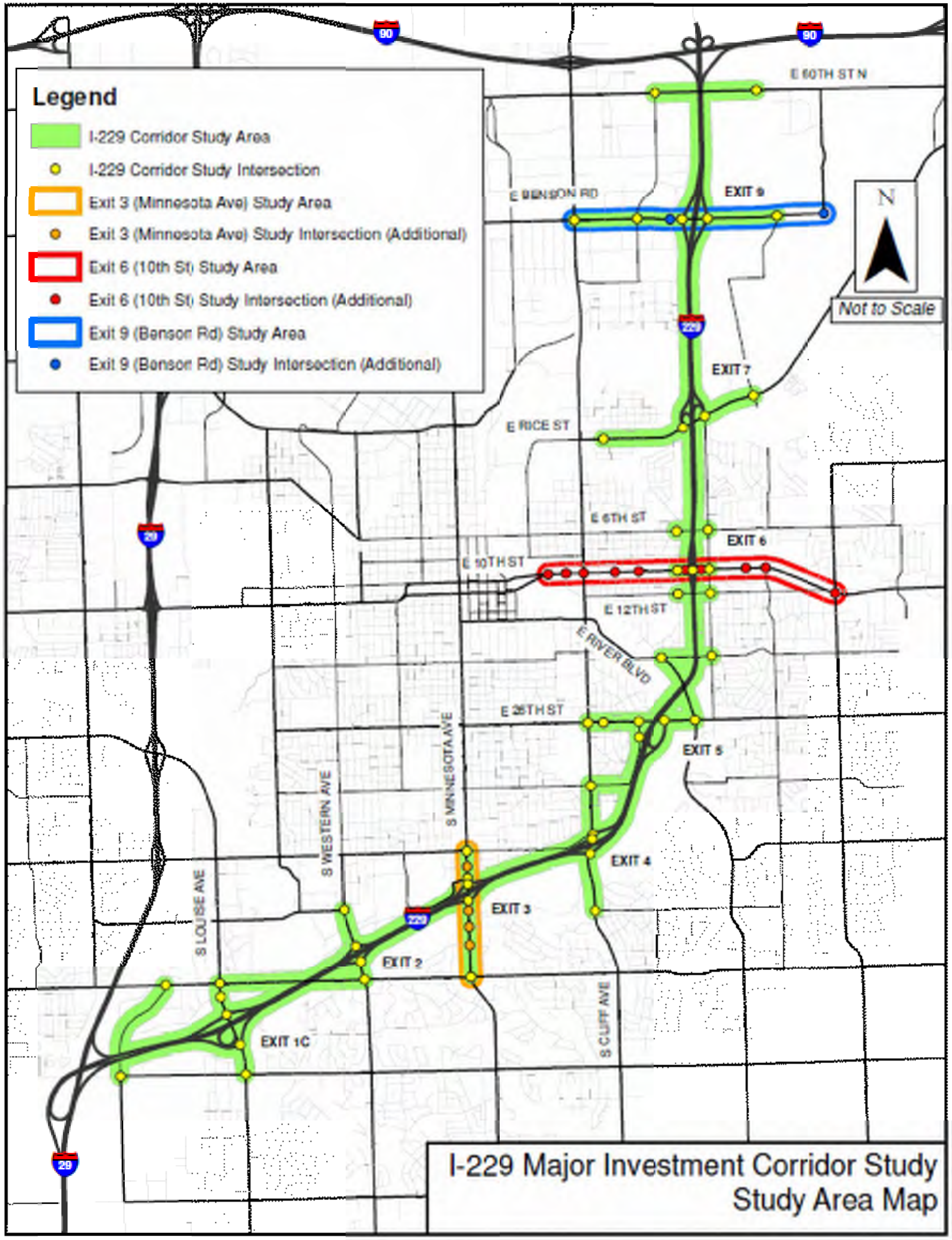
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road
Added Exit 4 – Cliff Avenue
Added Exit 7 – Rice Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

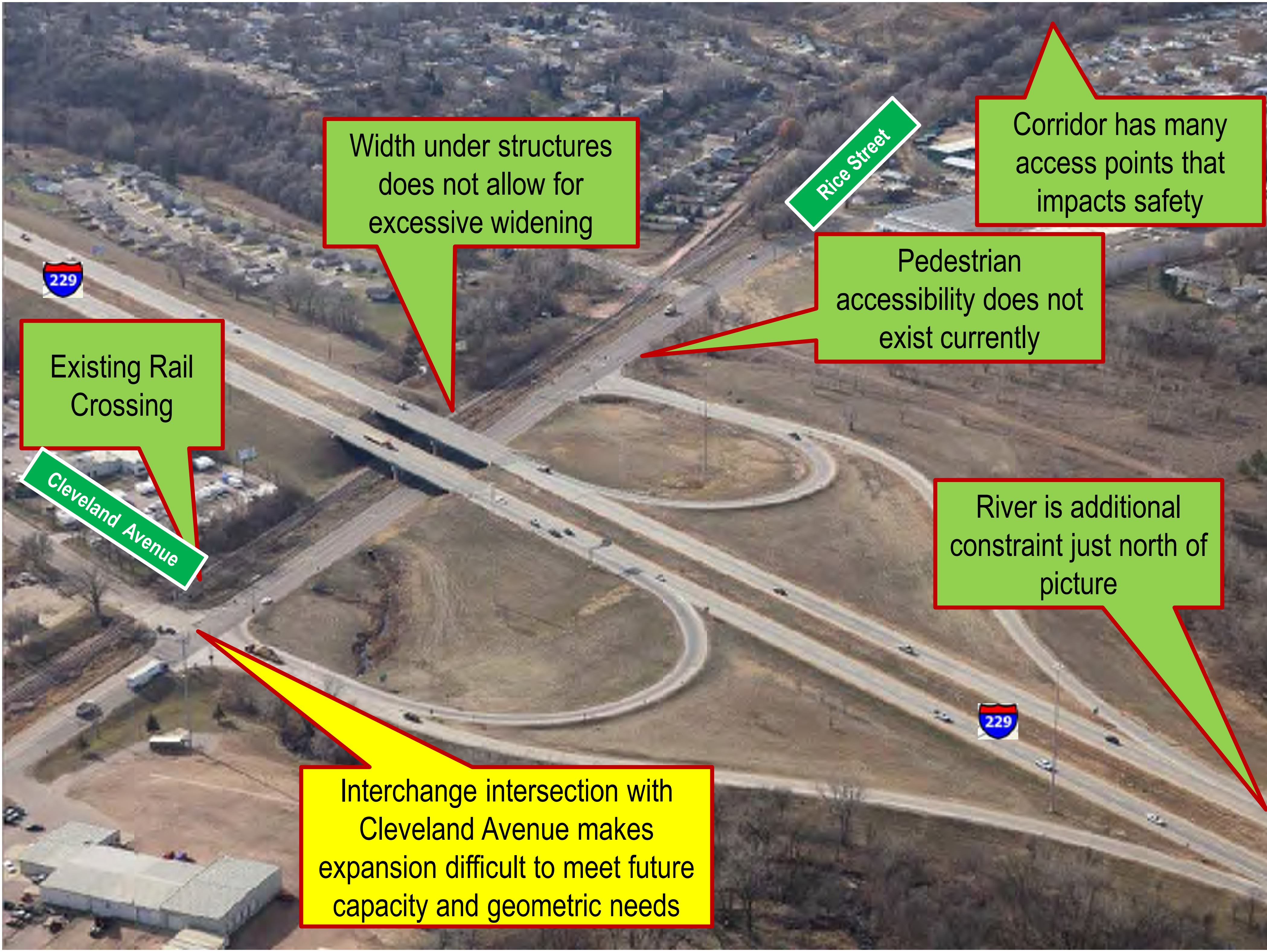
City of Sioux Falls

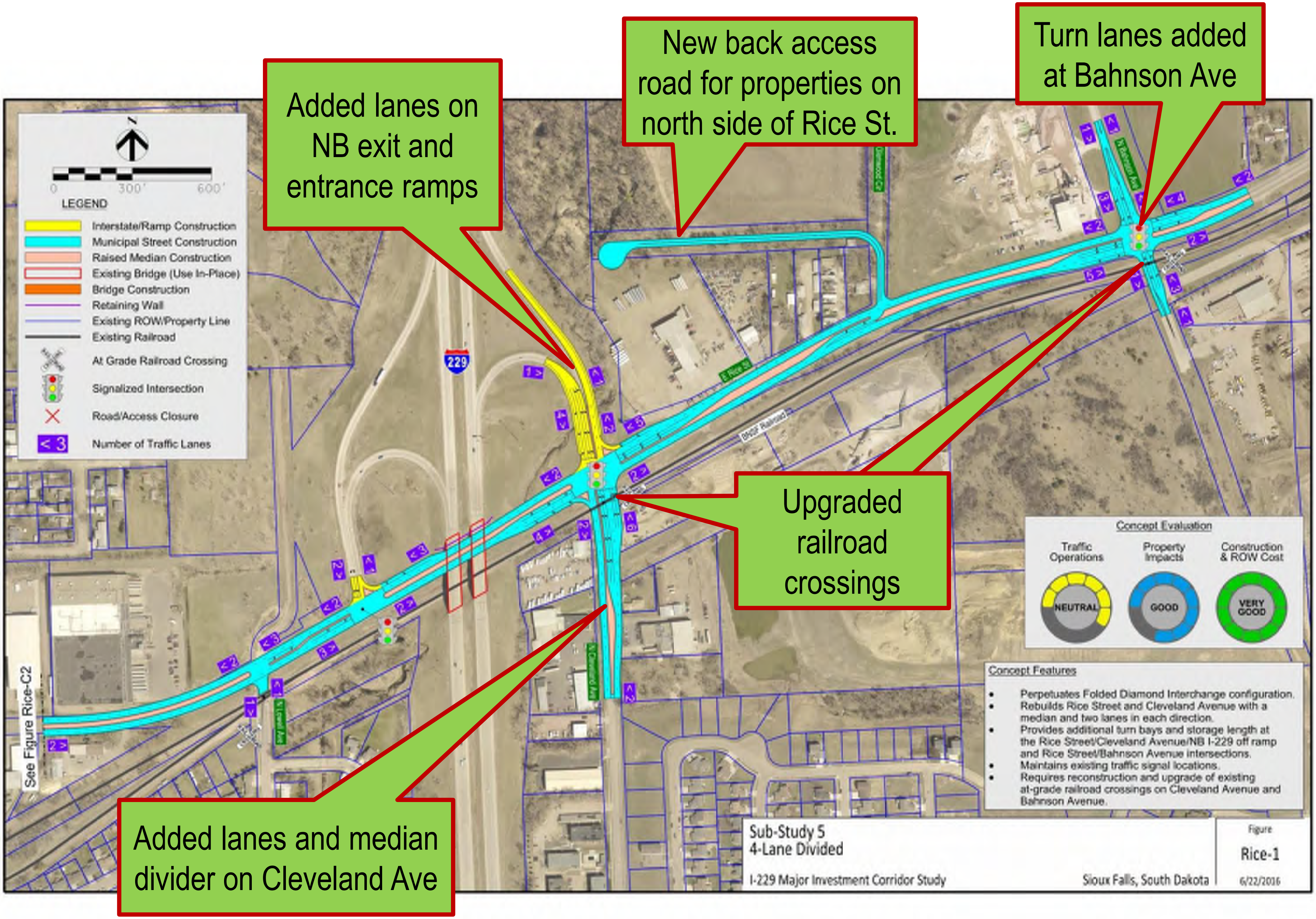
Sioux Falls Metropolitan Planning Organization (MPO)

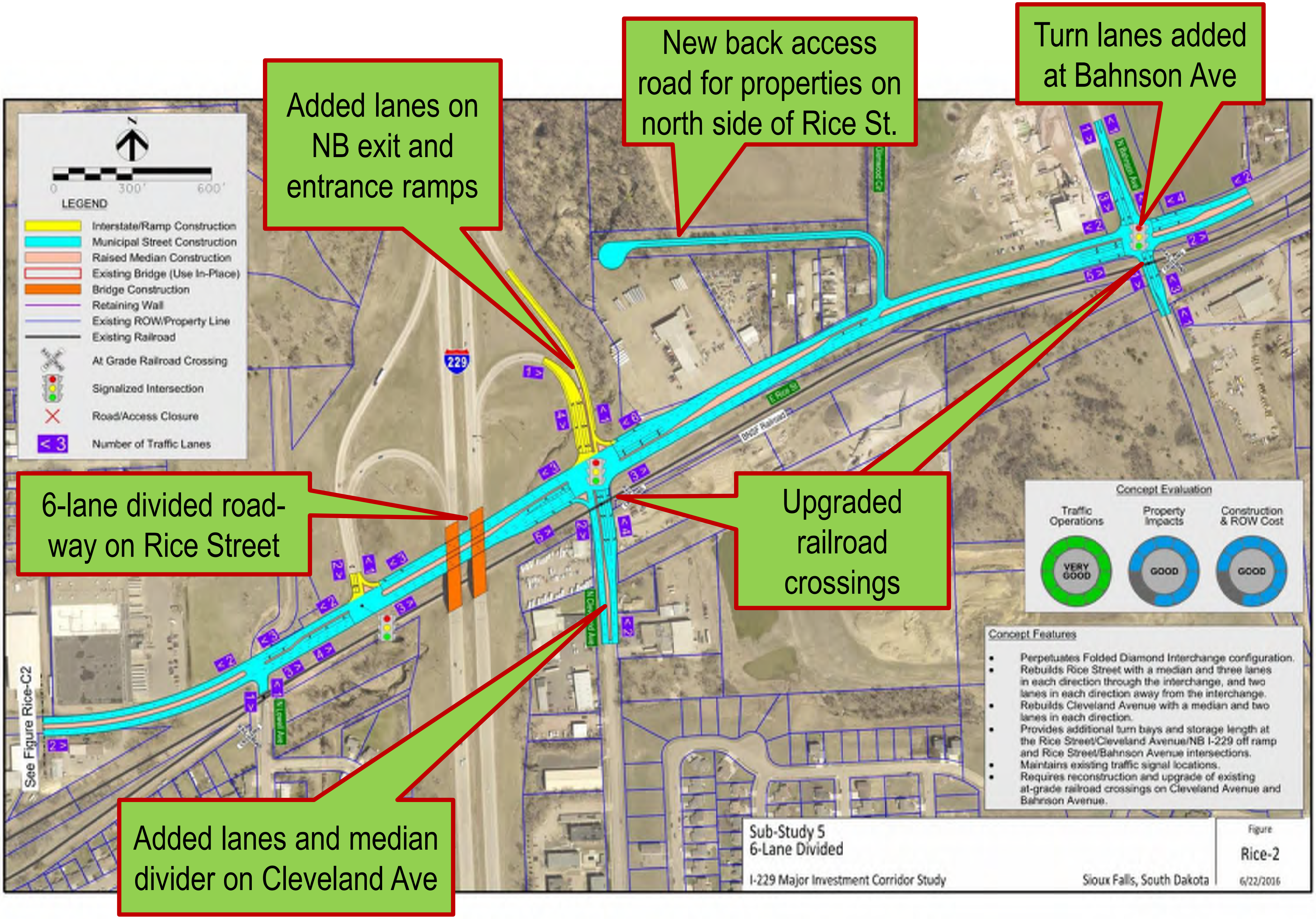
Federal Highway Administration (FHWA)

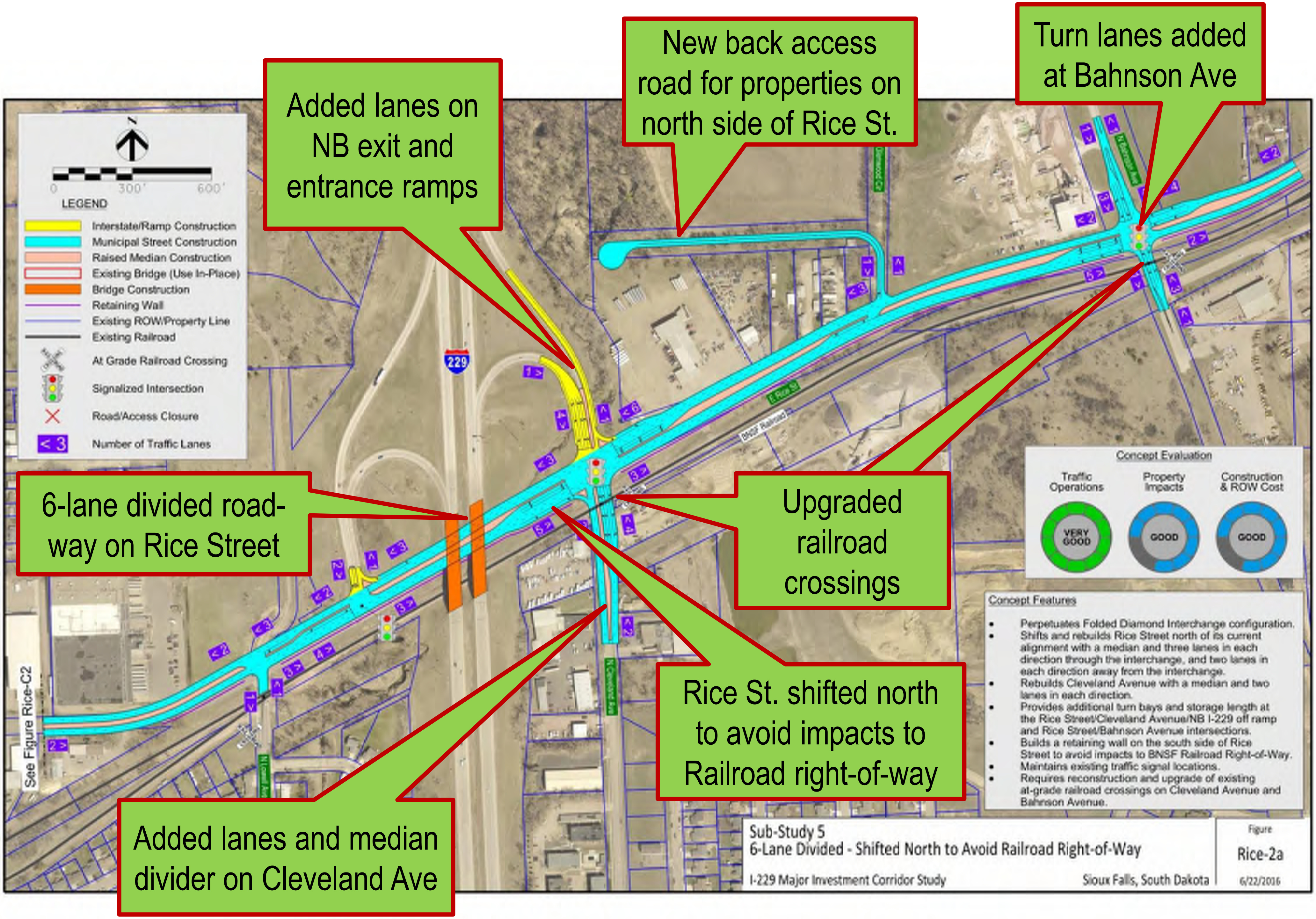
Exit 7 (Rice Street) Crossroad Study Goals

- Reduce traffic congestion
- Provide and Interchange that will meet the future capacity requirements
- Improve pedestrian mobility
- Improve safety for corridor users

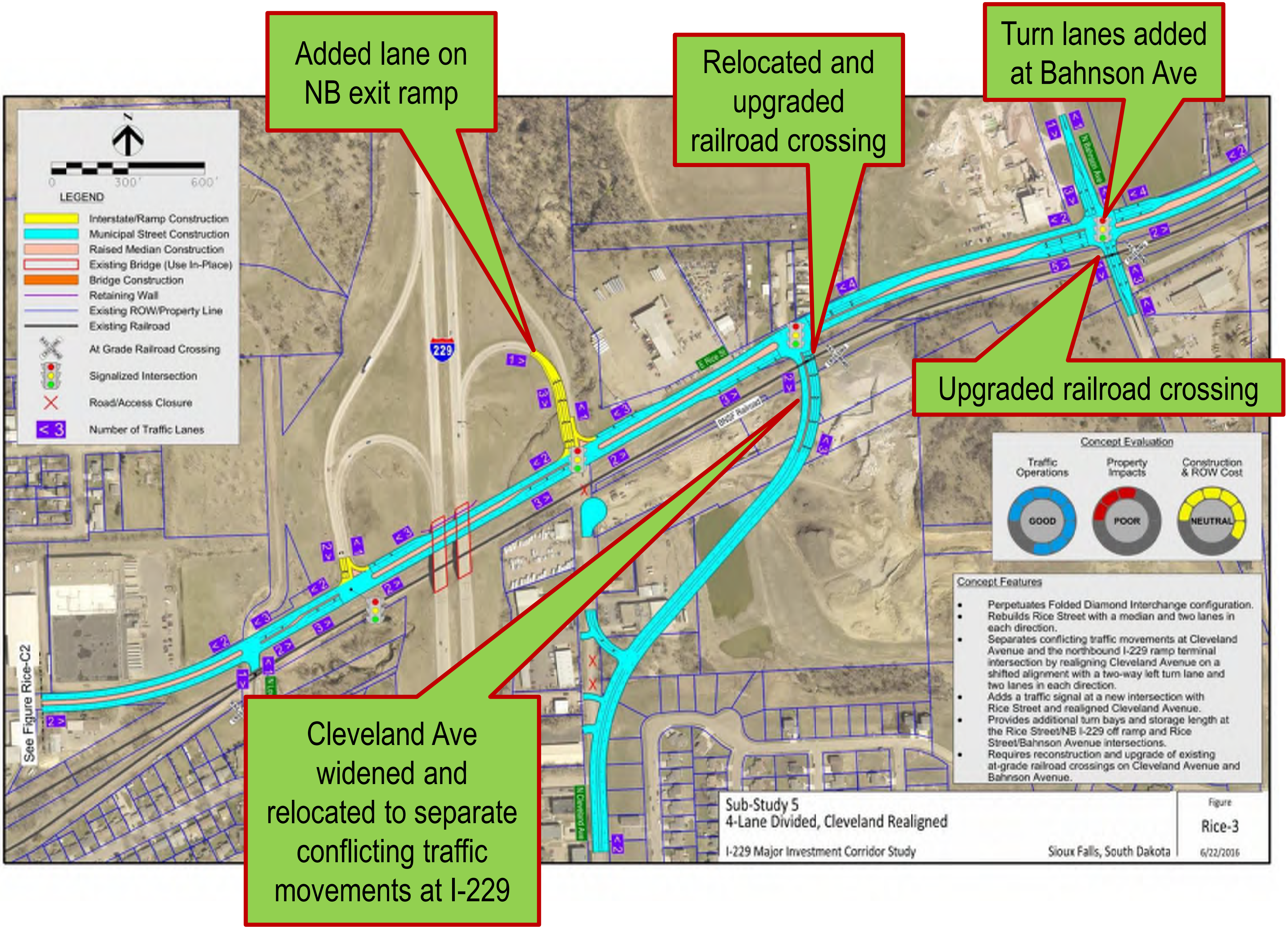

Width under structures does not allow for excessive widening
Rice Street
Corridor has many access points that impacts safety
Pedestrian accessibility does not exist currently
229
Existing Rail Crossing
Cleveland Avenue
River is additional constraint just north of picture
229
Interchange intersection with Cleveland Avenue makes expansion difficult to meet future capacity and geometric needs


Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
Upgraded railroad crossings
Added lanes and median divider on Cleveland Ave
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
N Cleveland Ave
N Bahnson Ave
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
NEUTRAL
GOOD
VERY GOOD
Concept Features
• Perpetuates Folded Diamond Interchange configuration.
• Rebuilds Rice Street and Cleveland Avenue with a median and two lanes in each direction.
• Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
• Maintains existing traffic signal locations.
• Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
4-Lane Divided
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-1
6/22/2016

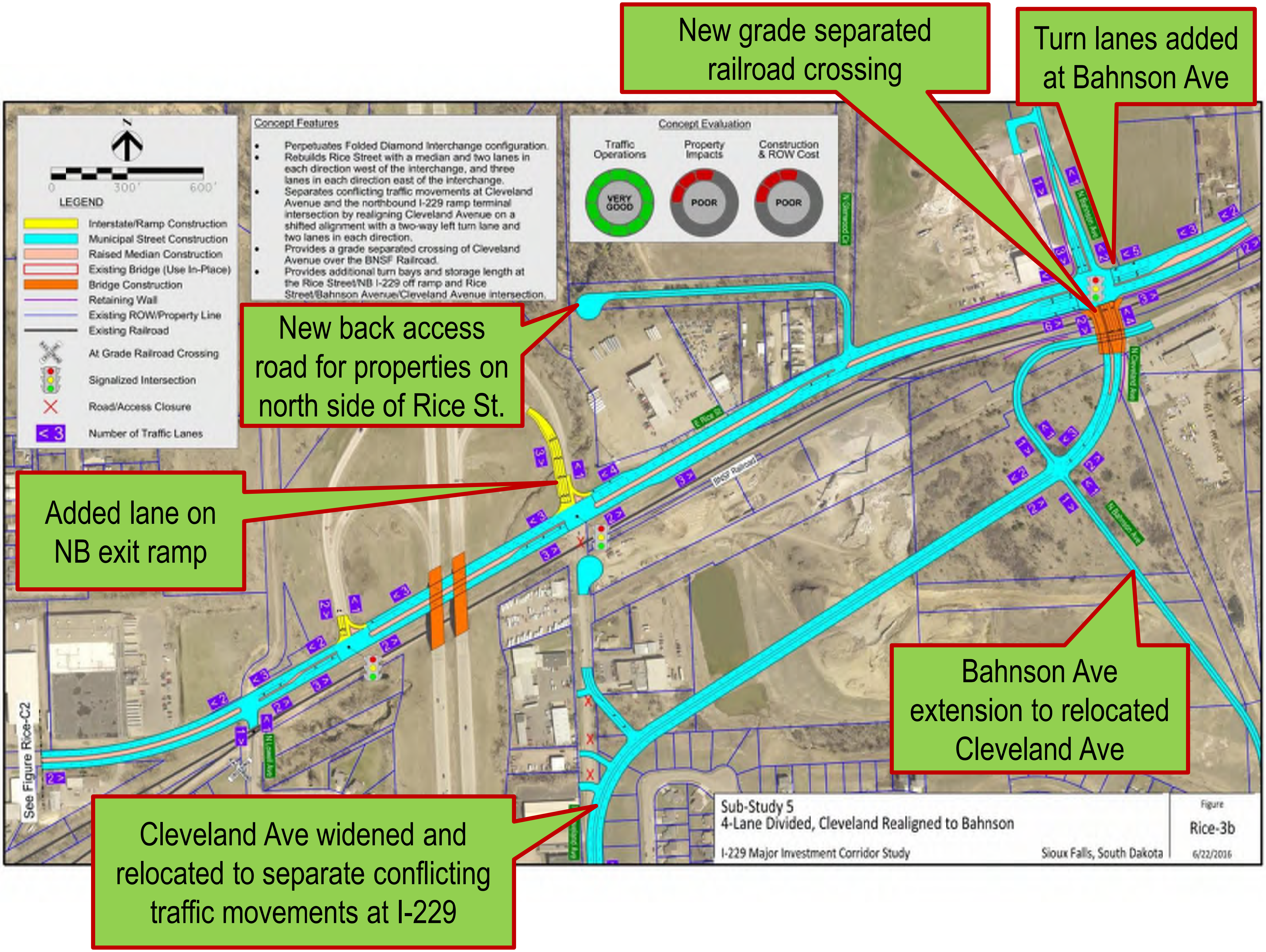

Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
6-lane divided road-way on Rice Street
Upgraded railroad crossings
Added lanes and median divider on Cleveland Ave
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
GOOD
GOOD
Concept Features
• Perpetuates Folded Diamond Interchange configuration.
• Rebuilds Rice Street with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
• Rebuilds Cleveland Avenue with a median and two lanes in each direction.
• Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
• Maintains existing traffic signal locations.
• Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
6-Lane Divided
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-2
6/22/2016

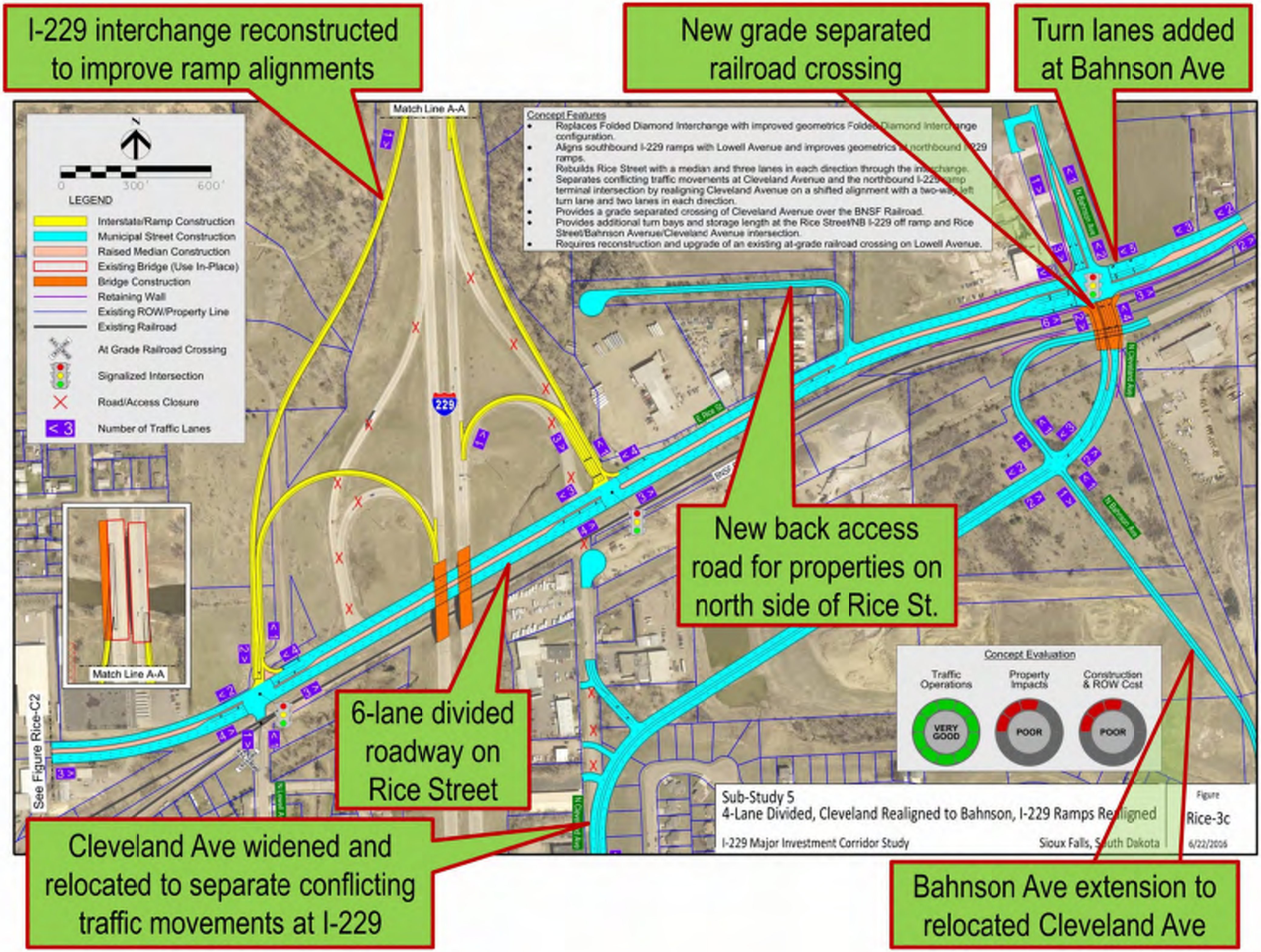


Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
6-lane divided road-way on Rice Street
Upgraded railroad crossings
Rice St. shifted north to avoid impacts to Railroad right-of-way
Added lanes and median divider on Cleveland Ave
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
GOOD
GOOD
Concept Features
Perpetuates Folded Diamond Interchange configuration.
Shifts and rebuilds Rice Street north of its current alignment with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
Rebuilds Cleveland Avenue with a median and two lanes in each direction.
Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
Builds a retaining wall on the south side of Rice Street to avoid impacts to BNSF Railroad Right-of-Way.
Maintains existing traffic signal locations.
Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
6-Lane Divided - Shifted North to Avoid Railroad Right-of-Way
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-2a
6/22/2016

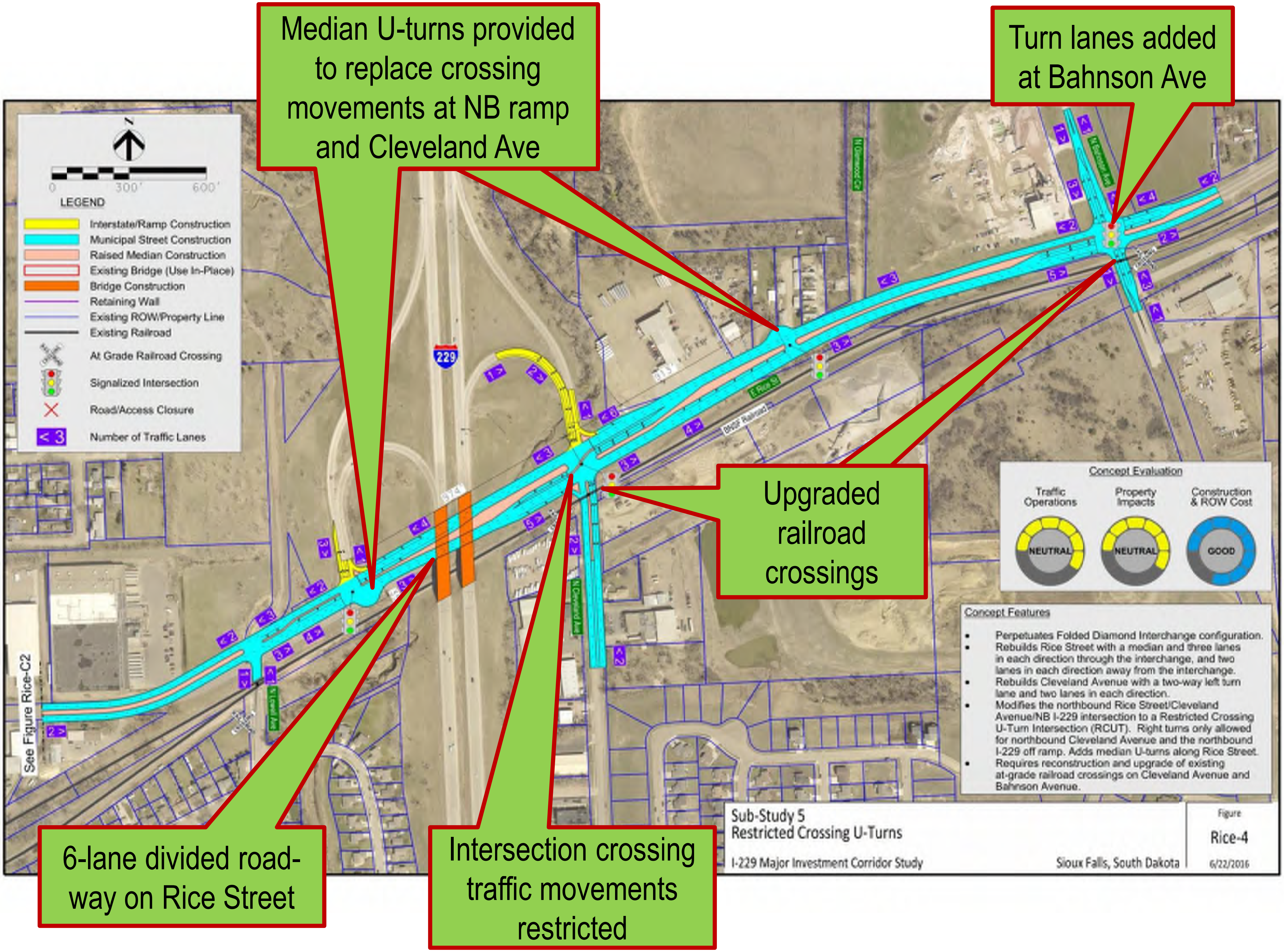


Added lane on NB exit ramp
Relocated and upgraded railroad crossing
Turn lanes added at Bahnson Ave
Upgraded railroad crossing
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
N Cleveland Ave
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
POOR
NEUTRAL
Concept Features
Perpetuates Folded Diamond Interchange configuration.
Rebuilds Rice Street with a median and two lanes in each direction.
Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
Adds a traffic signal at a new intersection with Rice Street and realigned Cleveland Avenue.
Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue intersections.
Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
4-Lane Divided, Cleveland Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3
6/22/2016

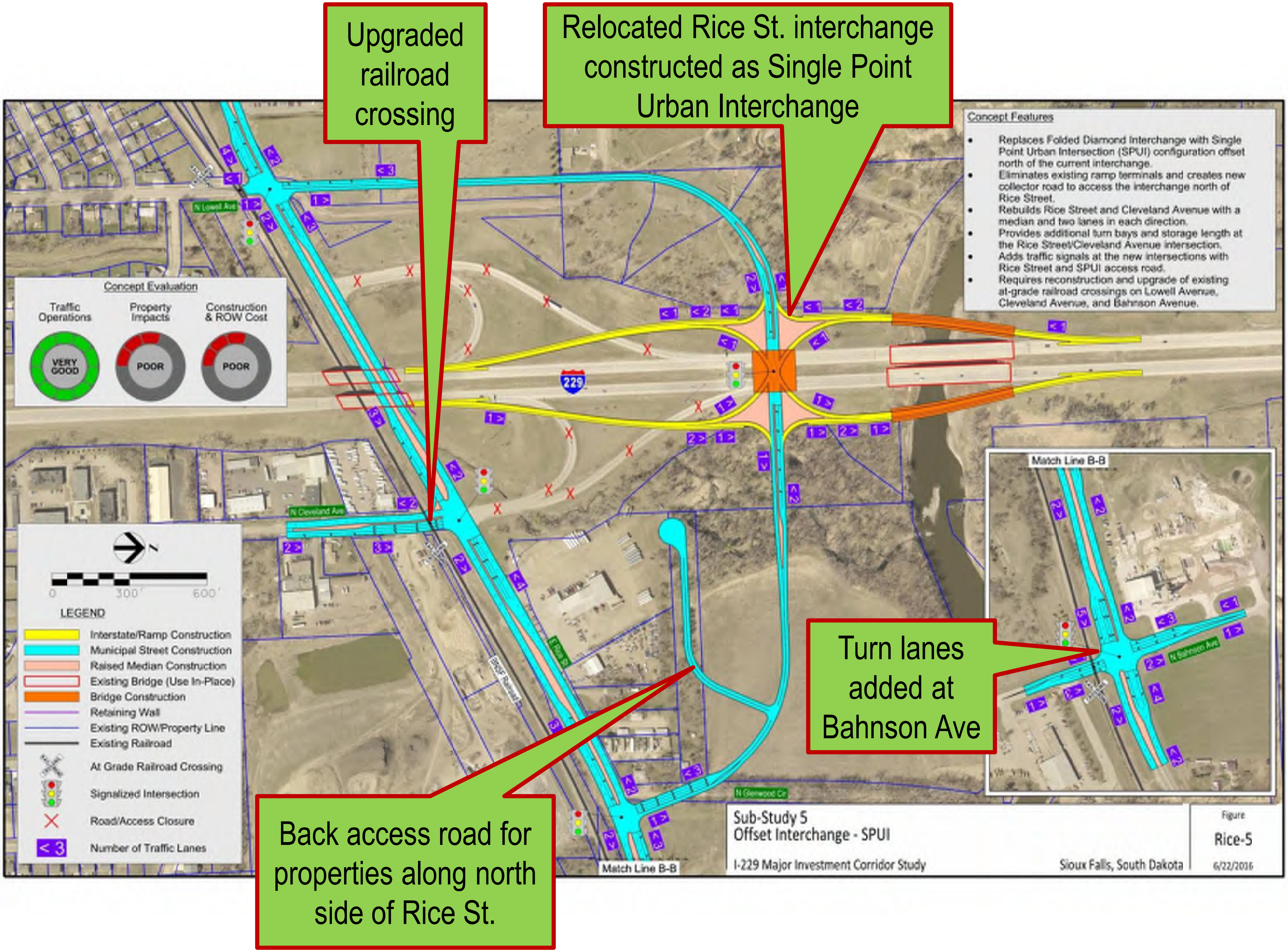

New grade separated railroad crossing
Turn lanes added at Bahnson Ave
New back access road for properties on north side of Rice St.
Added lane on NB exit ramp
Bahnson Ave extension to relocated Cleveland Ave
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
Concept Features
• Perpetuates Folded Diamond Interchange configuration.
• Rebuilds Rice Street with a median and two lanes in each direction west of the interchange, and three lanes in each direction east of the interchange.
• Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
• Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
• Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersection.
Concept Evaluation
Traffic Operations
VERY GOOD
Property Impacts
POOR
Construction & ROW Cost
POOR
See Figure Rice-C2
Sub-Study 5
4-Lane Divided, Cleveland Realigned to Bahnson
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3b
6/22/2016

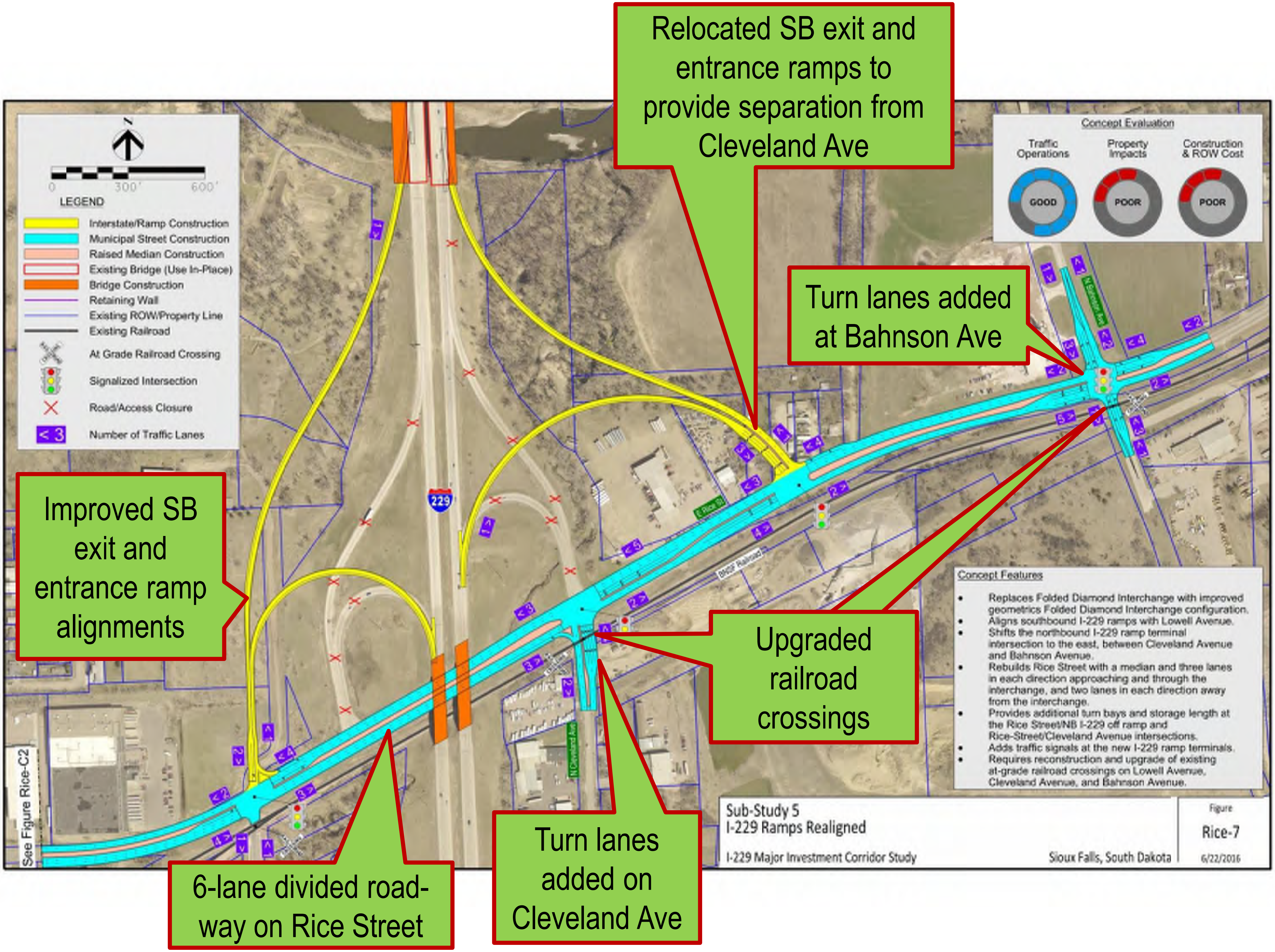


I-229 interchange reconstructed to improve ramp alignments
New grade separated railroad crossing
Turn lanes added at Bahnson Ave
Match Line A-A
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
Concept Features
• Replaces Folded Diamond Interchange with improved geometrics Folded Diamond Interchange configuration.
• Aligns southbound I-229 ramps with Lowell Avenue and improves geometrics at northbound I-229 ramps.
• Rebuilds Rice Street with a median and three lanes in each direction through the interchange.
• Separates conflicting traffic movements at Cleveland Avenue and the northbound I-229 ramp terminal intersection by realigning Cleveland Avenue on a shifted alignment with a two-way left turn lane and two lanes in each direction.
• Provides a grade separated crossing of Cleveland Avenue over the BNSF Railroad.
• Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice Street/Bahnson Avenue/Cleveland Avenue intersection.
• Requires reconstruction and upgrade of an existing at-grade railroad crossing on Lowell Avenue.
229
New back access road for properties on north side of Rice St.
Match Line A-A
See Figure Rice-C2
6-lane divided roadway on Rice Street
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
POOR
POOR
Sub-Study 5
4-Lane Divided, Cleveland Realigned to Bahnson, I-229 Ramps Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3c
6/22/2016
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
Bahnson Ave extension to relocated Cleveland Ave

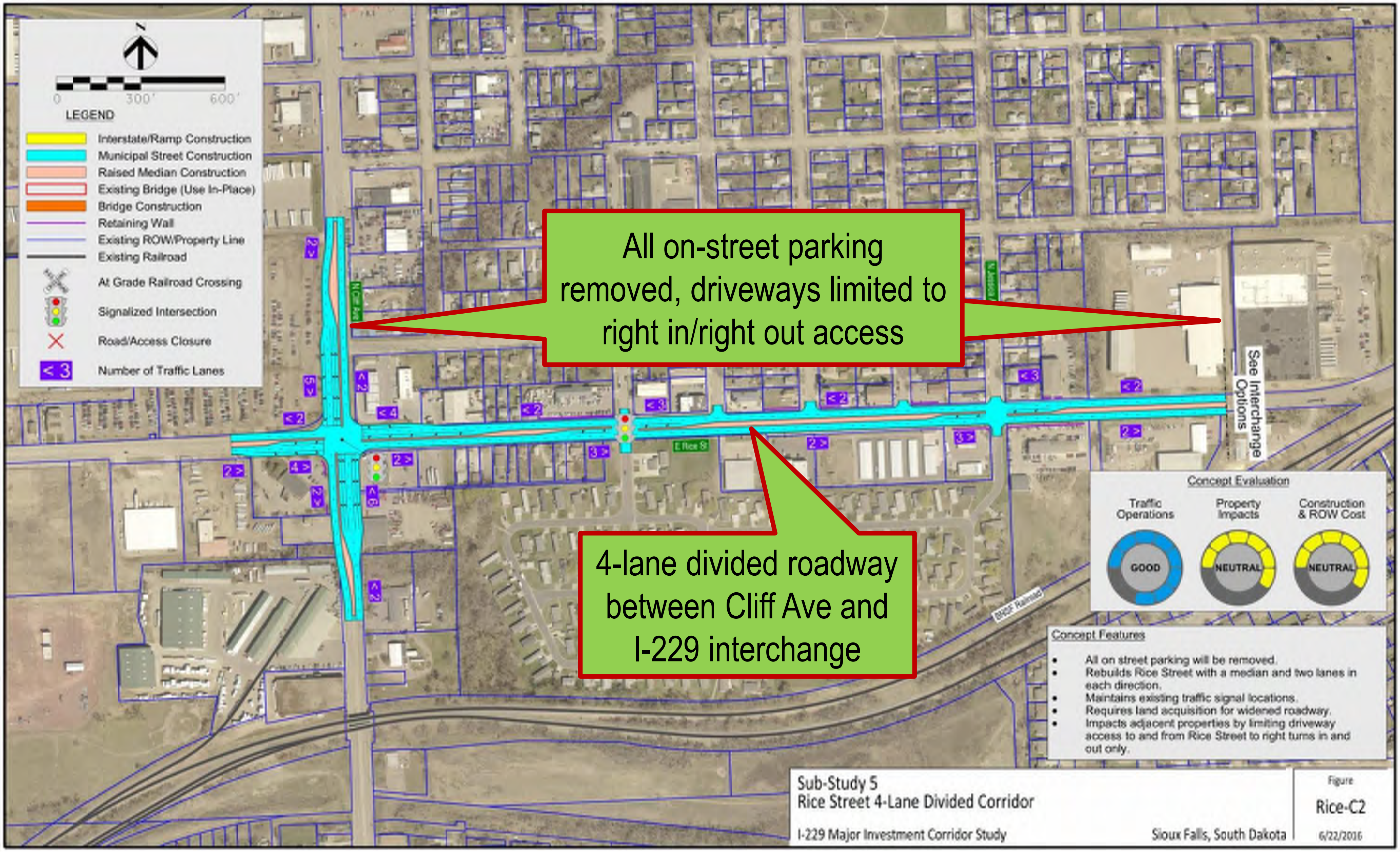


Median U-turns provided to replace crossing movements at NB ramp and Cleveland Ave
Turn lanes added at Bahnson Ave
Upgraded railroad crossings
6-lane divided road-way on Rice Street
Intersection crossing traffic movements restricted
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
229
E Rice St
BNSF Railroad
N Cleveland Ave
See Figure Rice-C2
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
NEUTRAL
NEUTRAL
GOOD
Concept Features
• Perpetuates Folded Diamond Interchange configuration.
• Rebuilds Rice Street with a median and three lanes in each direction through the interchange, and two lanes in each direction away from the interchange.
• Rebuilds Cleveland Avenue with a two-way left turn lane and two lanes in each direction.
• Modifies the northbound Rice Street/Cleveland Avenue/NB I-229 intersection to a Restricted Crossing U-Turn Intersection (RCUT). Right turns only allowed for northbound Cleveland Avenue and the northbound I-229 off ramp. Adds median U-turns along Rice Street.
• Requires reconstruction and upgrade of existing at-grade railroad crossings on Cleveland Avenue and Bahnson Avenue.
Sub-Study 5
Restricted Crossing U-Turns
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-4
6/22/2016


Upgraded railroad crossing
Relocated Rice St. interchange constructed as Single Point Urban Interchange
Concept Features
Replaces Folded Diamond Interchange with Single Point Urban Intersection (SPUI) configuration offset north of the current interchange.
Eliminates existing ramp terminals and creates new collector road to access the interchange north of Rice Street.
Rebuilds Rice Street and Cleveland Avenue with a median and two lanes in each direction.
Provides additional turn bays and storage length at the Rice Street/Cleveland Avenue intersection.
Adds traffic signals at the new intersections with Rice Street and SPUI access road.
Requires reconstruction and upgrade of existing at-grade railroad crossings on Lowell Avenue, Cleveland Avenue, and Bahnson Avenue.
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
POOR
POOR
N Lowell Ave
N Cleveland Ave
229
0
300'
600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
Match Line B-B
N Bahnson Ave
Turn lanes added at Bahnson Ave
Back access road for properties along north side of Rice St.
N Glenwood Cir
Sub-Study 5
Offset Interchange - SPUI
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-5
6/22/2016



Relocated SB exit and entrance ramps to provide separation from Cleveland Ave
Turn lanes added at Bahnson Ave
Improved SB exit and entrance ramp alignments
Upgraded railroad crossings
6-lane divided road-way on Rice Street
Turn lanes added on Cleveland Ave
N
0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
POOR
POOR
229
BNSF Railroad
N Cleveland Ave
See Figure Rice-C2
Concept Features
• Replaces Folded Diamond Interchange with improved geometrics Folded Diamond Interchange configuration.
• Aligns southbound I-229 ramps with Lowell Avenue.
• Shifts the northbound I-229 ramp terminal intersection to the east, between Cleveland Avenue and Bahnson Avenue.
• Rebuilds Rice Street with a median and three lanes in each direction approaching and through the interchange, and two lanes in each direction away from the interchange.
• Provides additional turn bays and storage length at the Rice Street/NB I-229 off ramp and Rice-Street/Cleveland Avenue intersections.
• Adds traffic signals at the new I-229 ramp terminals.
• Requires reconstruction and upgrade of existing at-grade railroad crossings on Lowell Avenue, Cleveland Avenue, and Bahnson Avenue.
Sub-Study 5
I-229 Ramps Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-7
6/22/2016



0 300' 600'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Existing Railroad
At Grade Railroad Crossing
Signalized Intersection
Road/Access Closure
Number of Traffic Lanes
All on-street parking removed, driveways limited to right in/right out access
4-lane divided roadway between Cliff Ave and I-229 interchange
E Rice St
See Interchange Options
BNSF Railroad
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
NEUTRAL
NEUTRAL
Concept Features
• All on street parking will be removed.
• Rebuilds Rice Street with a median and two lanes in each direction.
• Maintains existing traffic signal locations.
• Requires land acquisition for widened roadway.
• Impacts adjacent properties by limiting driveway access to and from Rice Street to right turns in and out only.
Sub-Study 5
Rice Street 4-Lane Divided Corridor
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-C2
6/22/2016

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Dave Meier – HDR Engineering, Inc.
402-399-1068 or Dave.Meier@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 7 – Rice Street

Thanks for Attending!!!!!

HDR

Cliff Avenue

June 22nd, 2016

- Sign-In Sheets
- PowerPoint Slides
- Meeting Notes (See Cliff Avenue and Rice Street Public Meetings Appendix)
- Comments (See Cliff Avenue and Rice Street Public Meetings Appendix)

DOT | CITY OF SIOUX FALLS PUBLIC WORKS | HDR

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Cliff Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Wednesday, June 22, 2016 2:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Linda Michelson Graham	4001 S Cliff Ave	605 940 4186	lindanle@aol.com
2	Jason Igrustad	6300 S. Old Village Pl	977-7740	jason.kjerstad@hdrinc.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for Cliff Avenue Sub Study
Client City of Sioux Falls/South Dakota Department of Transportation
Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030
Meeting Date Wednesday, June 22, 2016 2:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Gene Napier	1109 + 1111 E. Pam Rd	373-0377	napier10@sio.midco.net
2	Jim Becker for E.J. King	2507 S. Big Timber Pl 2611 S. Big Timber Pl	334-7091	jrbecker25@hotmail.com
3	Dwight Smidt	3216 S. Phillips	201-1299	PutHRAH1340@s.o.midco.net
4	JEFF KREITER	1101 N. WESTERN AVE	367-7965	JEFFREY.KREITER@KR.SD.US
5	Marsha Biggar	3000 S. 10th Ave	929-7637	MDB3000@sio.midco.net
6	Minnehaha Properties Phil Johnson	100 S Phillips Ave	782-4011	pjohnson@fnbsf.com
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Interstate 229 Major Investment Study

Exit 4 – Cliff Avenue

Stakeholder Meeting
June 22nd, 2016
2:30 pm to 3:30 pm

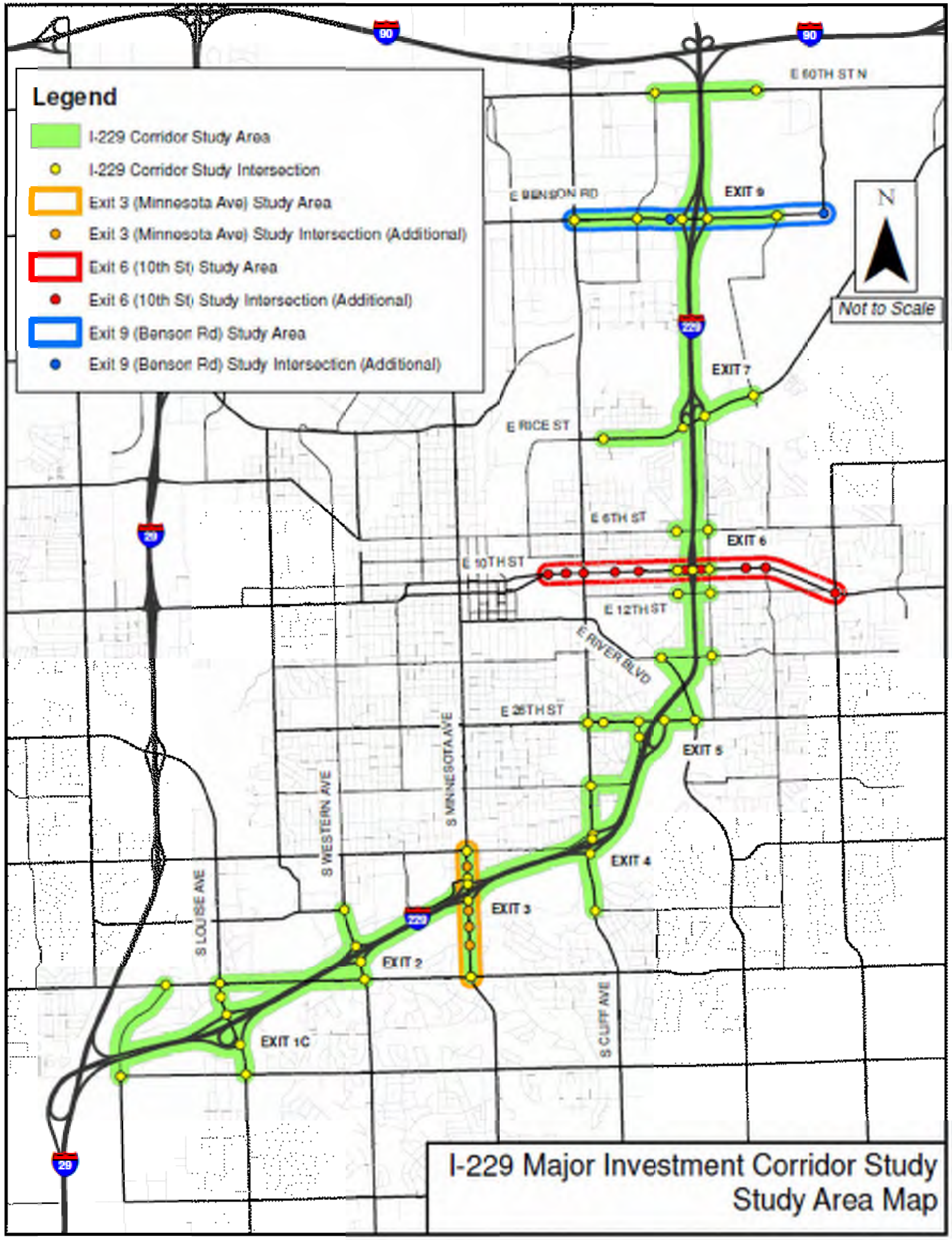
Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave
Exit 6 – 10th Street
Exit 9 – Benson Road
Added Exit 4 – Cliff Avenue
Added Exit 7 – Rice Street



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

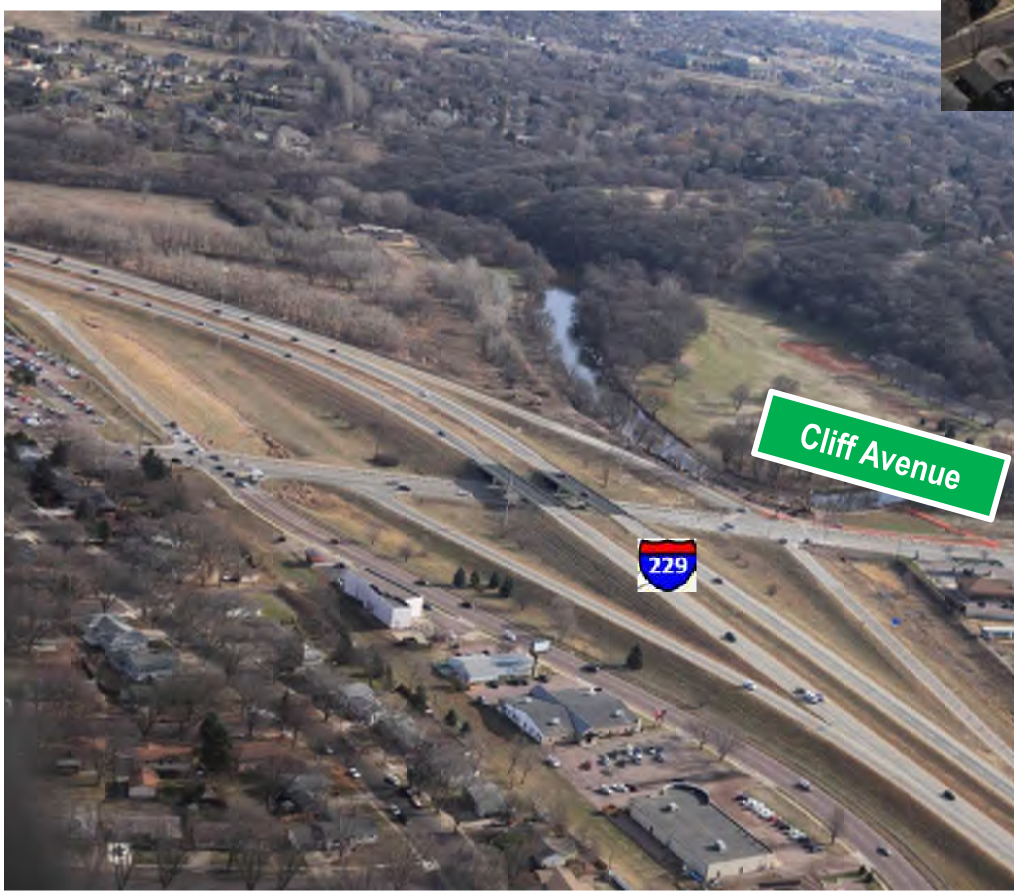
City of Sioux Falls

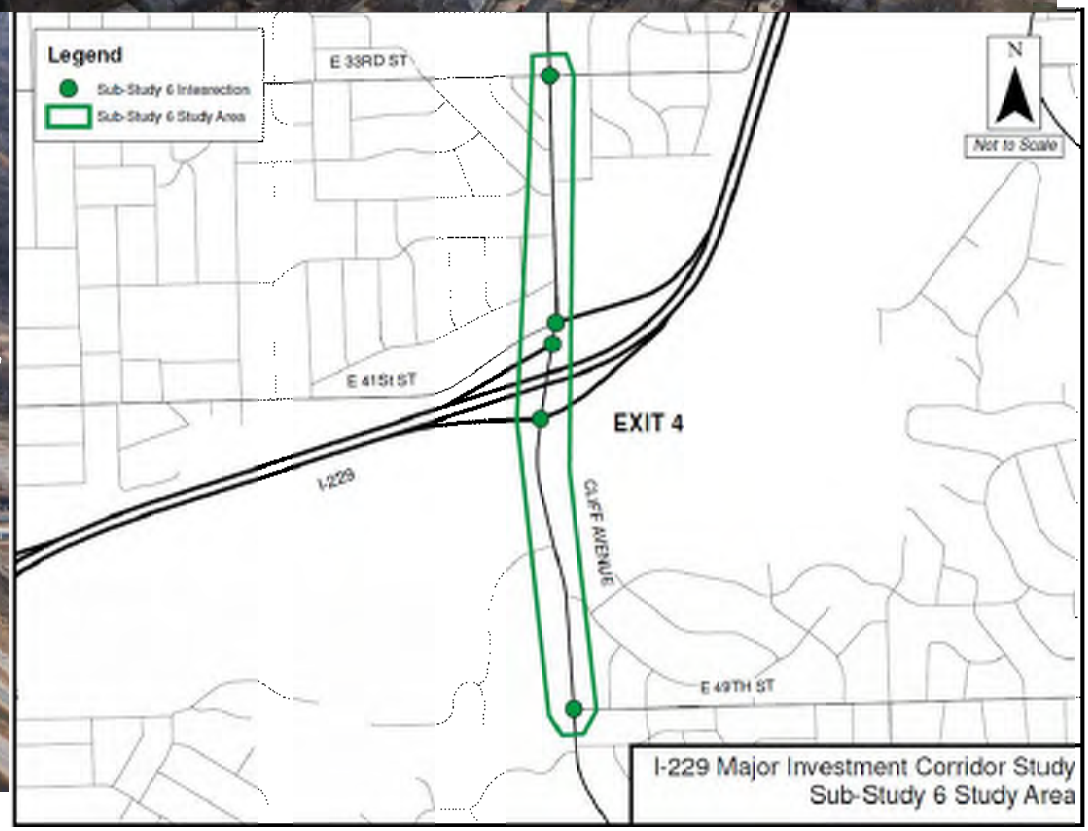
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

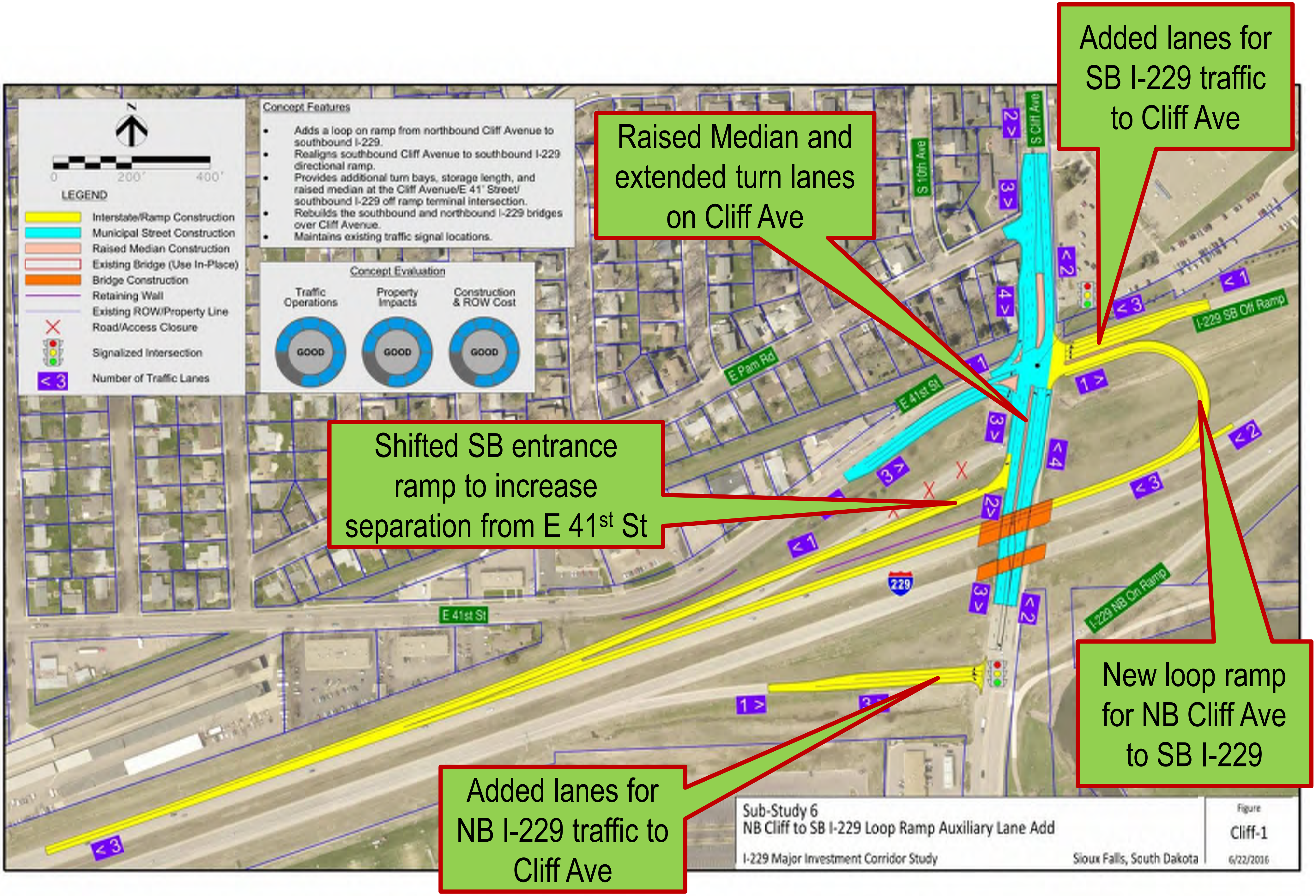
Exit 4 (Cliff Avenue)
Sub - Study Goals

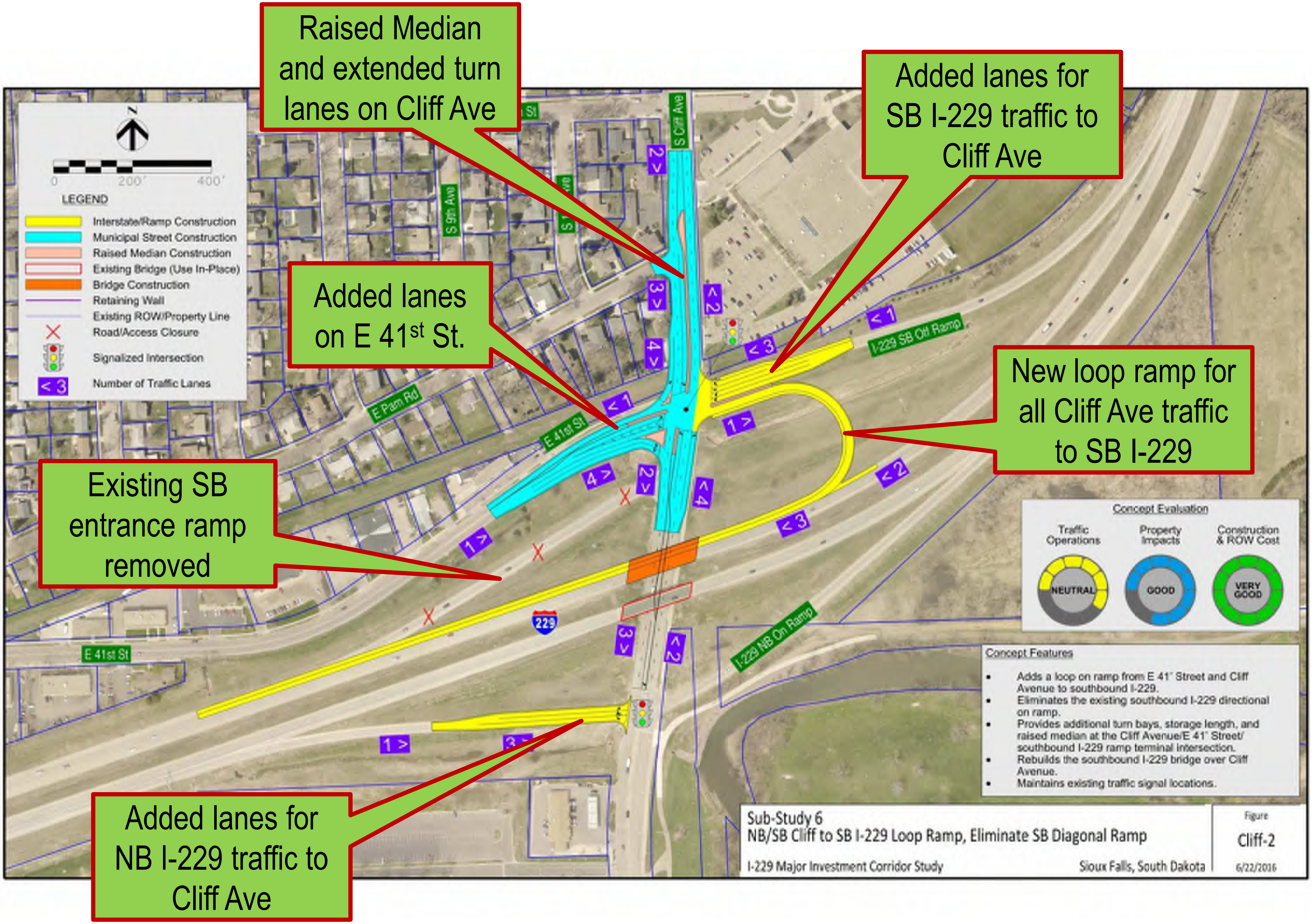
- Reduce traffic congestion
- Develop new geometrics to improve capacity at 41st Street and Interchange
- Improve pedestrian mobility
- Improve safety for corridor users



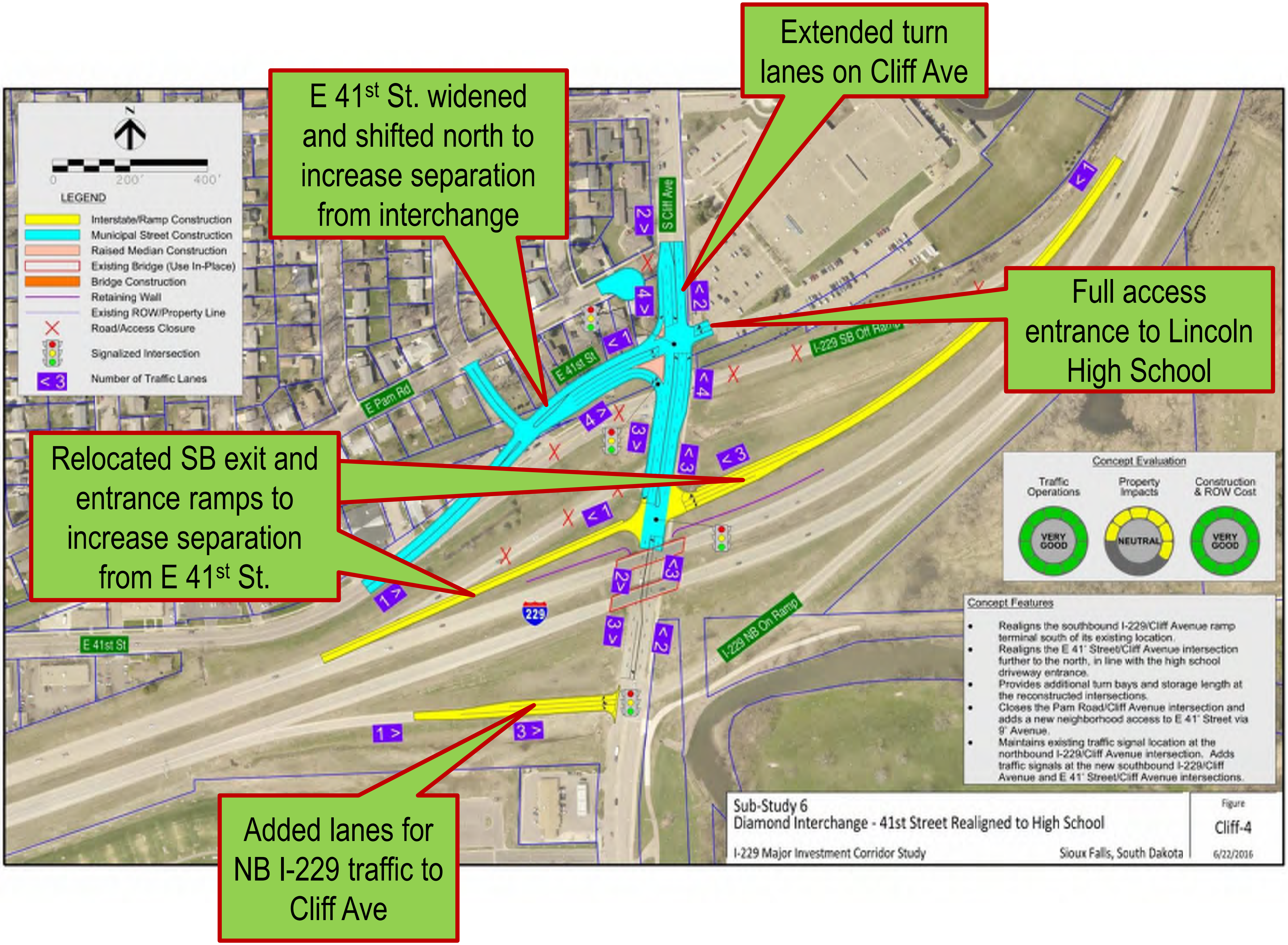


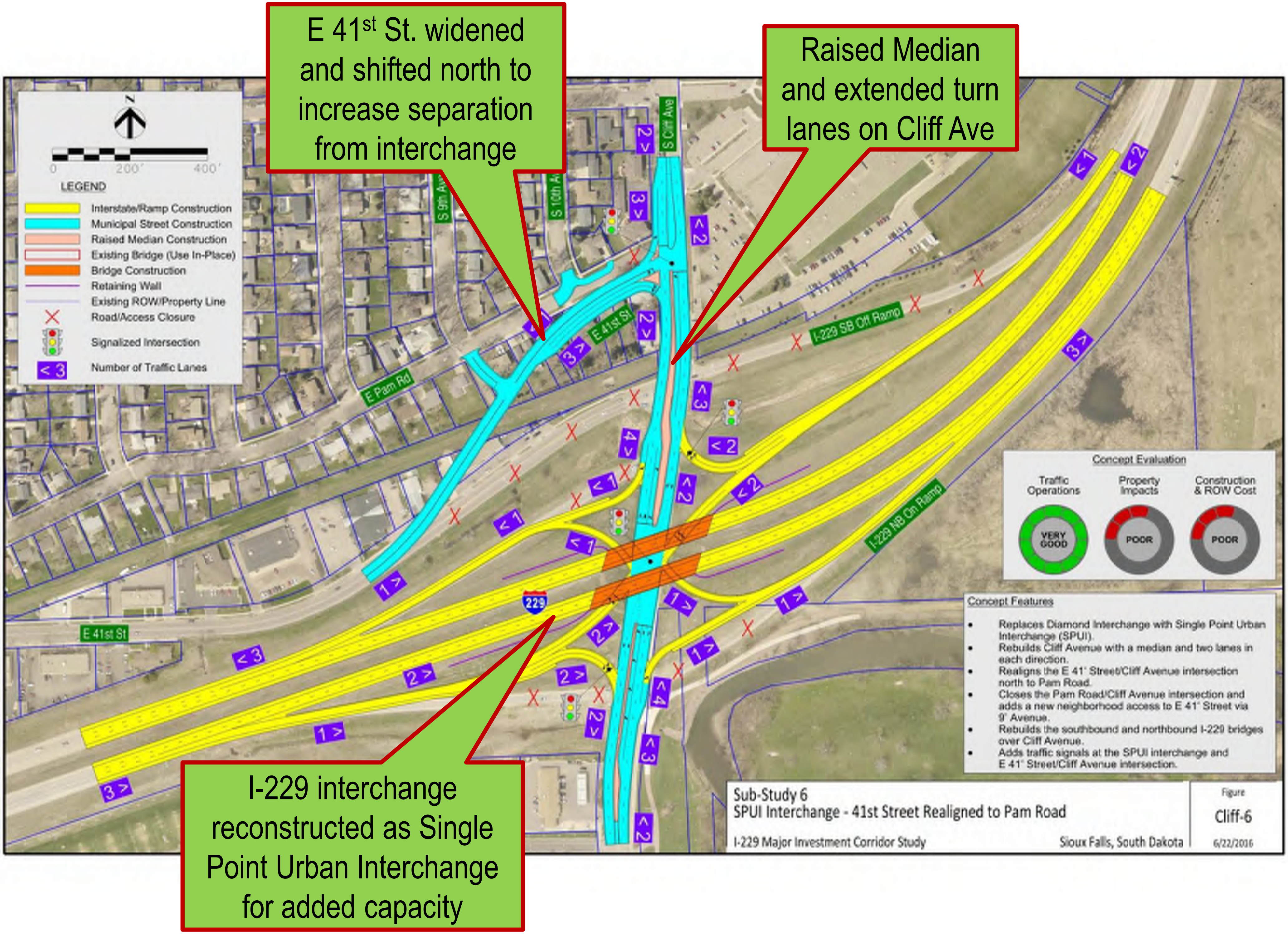

Access to Park close to interchange makes it difficult to exit during peak hour periods
Cliff Avenue
Turn Lane short and few gaps exist to complete left turn movement
229
Cliff Avenue
High Right Turn Volume in the PM Peak Hour
Congestion due to close proximity of 41st Street to I229 SB ON Ramp

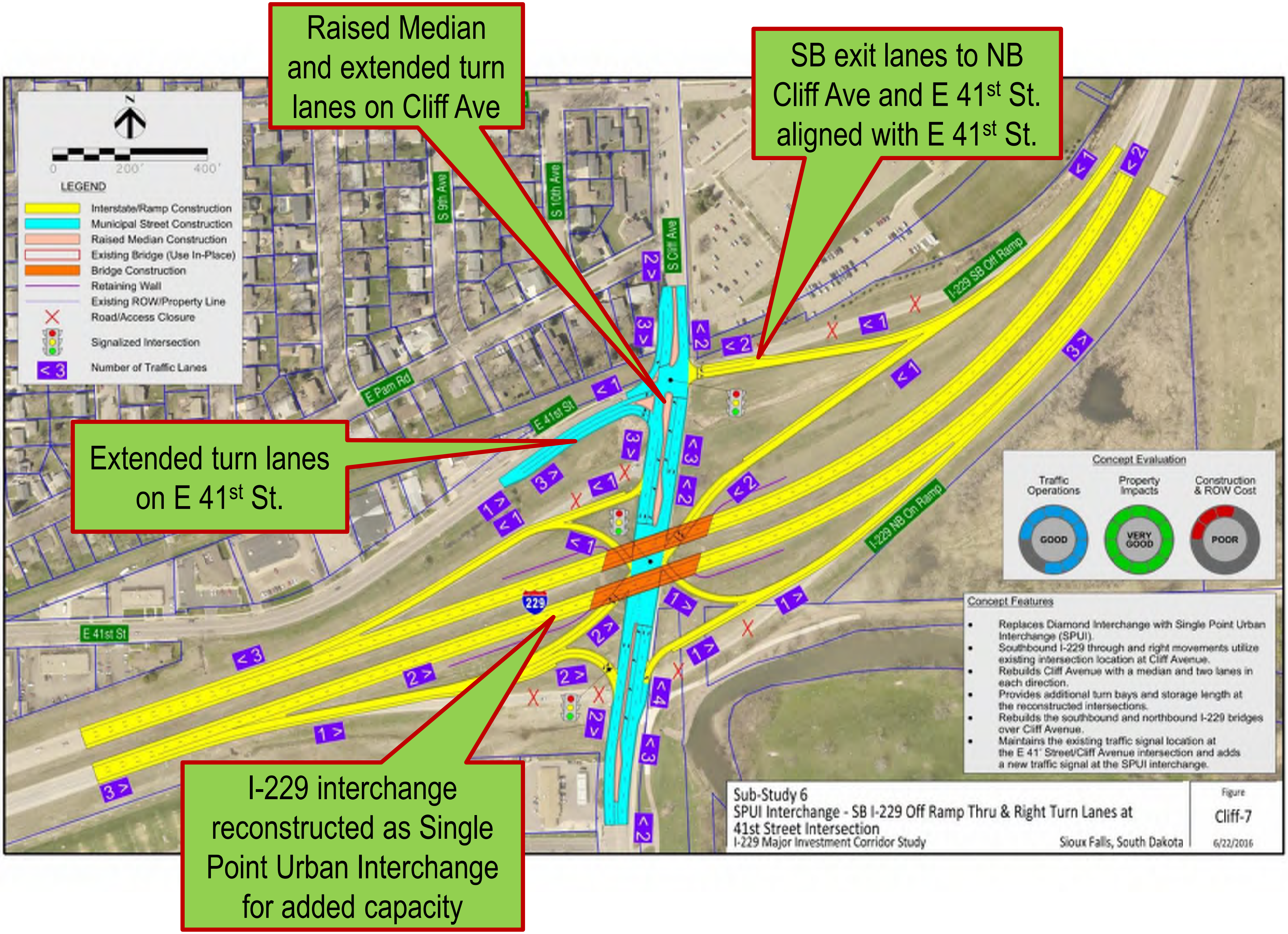

Added lanes for SB I-229 traffic to Cliff Ave
Raised Median and extended turn lanes on Cliff Ave
Shifted SB entrance ramp to increase separation from E 41st St
New loop ramp for NB Cliff Ave to SB I-229
Added lanes for NB I-229 traffic to Cliff Ave
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
Concept Features
Adds a loop on ramp from northbound Cliff Avenue to southbound I-229.
Realigns southbound Cliff Avenue to southbound I-229 directional ramp.
Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/southbound I-229 off ramp terminal intersection.
Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
Maintains existing traffic signal locations.
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
GOOD
GOOD
GOOD
S Cliff Ave
S 10th Ave
E Pam Rd
E 41st St
I-229 SB Off Ramp
I-229 NB On Ramp
Sub-Study 6
NB Cliff to SB I-229 Loop Ramp Auxiliary Lane Add
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-1
6/22/2016

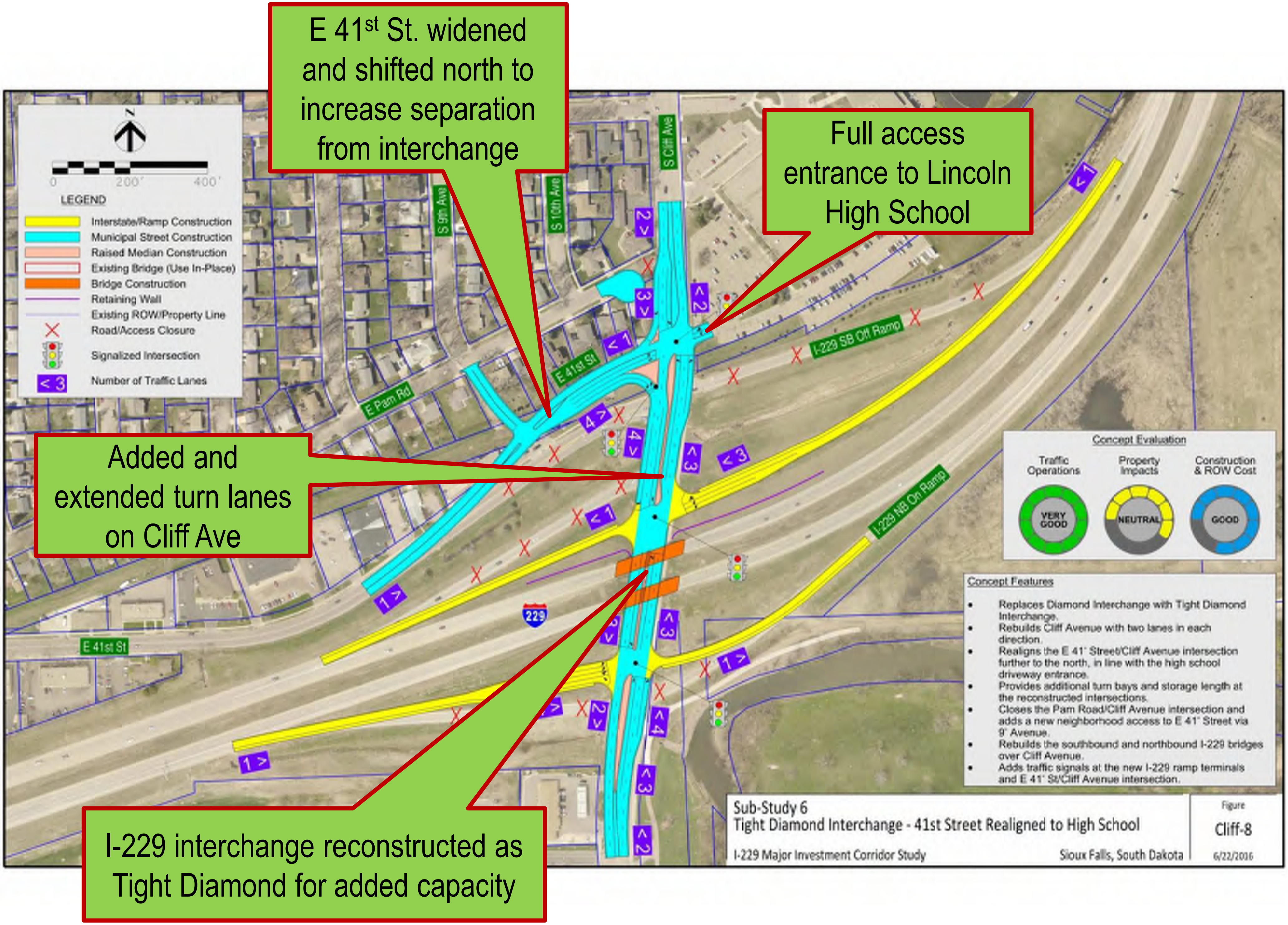


Raised Median and extended turn lanes on Cliff Ave
Added lanes for SB I-229 traffic to Cliff Ave
Added lanes on E 41st St.
New loop ramp for all Cliff Ave traffic to SB I-229
Existing SB entrance ramp removed
Added lanes for NB I-229 traffic to Cliff Ave
N
0 200' 400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S Cliff Ave
S 9th Ave
E Pam Rd
E 41st St
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
NEUTRAL
GOOD
VERY GOOD
Concept Features
Adds a loop on ramp from E 41st Street and Cliff Avenue to southbound I-229.
Eliminates the existing southbound I-229 directional on ramp.
Provides additional turn bays, storage length, and raised median at the Cliff Avenue/E 41st Street/southbound I-229 ramp terminal intersection.
Rebuilds the southbound I-229 bridge over Cliff Avenue.
Maintains existing traffic signal locations.
Sub-Study 6
NB/SB Cliff to SB I-229 Loop Ramp, Eliminate SB Diagonal Ramp
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-2
6/22/2016


E 41st St. widened and shifted north to increase separation from interchange
Extended turn lanes on Cliff Ave
Full access entrance to Lincoln High School
Relocated SB exit and entrance ramps to increase separation from E 41st St.
Added lanes for NB I-229 traffic to Cliff Ave
N
0 200' 400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S Cliff Ave
E 41st St
E Pam Rd
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
NEUTRAL
VERY GOOD
Concept Features
• Realigns the southbound I-229/Cliff Avenue ramp terminal south of its existing location.
• Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
• Provides additional turn bays and storage length at the reconstructed intersections.
• Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
• Maintains existing traffic signal location at the northbound I-229/Cliff Avenue intersection. Adds traffic signals at the new southbound I-229/Cliff Avenue and E 41st Street/Cliff Avenue intersections.
Sub-Study 6
Diamond Interchange - 41st Street Realigned to High School
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-4
6/22/2016


E 41st St. widened and shifted north to increase separation from interchange
Raised Median and extended turn lanes on Cliff Ave
I-229 interchange reconstructed as Single Point Urban Interchange for added capacity
N
0
200'
400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S Cliff Ave
S 9th Ave
S 10th Ave
E 41st St
E Pam Rd
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
POOR
POOR
Concept Features
Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
Rebuilds Cliff Avenue with a median and two lanes in each direction.
Realigns the E 41st Street/Cliff Avenue intersection north to Pam Road.
Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
Adds traffic signals at the SPUI interchange and E 41st Street/Cliff Avenue intersection.
Sub-Study 6
SPUI Interchange - 41st Street Realigned to Pam Road
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-6
6/22/2016


Raised Median and extended turn lanes on Cliff Ave
SB exit lanes to NB Cliff Ave and E 41st St. aligned with E 41st St.
Extended turn lanes on E 41st St.
I-229 interchange reconstructed as Single Point Urban Interchange for added capacity
N
0 200' 400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S 9th Ave
S 10th Ave
S Cliff Ave
E Pam Rd
E 41st St
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
GOOD
Property Impacts
VERY GOOD
Construction & ROW Cost
POOR
Concept Features
• Replaces Diamond Interchange with Single Point Urban Interchange (SPUI).
• Southbound I-229 through and right movements utilize existing intersection location at Cliff Avenue.
• Rebuilds Cliff Avenue with a median and two lanes in each direction.
• Provides additional turn bays and storage length at the reconstructed intersections.
• Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
• Maintains the existing traffic signal location at the E 41st Street/Cliff Avenue intersection and adds a new traffic signal at the SPUI interchange.
Sub-Study 6
SPUI Interchange - SB I-229 Off Ramp Thru & Right Turn Lanes at 41st Street Intersection
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-7
6/22/2016


E 41st St. widened and shifted north to increase separation from interchange
Full access entrance to Lincoln High School
Added and extended turn lanes on Cliff Ave
I-229 interchange reconstructed as Tight Diamond for added capacity
N
0 200' 400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Retaining Wall
Existing ROW/Property Line
Road/Access Closure
Signalized Intersection
Number of Traffic Lanes
S Cliff Ave
S 9th Ave
S 10th Ave
E 41st St
E Pam Rd
I-229 SB Off Ramp
I-229 NB On Ramp
229
Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
VERY GOOD
NEUTRAL
GOOD
Concept Features
• Replaces Diamond Interchange with Tight Diamond Interchange.
• Rebuilds Cliff Avenue with two lanes in each direction.
• Realigns the E 41st Street/Cliff Avenue intersection further to the north, in line with the high school driveway entrance.
• Provides additional turn bays and storage length at the reconstructed intersections.
• Closes the Pam Road/Cliff Avenue intersection and adds a new neighborhood access to E 41st Street via 9th Avenue.
• Rebuilds the southbound and northbound I-229 bridges over Cliff Avenue.
• Adds traffic signals at the new I-229 ramp terminals and E 41st St/Cliff Avenue intersection.
Sub-Study 6
Tight Diamond Interchange - 41st Street Realigned to High School
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Cliff-8
6/22/2016

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Brian Ray– HDR Engineering, Inc.
402-548-5066 or Brian.Ray@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

Interstate 229 Major Investment Study
Exit 4 – Cliff Avenue

Thanks for Attending!!!!!

APPENDIX -

STAKEHOLDER MEETINGS #2 – DECEMBER 5TH & 6TH, 2016

Benson Road

December 5th, 2016

- **Meeting Notes**
- **Sign-In Sheets**
- **PowerPoint Slides**
- **Comments (See Public Meeting #3 Appendix)**

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 4 – Benson Road Exit 9
Date:	Monday, December 05, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 5 Participants

Stakeholder comments and questions noted:

1. Stakeholders representing Boyer Trucks (West side of St Paul Ave, south of Benson Rd) – The proposed concept will prevent westbound traffic on Benson Rd from turning left at St Paul Ave to go south. Concern noted in particular for westbound semi-trailer truck traffic headed for businesses along St Paul Ave. That traffic would have to turn onto Potsdam Ave or Lewis Ave and find their way to St Paul Ave via 39th St N. Truck drivers headed for businesses along St Paul Ave may get lost along the way. The routing is too inconvenient. Boyer Truck has no access to Lewis Ave.

2. At least half of the businesses located south of Benson Rd and west of I-229 are trucking-related.

3. Opposed to proposed median treatment on Benson Rd at Potsdam Avenue.

4. Stakeholder opinion - Crashes on Benson Road at intersections are due to speed on Benson Road (the existing posted speed limit is 40 mph).

5. Will Concept Benson-4 impact the property to the northeast of the northbound I-229 entrance ramp at Benson Rd? Response: At this stage of concept development, it appears that property impacts along the northbound entrance ramp would be very limited.

6. Will right of way acquisition be needed for proposed widening at Benson Rd and Lewis Ave? Response: Probably.

7. How many years in the future will the proposed improvements be constructed? Response: At least six years.

Meeting Minutes

Project:	I-229 MIS; PL 0100 (87) 3616P, PCN 044K
Subject:	Sub-study 4 (Benson Road) Stakeholder Meeting Notes
Date:	Monday, December 05, 2016
Location:	SF Convention Center
Attendees:	See sign in sheets

1. Presentation by Jason Kjenstad. I229 MIS Set 2 Stakeholder Mtg_Benson Rd
2. Stakeholder questions/comments and *responses* during and after presentation:
   - Trucking company on south side of St. Paul Avenue is concerned about loss of access from the proposed raised center median on Benson Road. *Kjenstad response was that center median is needed for safety benefits; City design standards call for raised center median for roadways with 3 through lanes in each direction.*
   - With the proposed raised median at Benson Road/St. Paul Avenue intersection, trucks will be forced to use Lewis Avenue/Potsdam Avenue/39th Street combination to get to the trucking businesses along St. Paul Avenue. These streets do not now accommodate the widths and intersection radii required for truck movements. *Kjenstad response was that alternative access routes would have to be reviewed for truck traffic and potential improvements would need to be considered.*
   - Recommend speed control/reduction methods on Benson Road to address traffic speeds in excess of posted speed limits. *Kjenstad response was that besides speed limit enforcement, for arterial streets like Benson Road, the City typically does not incorporate speed control/reduction methods.*
   - South-side landowners were assessed for 2016 installation of sidewalk along the south side of Benson Road. Would landowners get assessed again for future sidewalk improvements associated with Benson Road reconstruction/widening? *City response was that there would not be additional assessments to landowners for sidewalk work.*
   - Recommended adding a traffic signal at Benson Road/St. Paul Avenue intersection. *Kjenstad response was that signals are spaced to facilitate traffic movements and a signal at the Benson Road/St. Paul Avenue intersection would not meet City or SDDOT signal spacing criteria.*
   - What is the timeframe for proposed Benson Road improvements? *Kjenstad response was 7 to 10 years from now before any construction begins.*
   - SF Development owns the property in the northeast quadrant of the I-29/Benson Road interchange. They are concerned about the additional roadway right-of-way needed for the interchange loop options. *Kjenstad response was that the City will work with the landowner throughout the development plan process.*
   - Benson Road traffic is not bad during off-peak hours; why is widening required? *Kjenstad response was that peak period traffic is the basis for design and 3 through traffic lanes in each direction are needed to accommodate predicted peak period traffic to meet City and SDDOT level of service criteria.*
   - What is the cost difference between the interchange options? *Response by Unruh was that DDI option is about $4M less that the loop options ($40M estimated cost for options with loops; $36M estimated cost for DDI option).*

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Benson Road Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 3:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Shannon Ausen	224 W 9th St SFSD	367-8607	sausen@siouxfalls.org
2	James Unruh	HDR 6300 S. Old Village Pl. SFSD	605-977-7740	james.unruh@hdrinc.com
3	Jason Kjenstad	HDR 6300 S. Old Village Pl SF	605-977-7740	jason.kjenstad@hdrinc.com
4	Steve Gramm	700 E. Broadway Ave Pierre	605-773-6641	steve.gramm@state.sd.us
5	Bruce Mutschler	2101 E. Benson Rd	605-336-6100	bmutschler@beyertrucks.com
6	Lori Clemmensen	SFDF 200 N. Phillips Ave	605-339-0720	lmc@siouxfalls.com
7	CHRIS RANS	3412 N POTSDAM AVE.	(605) 338-9110	CHRIS@SUNKOTACONSTRUCTION.COM
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INTERSTATE 229 MAJOR INVESTMENT STUDY

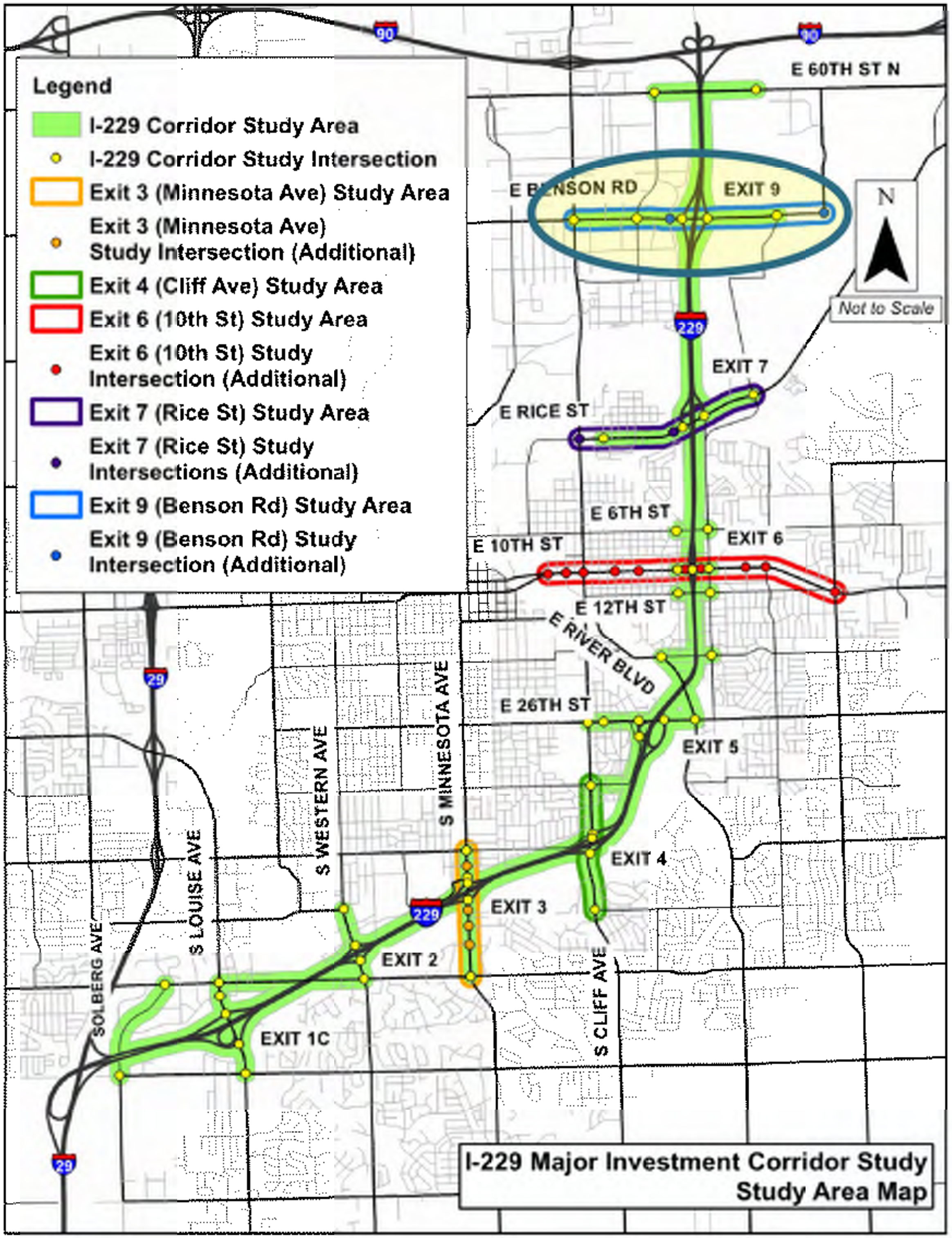
Exit 9 – Benson Rd Sub-Study

Stakeholder Meeting

December 5th, 2016
3:00 pm to 4:00 pm

HDR

STUDY AREA MAP



I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 9 – Benson Road

STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

- Evaluation Factors:

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	**Advance** or **Eliminate**

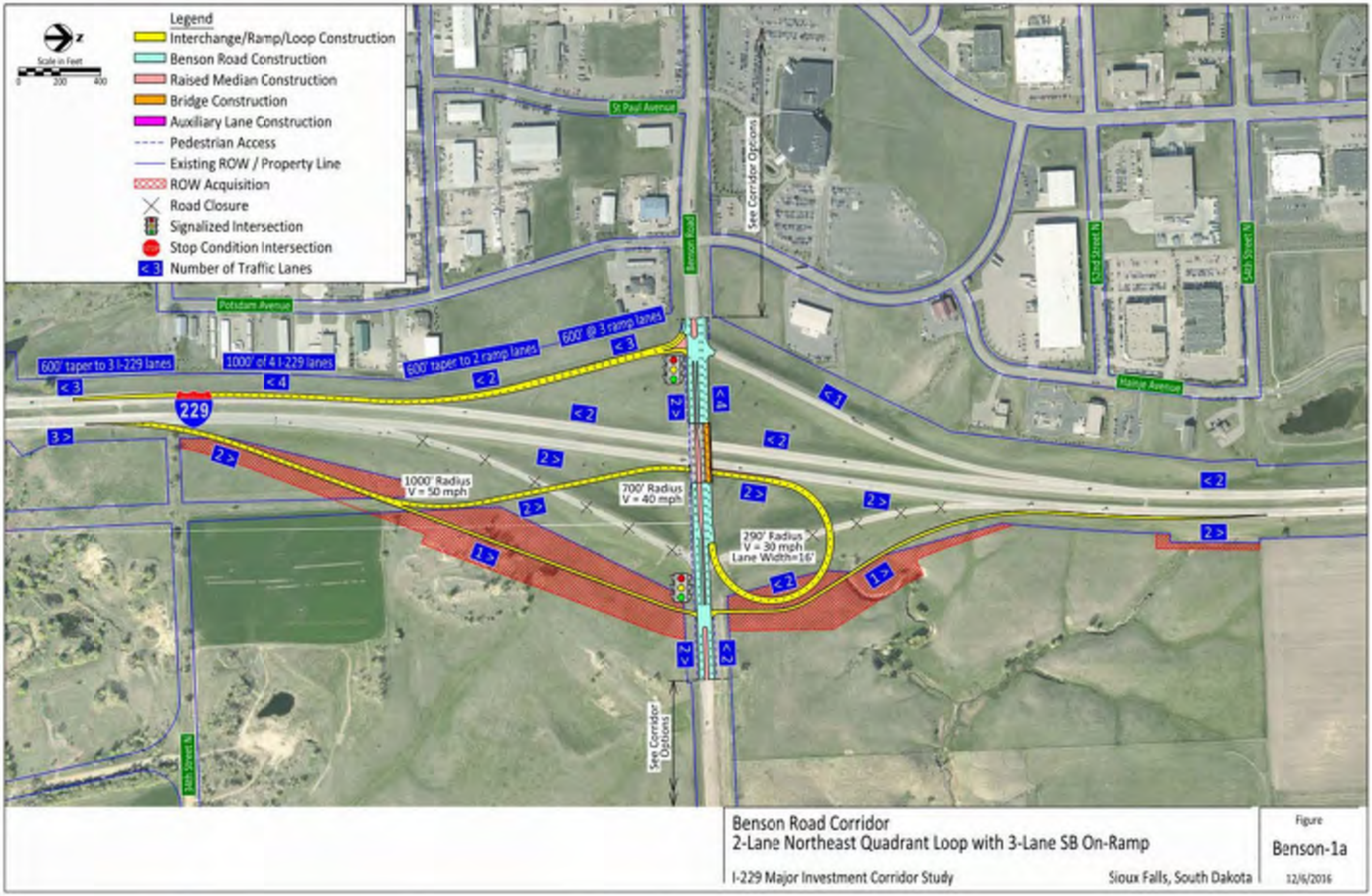
- Evaluation Matrix to Compare Concepts
- Recommended Action

CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
Benson-1A	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp	VERY GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	Advance
Benson-1B	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp	VERY GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	Advance
Benson-4	Diverging Diamond Interchange	NEUTRAL	VERY GOOD	GOOD	VERY GOOD	NEUTRAL	Advance

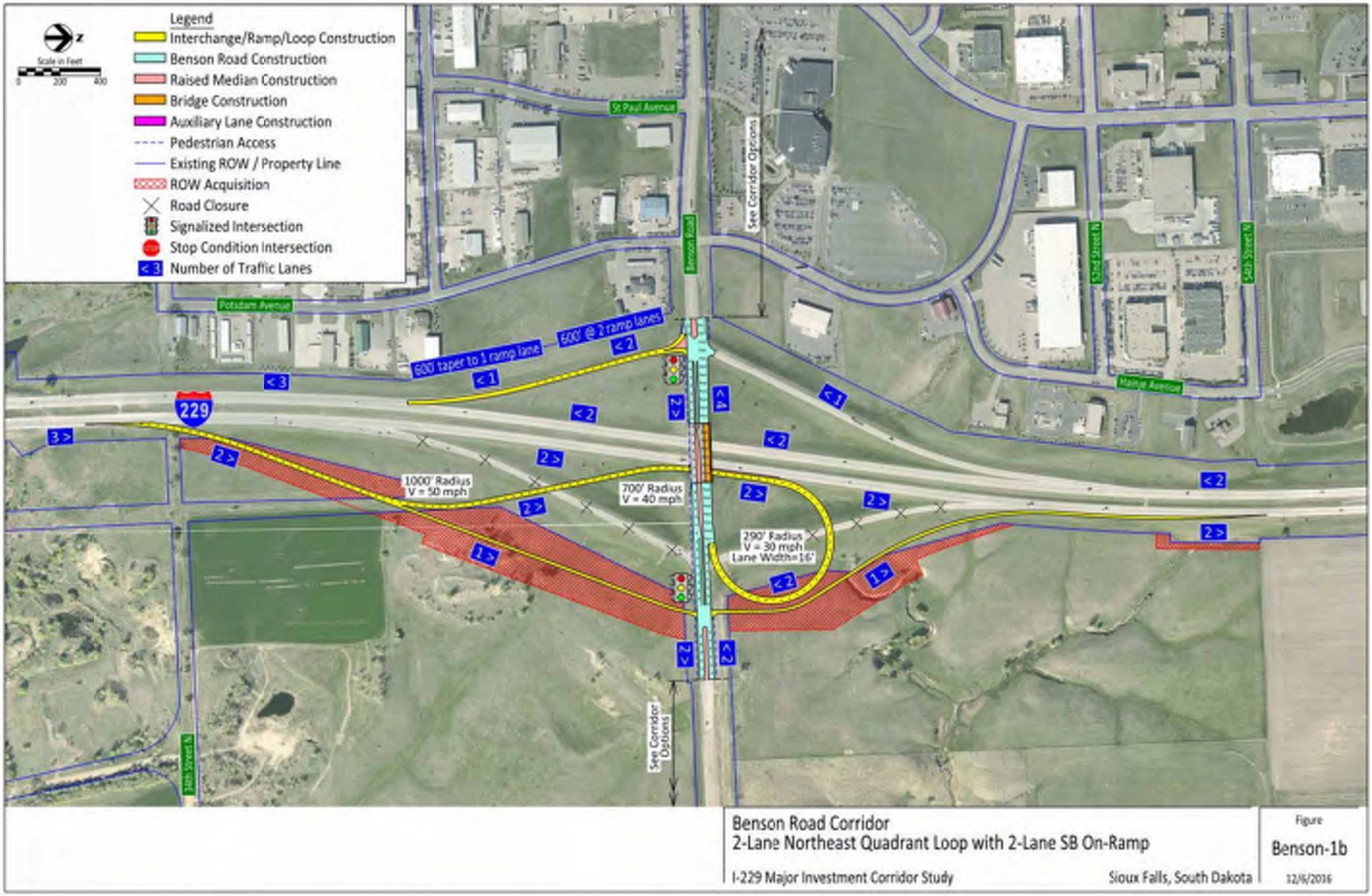
CONCEPTS FOR FURTHER CONSIDERATION

BENSON-1A



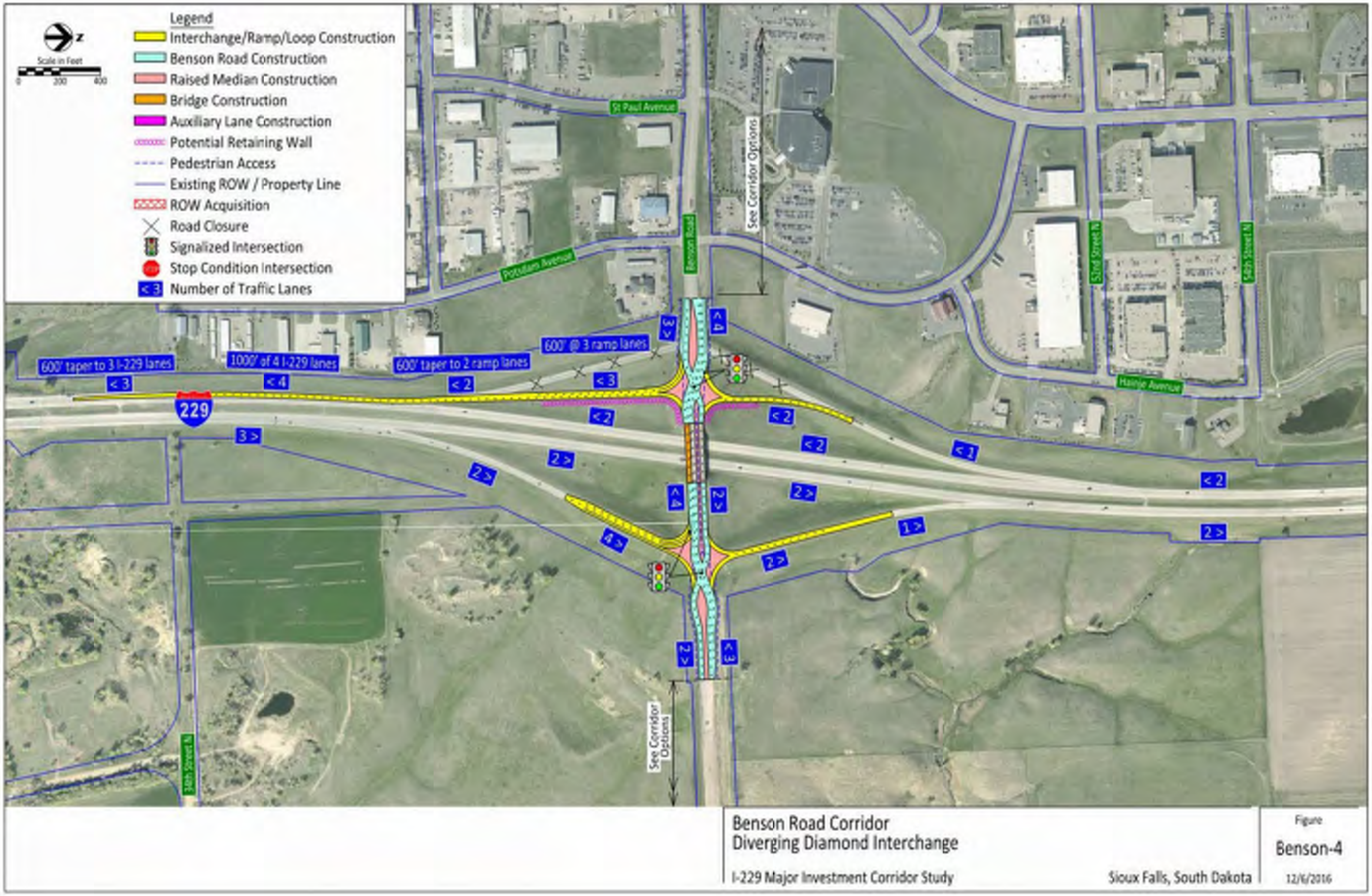
CONCEPTS FOR FURTHER CONSIDERATION

BENSON-1B

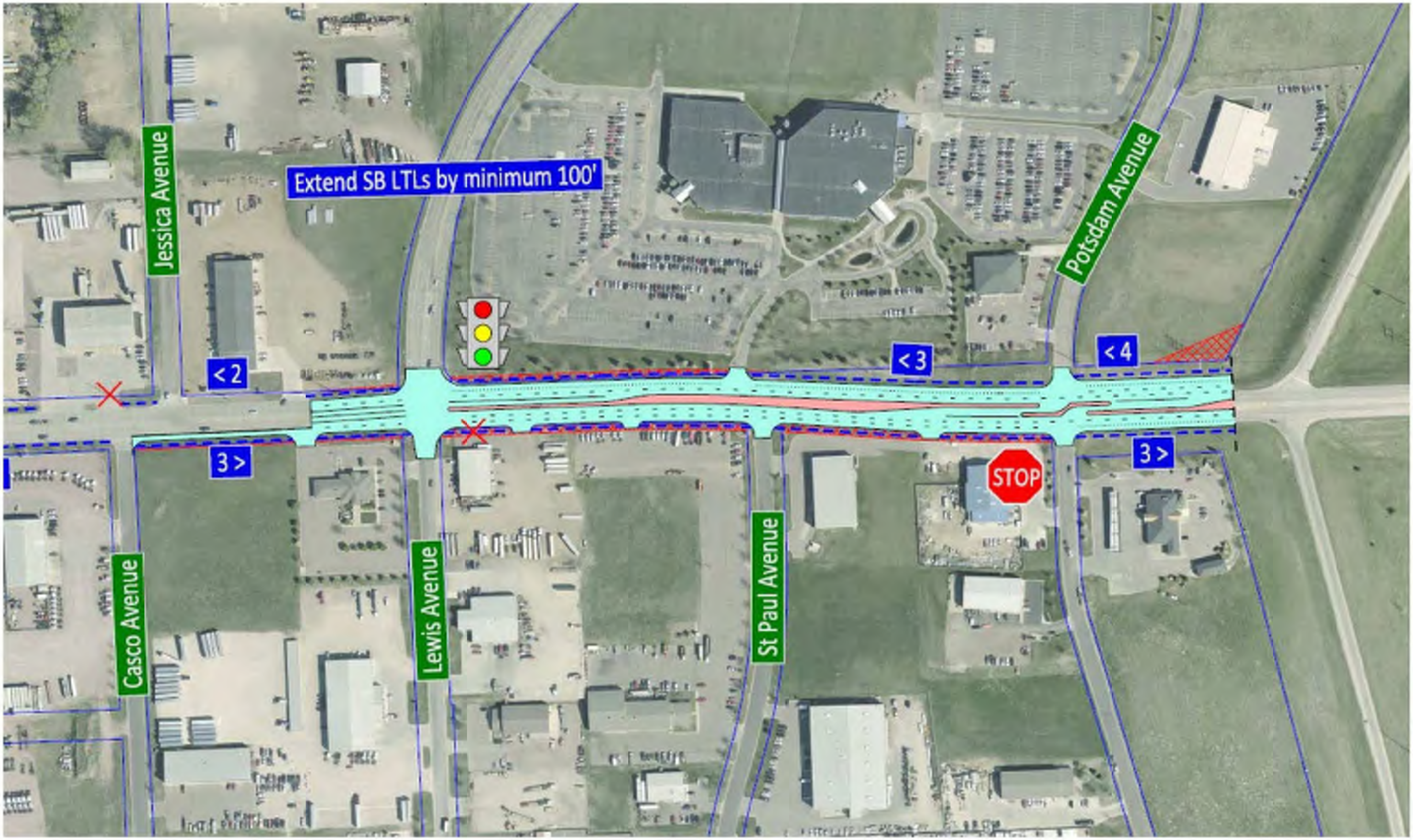


CONCEPTS FOR FURTHER CONSIDERATION

BENSON-4



CONCEPTS FOR FURTHER CONSIDERATION
BENSON IMPROVEMENTS



BENSON ROAD
PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- Benson Road Interchange and Corridor improvements = High Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
  - Prepare Interchange Modification Justification Report and Environmental Document
  - Develop Project Design
  - Acquire Right of Way
  - Construction

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

James Unruh – HDR Engineering, Inc.
605-977-7740 or james.unruh@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 9 – Benson Rd Sub-Study

Thanks for attending!

HDR

10TH STREET

DECEMBER 5TH, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES
- COMMENTS (SEE PUBLIC MEETING #3 APPENDIX)

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 3 - Exit 6 (10th Street) Sub-Study
Date:	Monday, December 05, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 5 Participants

Stakeholder comments and questions noted:

1. Question from stakeholder associated with Fry'in Pan Restaurant (Northwest corner 10th & Cleveland) - Is a median proposed on Cleveland Avenue both north and south of 10th Street? Response: The alternatives include a median on Cleveland Avenue both north and south of 10th Street and dual left turn lanes are proposed on each Cleveland Ave approach to serve anticipated traffic.

The stakeholder noted that Cleveland Ave is only busy after school is dismissed, for about 45 minutes per day, so dual left turn lanes are not needed.

He stated that he does not support the proposed medians on Cleveland because he perceives that similar medians on 12th St "ruined" businesses there.

2. How will parking impacts will be addressed? Response: Replacement parking would be sought, but if replacement parking could not be identified, acquisition of the property would be considered.

3. What happens to the Super 8 Hotel on the northeast corner of I-229/10th Street? Response: It was noted that all of the alternatives impact the hotel similarly.

SD DOT

CITY OF SIOUX FALLS PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for 10th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 4:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	gary busselman	7201 E Madison ST Sioux Falls SD 57110	605 334 5692	gary@garybuss.com
2	HERSIL PATEL	2616 E 10TH ST Sioux Falls SD 57103	727 776 1476 605 358 8881	hersil@yogimgt.com
3	CHUCK GUSTAFSON	705 E RIDGE RD SFSD 57105	332-1000	CGUSTAFSON@MAC.COM
4	STAN MITZEL	2708 East 10th SF SD 57103	605-361-7804	Smitzel@FryNPan.net
5	~~JAMES NORD~~			
6	RYAN TYSON	LLOYD COMPANIES	376-0127	RyanE LloydCompanies.com
7	Jason Kjenstad	HDR 1300 S. old Village Pl	977-7740	jason.kjenstad@hdrinc.com
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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 6 – 10th Street Sub-Study

Stakeholder Meeting

December 5th, 2016
4:30 pm to 5:30 pm

HDR

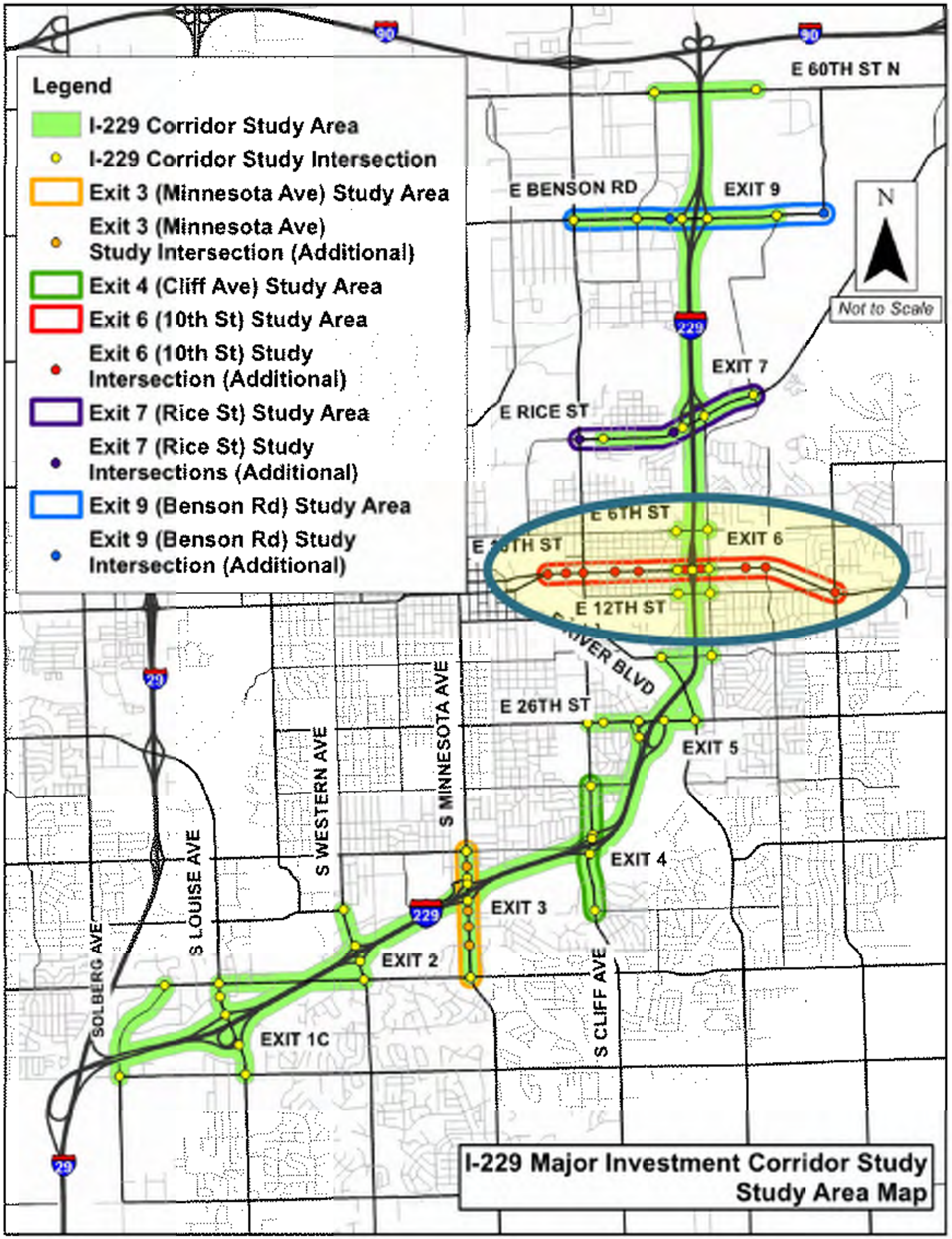
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 6 – 10th Street



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

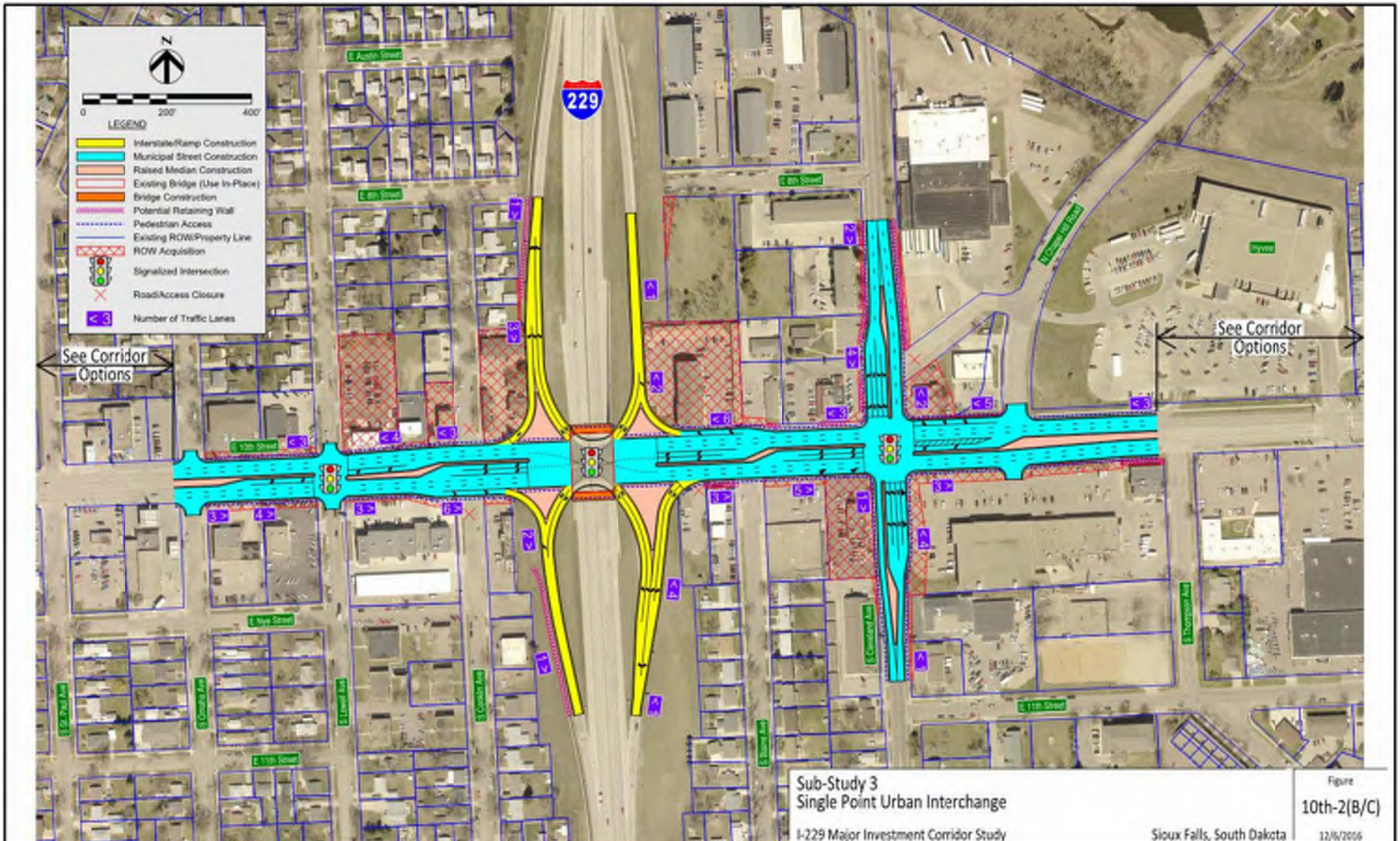
- Evaluation Factors:

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	Advance or Eliminate

- Evaluation Matrix to Compare Concepts
- Recommended Action

CONCEPTS FOR FURTHER CONSIDERATION

10TH-2 (B/C)

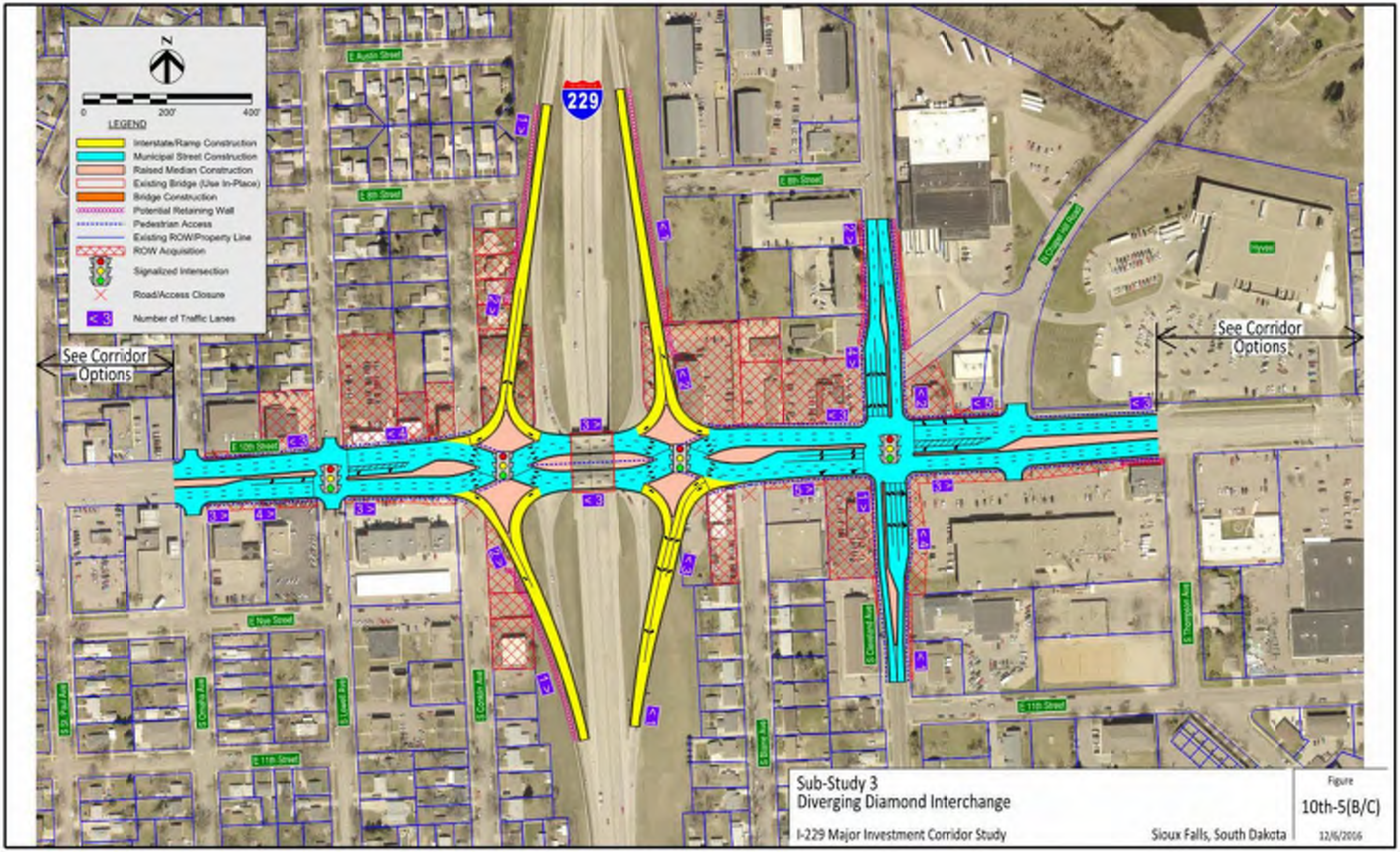


CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
10th-2A	Single Point Urban Interchange, 6-Lane Divided Corridor	VERY GOOD	NEUTRAL	NEUTRAL	POOR	POOR	Eliminate Property impacts, environmental impacts, and cost
10th-2B	Single Point Urban Interchange, 4-Lane Divided Corridor	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	NEUTRAL	Advance
10th-2C	Single Point Urban Interchange, 5-Lane Undivided Corridor	GOOD	NEUTRAL	NEUTRAL	GOOD	GOOD	Advance

CONCEPTS FOR FURTHER CONSIDERATION

10TH-5 (B/C)

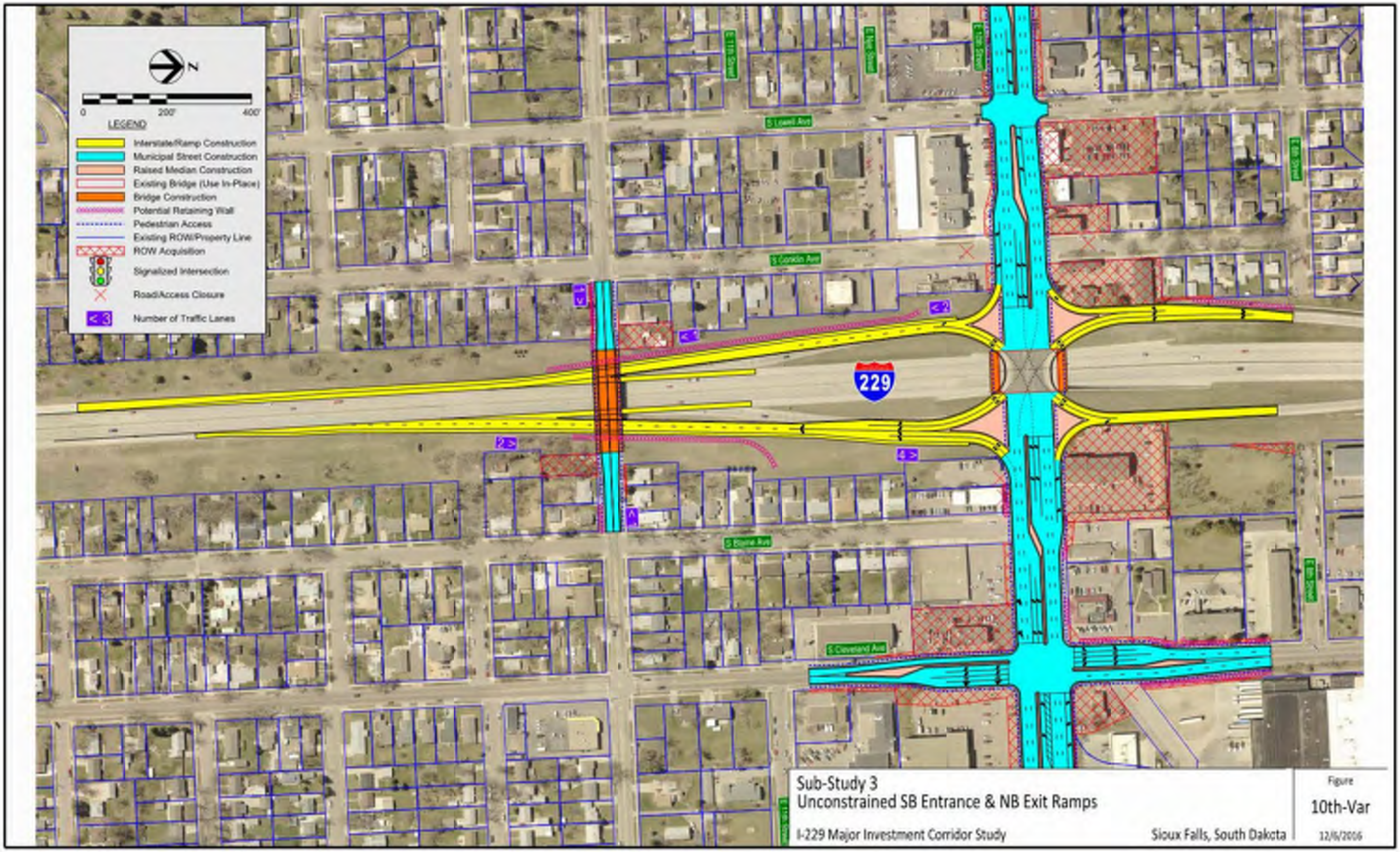


CONCEPT EVALUATION RESULTS (cont.)

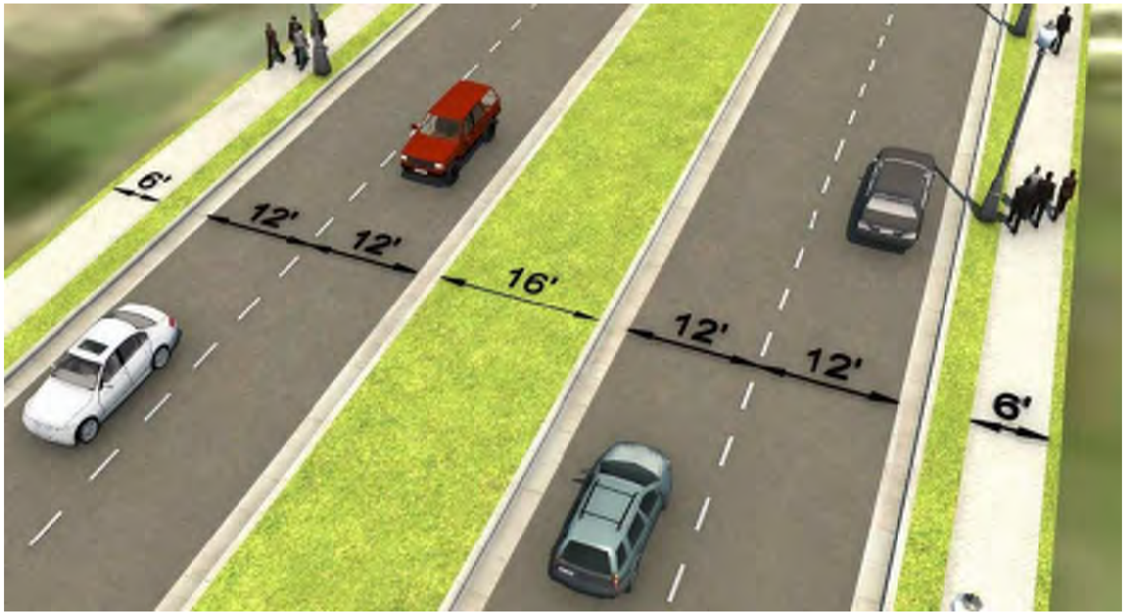
Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
10th-5A	Diverging Diamond Interchange, 6-Lane Divided Corridor	VERY GOOD	GOOD	NEUTRAL	POOR	POOR	**Eliminate** Property impacts, environmental impacts, and cost
10th-5B	Diverging Diamond Interchange, 4-Lane Divided Corridor	GOOD	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	**Advance**
10th-5C	Diverging Diamond Interchange, 5-Lane Undivided Corridor	GOOD	GOOD	NEUTRAL	GOOD	GOOD	**Advance**
10th-9A	Tight Split Diamond, 6th St/10th St with 4-Lane Divided Corridor	NEUTRAL	POOR	POOR	NEUTRAL	POOR	**Eliminate** Environmental impacts, cost, and lower traffic & safety benefits
10th-9B	Tight Split Diamond, 6th St/10th St with 5-Lane Undivided Corridor	NEUTRAL	POOR	POOR	GOOD	NEUTRAL	**Eliminate** Environmental impacts and lower traffic & safety benefits
10th-Var							**Advance**

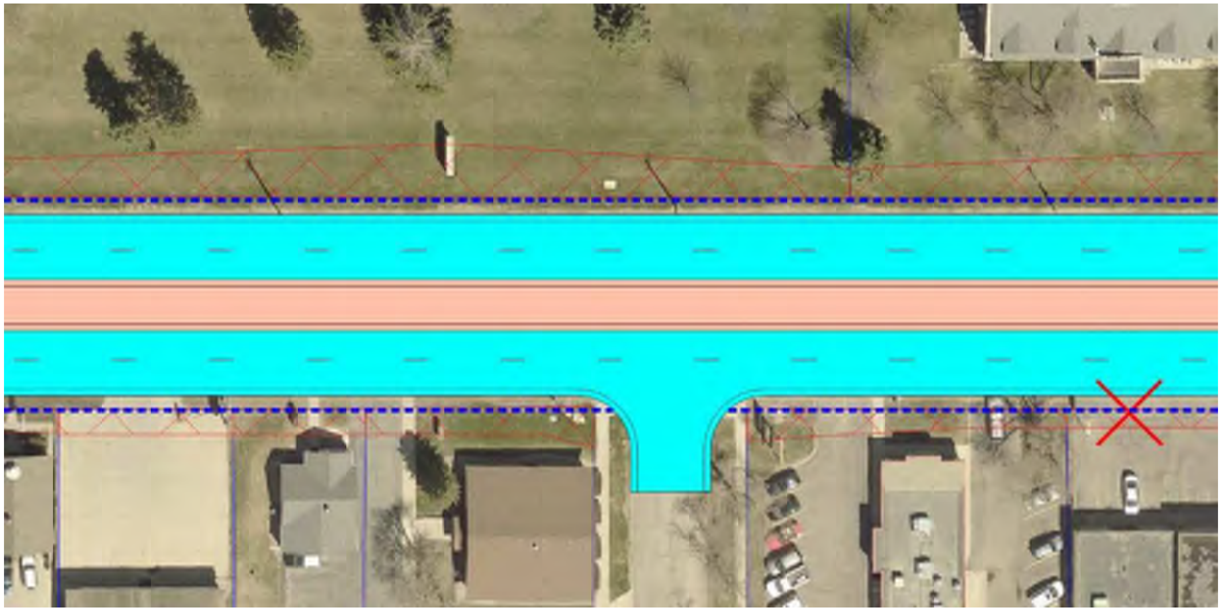
CONCEPTS FOR FURTHER CONSIDERATION

10TH-Var

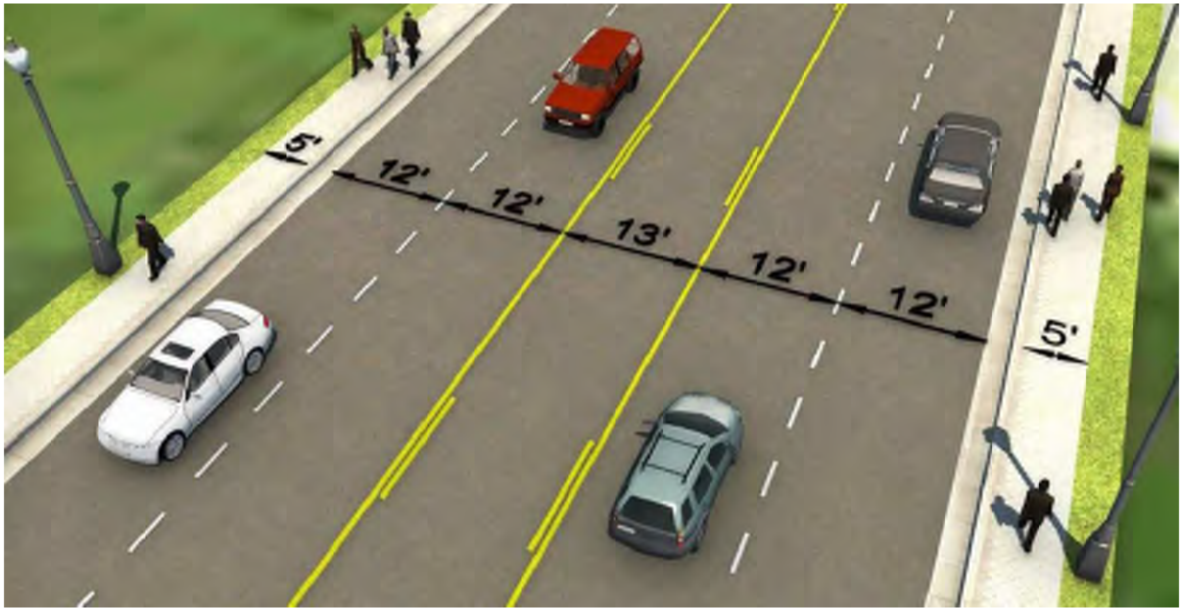


4-Lane Divided Corridor





5-Lane Undivided Corridor



10TH STREET
PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- 10th Street Interchange = High Priority
- 10th Street Corridor improvements = Low Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
    - Prepare Interchange Modification Justification Report and Environmental Document
    - Develop Project Design
    - Acquire Right of Way
    - Construction

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Chris Malmberg – HDR Engineering, Inc.
402-399-4959 or chris.malmberg@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 6 – 10th Street Sub-Study

Thanks for attending!

CLIFF AVENUE

DECEMBER 5TH, 2016

- **MEETING NOTES**
- **SIGN-IN SHEETS**
- **POWERPOINT SLIDES**
- **COMMENTS (SEE PUBLIC MEETING #3 APPENDIX)**

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 6 – Cliff Avenue Exit 4
Date:	Monday, December 05, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 10 Participants

Stakeholder comments and questions noted:

1. Are the crashes recorded within the Minnesota Ave study limits car crashes only? Response: A range of types of crashes involving a variety of vehicle types has been recorded in the Minnesota corridor.

2. Does the environmental impact assessment process consider loss of affordable housing? Development is taking affordable houses in the central city and the lost housing is replaced with higher cost housing on the metropolitan area periphery.

DOT

CITY OF SIOUX FALLS PUBLIC WORKS

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Cliff Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 6:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	JAMES NORD	904 E 38th	605 254 2480	jnord@sio.midco.net
2	Shannon Ausen	224 W. 9th St SFSD 57104	605-367-8607	Sausen@~~sio.mid~~ siouxfallssos
3	Marlys Roskens	3105 S. 9th Ave	605-336-6226	marlys@sio.midco.net
4	PAUL HARTMAN	1201 OTONKA	605-929-9768	HART Z HART @ SIO.MIDCO.NET
5	JEFF KOSHTE			
6	Gene Napier	1109 E. Pam Rd	605-373-0377	napier10@sio.midco.net
7	Jeff Roskens	3105 S. 9th Ave	605 553 2762	Jroskens@sio.midco.net
8	Barbara Richards	1112 East 38th St.	605-3382387	brichards@sio.midco.net
9	Lois Merritt	3004 S. 10th Ave.	(605)334-9498	
10	Wendy Butler Boysen	1104 E. Pam Rd.	605-906-1223	wbutler.boysen@gmail.com
11	Jason Kjenstad	6300 S. Old Village Pl Suite 100 SF SD 57108	605.977-7741	jason.kjenstad@hdrinc.com
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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 4 – Cliff Avenue Sub-Study

Stakeholder Meeting

December 5th, 2016
6:00 pm to 7:00 pm

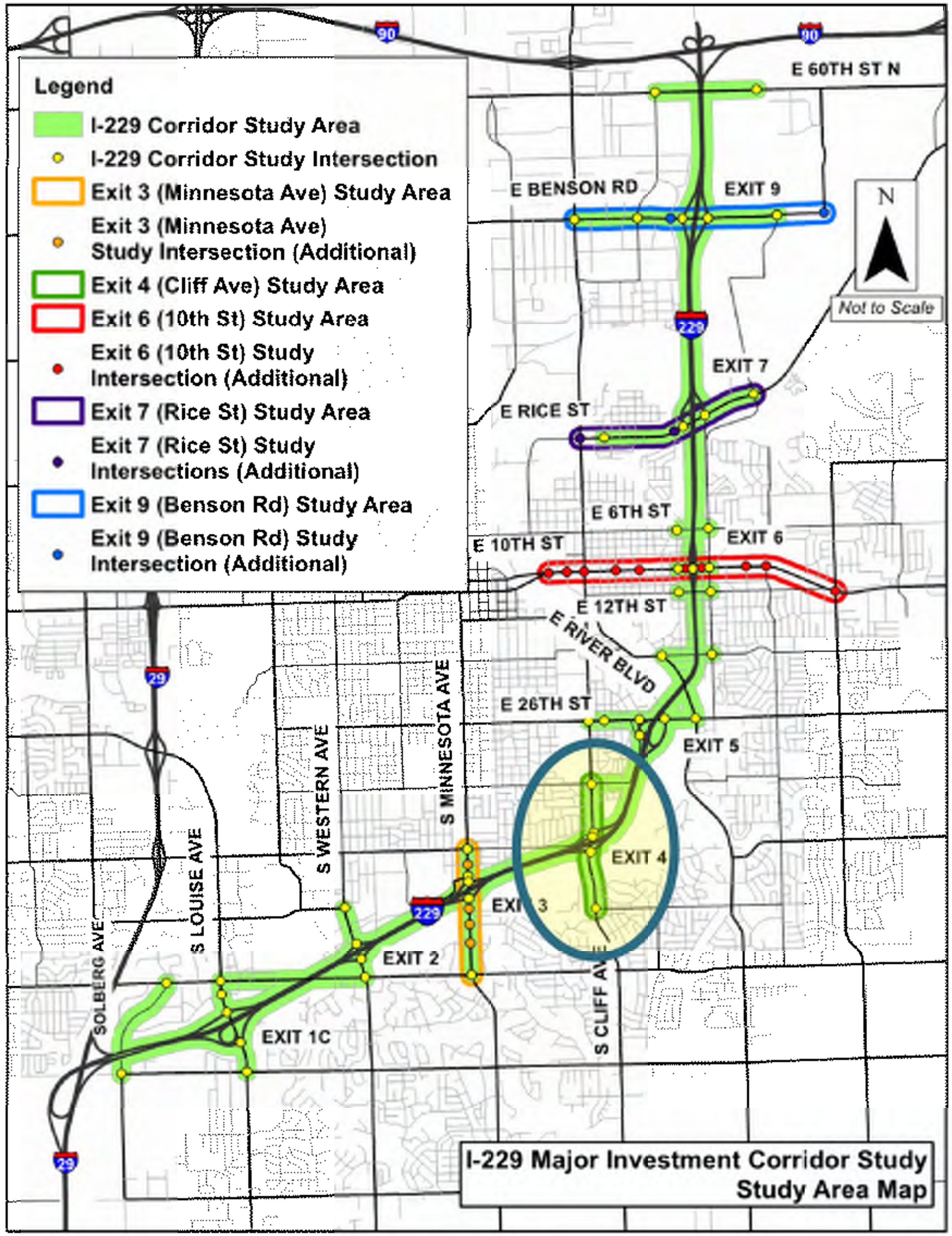
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 4 – Cliff Avenue



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

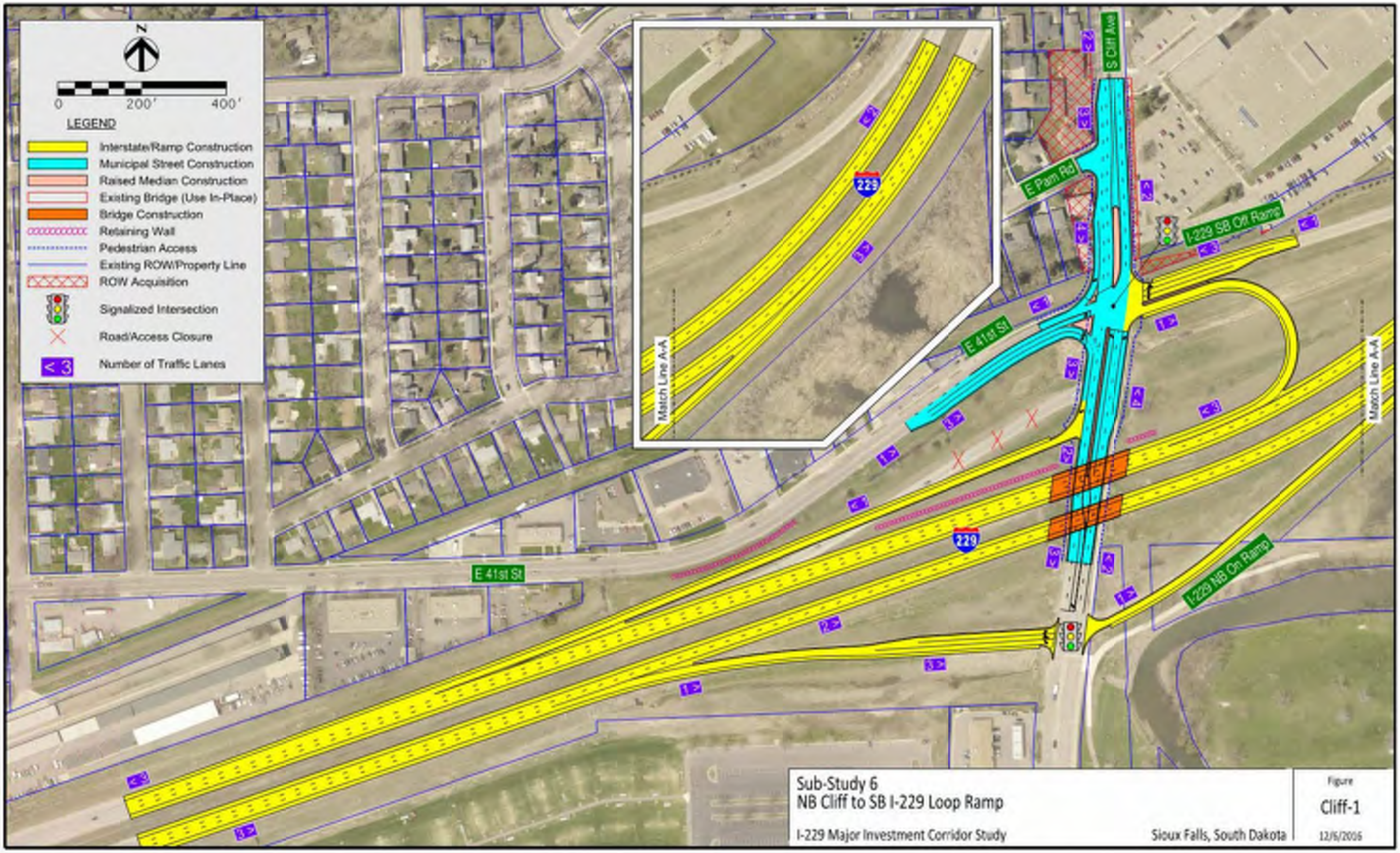
- Evaluation Factors:

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	**Advance** **or** **Eliminate**

- Evaluation Matrix to Compare Concepts
- Recommended Action

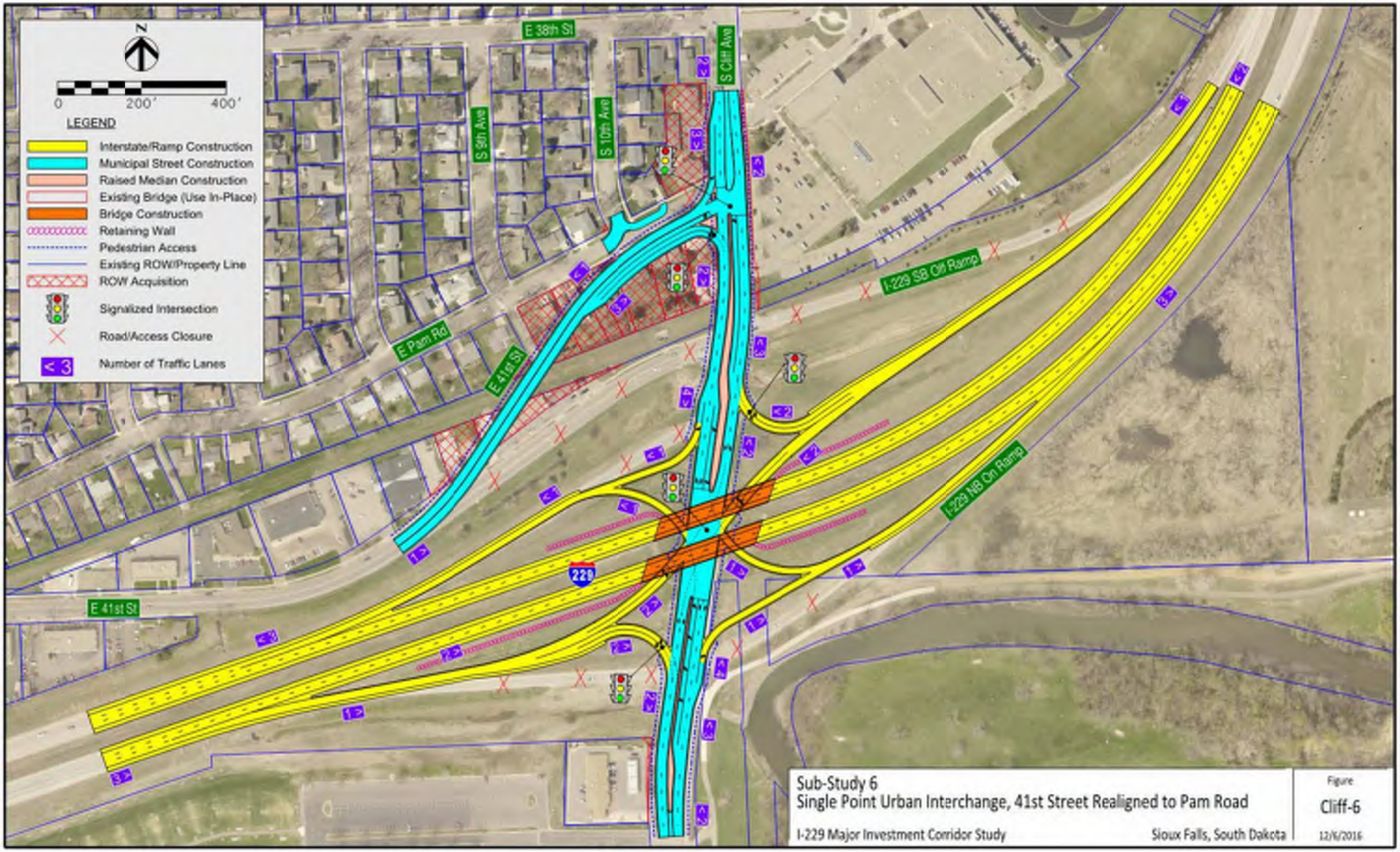
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF-1

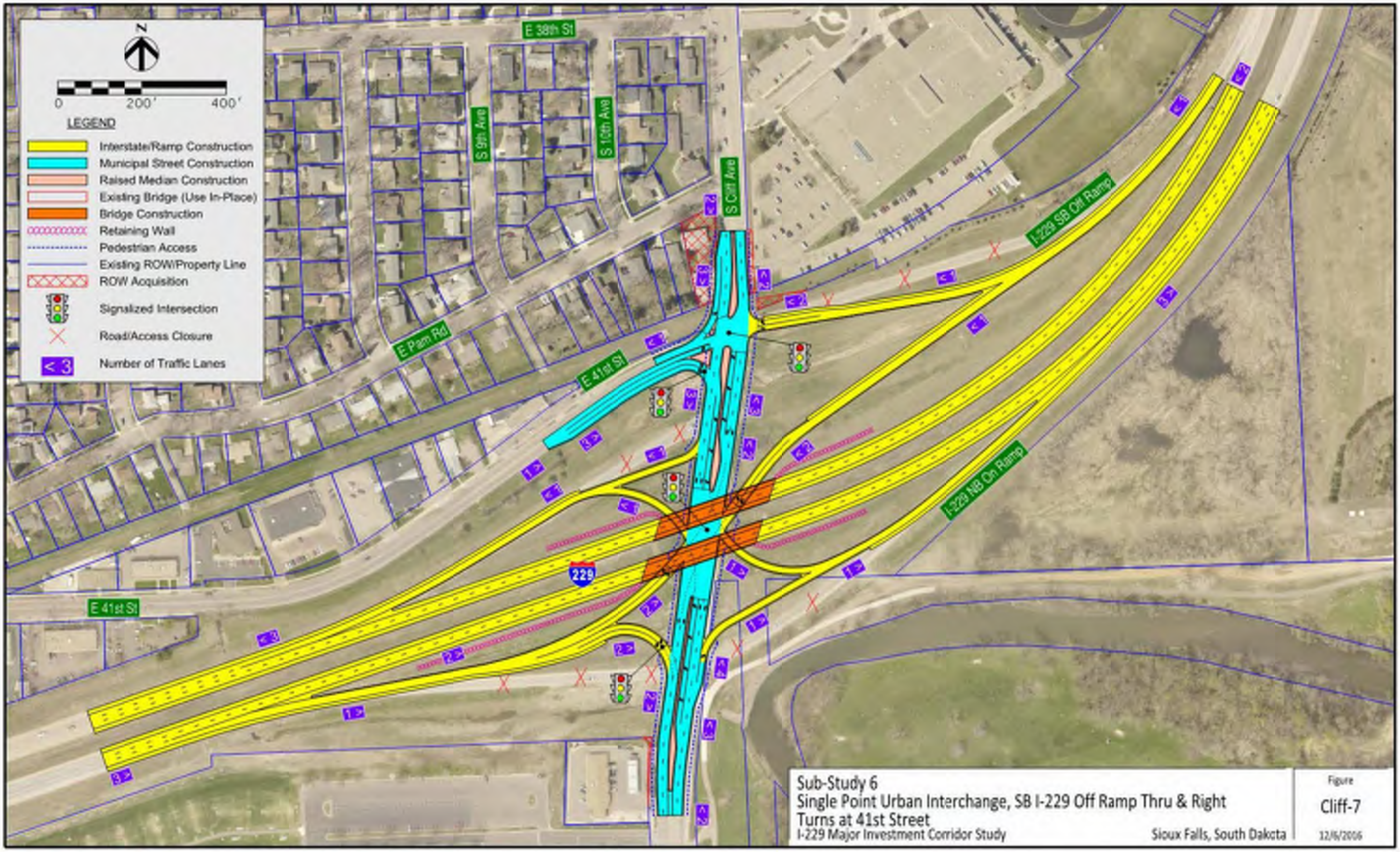


CONCEPTS FOR FURTHER CONSIDERATION

CLIFF- 6



CONCEPTS FOR FURTHER CONSIDERATION
CLIFF - 7



CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
Cliff-1	NB Cliff to SB I-229 Loop Ramp	GOOD	NEUTRAL	GOOD	GOOD	GOOD	Advance
Cliff-6	Single Point Urban Interchange, 41st St Realigned to Pam Rd	VERY GOOD	GOOD	GOOD	POOR	POOR	Advance
Cliff-7	Single Point Urban Interchange, SB I-229 Off-Ramp Thru & Right Turns at 41st St	GOOD	GOOD	GOOD	VERY GOOD	POOR	Advance

CLIFF AVENUE PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- Cliff Avenue Interchange = Medium Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
  - Prepare Interchange Modification Justification Report and Environmental Document
  - Develop Project Design
  - Acquire Right of Way
  - Construction

PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Brian Ray– HDR Engineering, Inc.
402-548-5066 or Brian.Ray@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us

INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 4 – Cliff Avenue

Thanks for attending!

RICE STREET

DECEMBER 6TH, 2016

- MEETING NOTES
- SIGN-IN SHEETS
- POWERPOINT SLIDES
- COMMENTS (SEE PUBLIC MEETING #3 APPENDIX)

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 5 – Rice Street Exit 7
Date:	Tuesday, December 06, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 21 Participants

Stakeholder comments and questions noted:

1. Railroad spur crossing ties up traffic on Rice Street to the east. Response (City): There are 3 to 5 unit trains per day using the spur line, with no projected increase indicated by BNSF Railroad. Growth is anticipated in the number of daily local trains, however.

2. The amount of additional right of way acquired from businesses along the north side of Rice St to avoid the need for an easement from BNSF along the south side of Rice St could create problems for those businesses in complying with City code requirements for customer and employee parking.

3. How would the residential property east of Eastgate Towing get access from Rice St? Response: Access to each of the properties on the north side of Rice St and between the I-229 interchange and N Glenwood Cir would be via the proposed back access road on the north side of the properties.

4. Public access along the proposed back access road poses a security concern for properties on the north side of Rice St. Response: The back access road would be lighted as a City street, but would not be designated an emergency snow route.

5. The contract that Eastgate Towing has with the City Police Dept requires towing operation in all weather. Eastgate Towing would need to use the back access road during and immediately after snow events.

6. Do the Rice St concepts assume that the proposed SD-100 project will be constructed? Response: Yes.

7. City – Would like to begin environmental impact assessment process sooner, if it is believed that Concept Rice-3C is the locally preferred option.

8. Will Concept Rice-3C slow down traffic on Cleveland Ave compared to existing conditions?

9. On Concept Rice-3C, how would access to the recycling pit be provided from realigned Cleveland Ave? There is no other access street shown.

10. Would storm sewers along Rice St be constructed as part of the proposed improvements? Response: Yes, storm sewers would be part of the Rice St improvements.

11. Will sidewalks along Rice St be constructed as part of the proposed improvements? Response: Yes, sidewalks on both sides of Rice St are proposed as part of the Rice St improvements. However, first time sidewalk construction costs will be assessed to adjacent property owners.

12. Will the proposed Rice St improvements with pedestrian or trail access along Rice St result in elimination of the existing trail along the Big Sioux River? Response: No. The river trail would not be impacted by proposed improvements along Rice St.

13. Is the Bahnson Ave extension to Benson Rd included in the proposed Rice St improvements? Response: No, construction of the Bahnson Ave extension would be tied to development need.

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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Rice Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 2:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SDDOT - PIERRE	773-6488	pete.longman@state.sd.us
2	Steve Gramm	700 E. Broadway Ave	773-6641	steve.gramm@state.sd.us
3	[illegible]	2904 E Rice St. SF, SD	334-3160	[illegible]@midconetwork.com
4	Kim Meester	1811 N Lowell Ave	367-9871	ArcheryOutfitters@Live.Com
5	Myrl & Roys Paving Chad Hartman	1300 N Bahnson	334-3204	Chad.h@marpaving.com
6	Myrl & Roys Paving Luke Klein	" "	334-3201	luke.k@marpaving.com
7	DAN KEARNEY	47046 255 St SF	351-5705	DKSL5489@Aol.com
8	Jason Kjenstad	6800 S. Old Village Place Suite 100 SF SD	977-7740	jason.kjenstad@[illegible].com
9	[illegible]	1500 N Sweetman PL. SF, SD	605-728-2966	bschmidt@cmesd.com
10	Clark Meyer	[illegible] " "	605-336-5763	cmeyer@cmesd.com
11	Shawn Anson	224 W. [illegible] ST SF SD	605-367-[illegible]	[illegible]@[illegible]
12	[illegible] Hartman	2908 E. Rice SF SD	605-728-2457	
13	Patty Nolte	1300 N. Bahnson Ave	334-3204	Patty.n@marpaving.com
14	Stu Horsted	4009 E. Rice St	231-1763	shorsted@cmesd.com
15	Eva Sadat	1410 E Rice St	605-271-1099	gsauto sales@midco network.com
16	Osman Sadat	"	"	"
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Rice Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Monday, December 5th, 2016 2:00 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Rodney Hartman	2908 E. Rice St	605-728-1667	RMS011@Net2000.net
2	Greg Rubin	2200 N. Bahnson	605-940-8501	GAJRUBIN@YAHOO.COM
3	Tammy Meland	1205 N. Caleb Ave	605-408-6763	
4	[illegible]	3501 River Bluff Rd	605 366 2179	
5	Gary Harr	3408 Sycamore A	376 7328	
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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 7 – Rice Street Sub-Study

Stakeholder Meeting

December 6th, 2016
2:00 pm to 3:00 pm

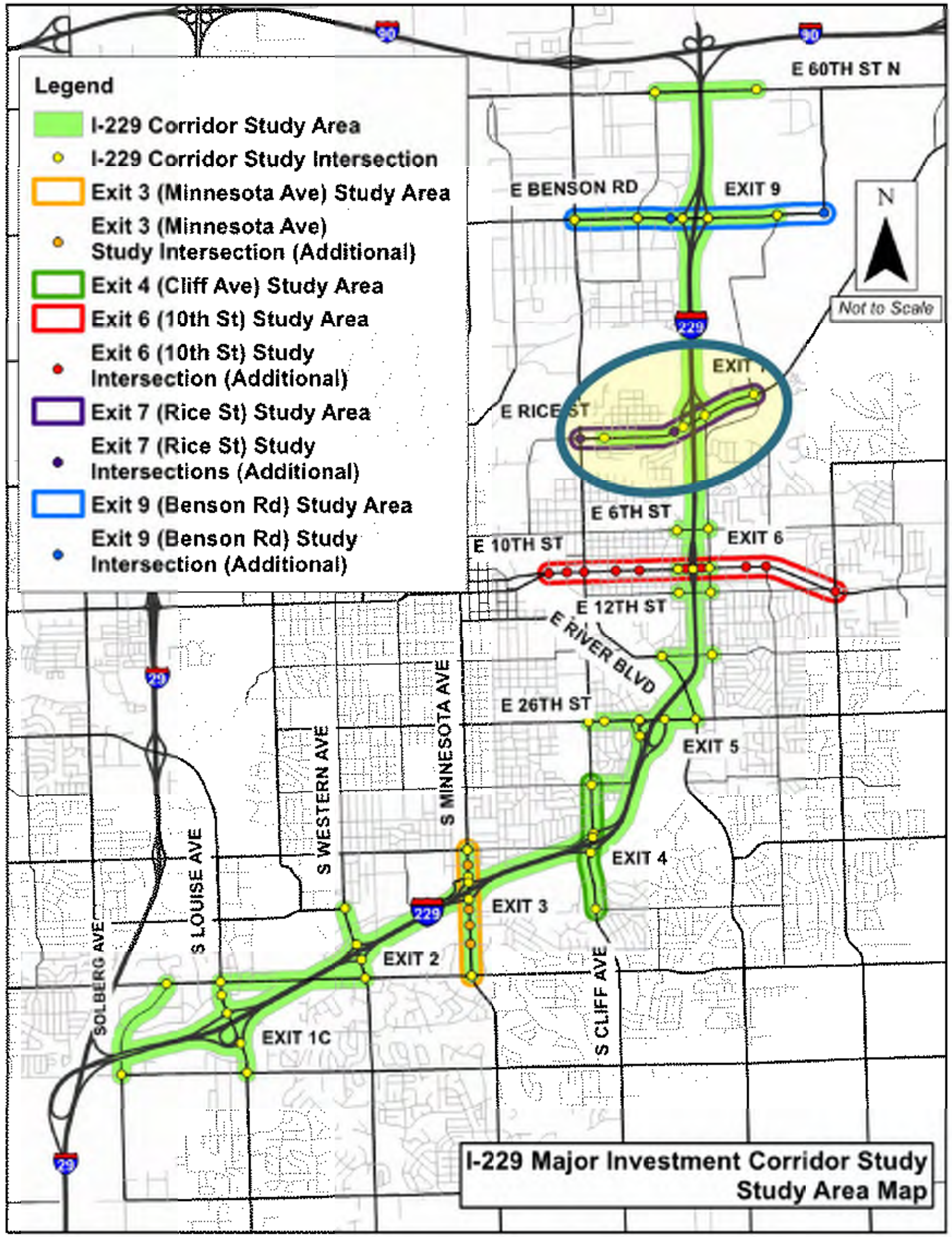
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 7 – Rice Street



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

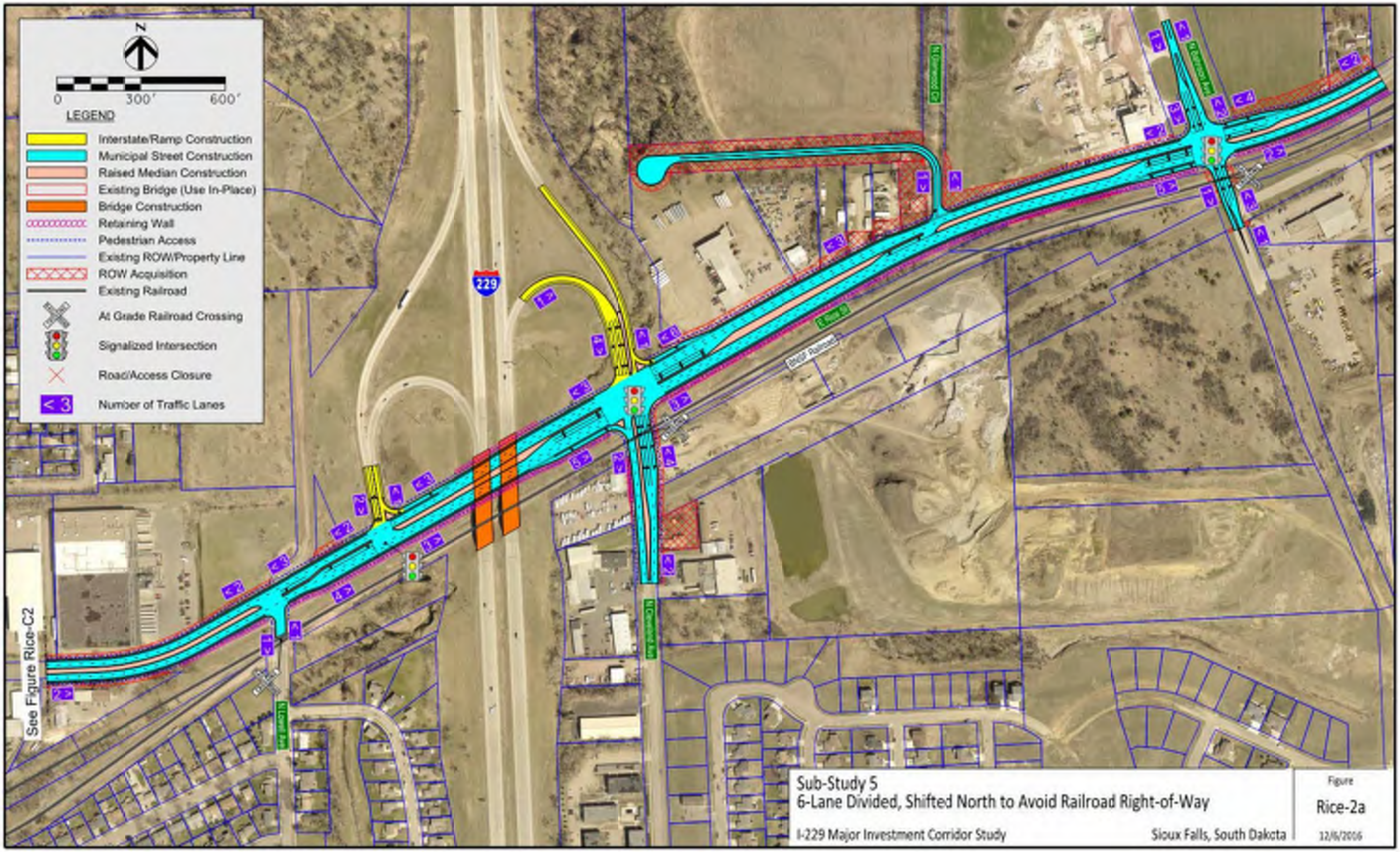
- Evaluation Factors:

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	Advance or Eliminate

- Evaluation Matrix to Compare Concepts
- Recommended Action

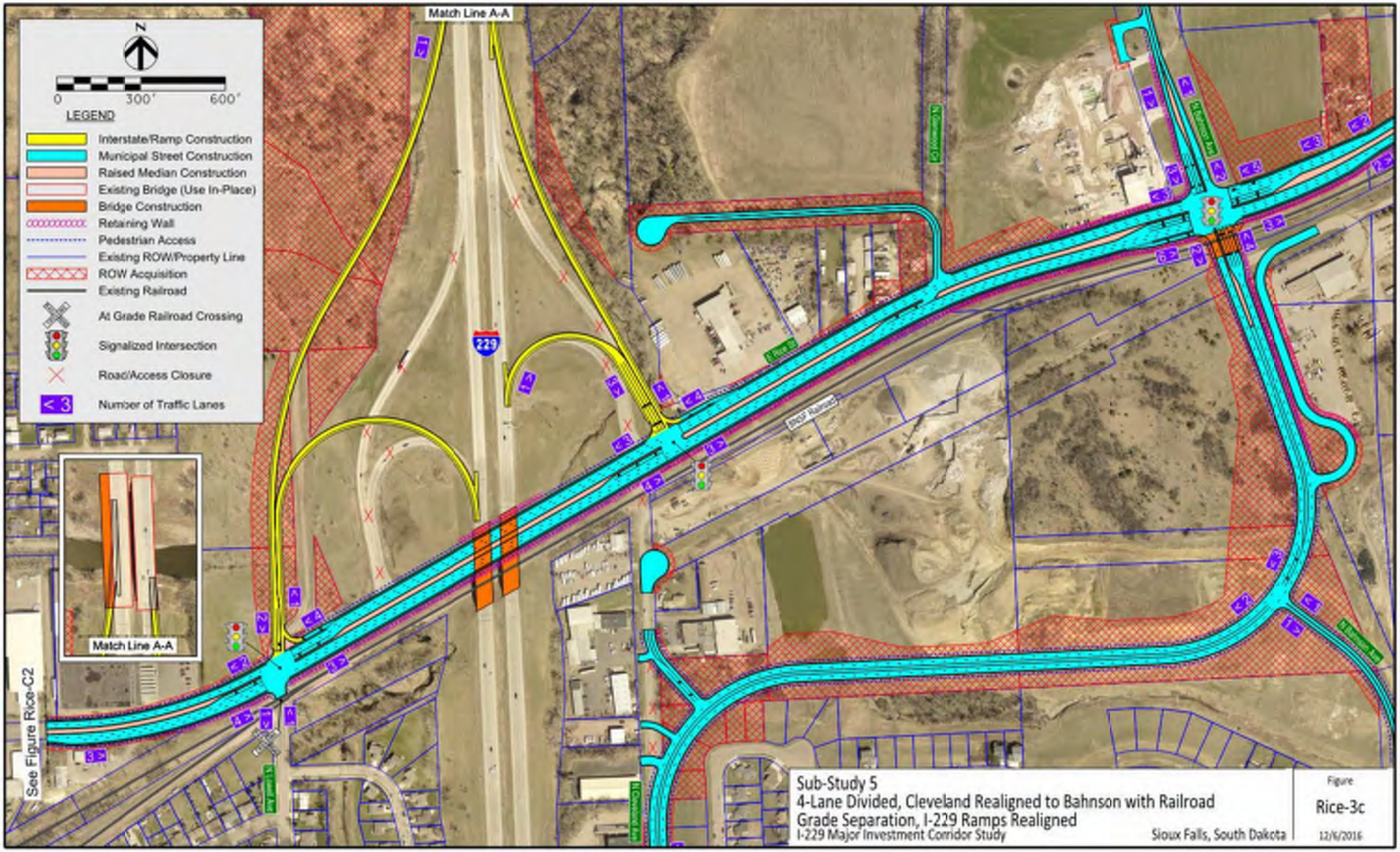
CONCEPTS FOR FURTHER CONSIDERATION

RICE-2A



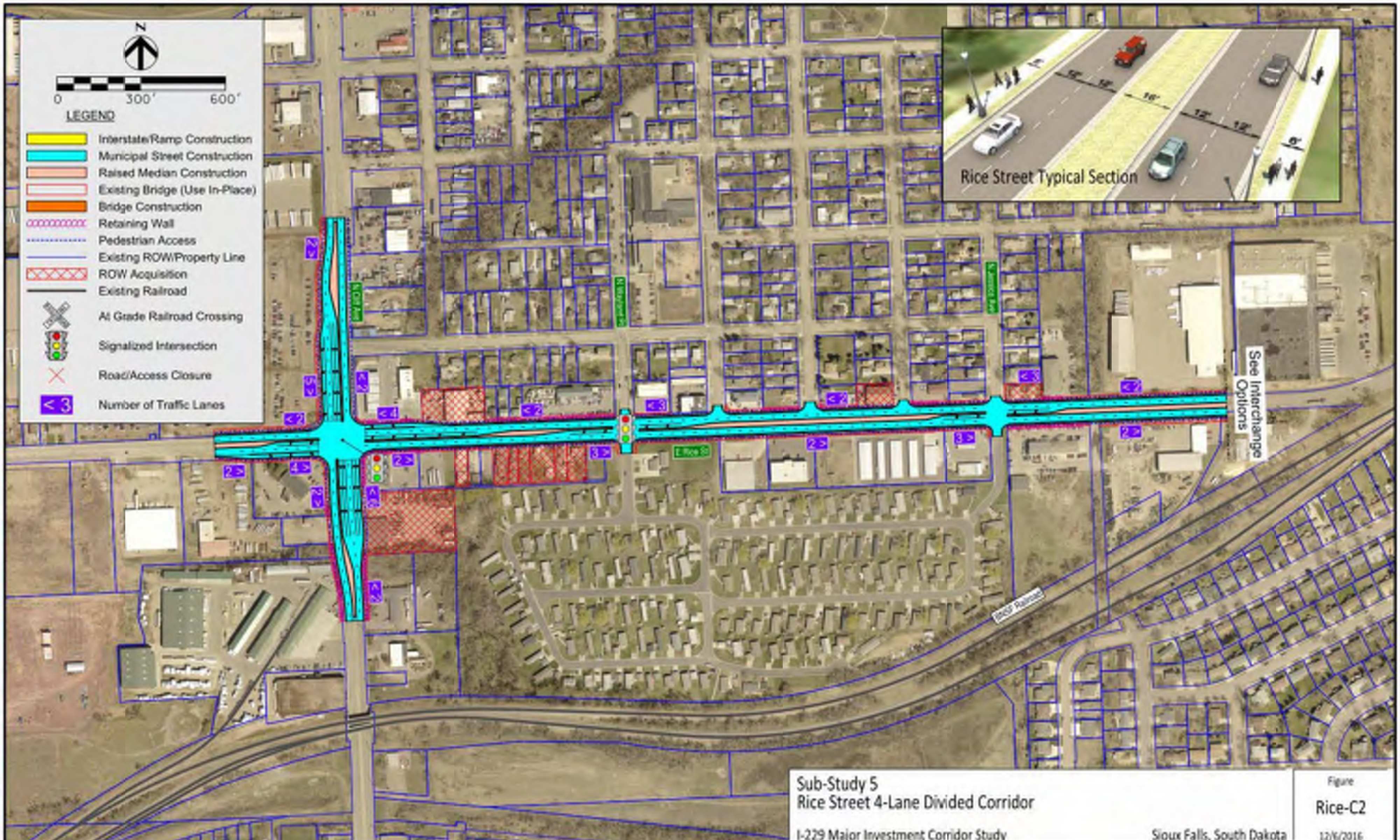
CONCEPTS FOR FURTHER CONSIDERATION

RICE-3C



CONCEPTS FOR FURTHER CONSIDERATION

RICE-C2



CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
Rice-2	6-Lane Divided	VERY GOOD	GOOD	NEUTRAL	GOOD	GOOD	Advance
Rice-2A	6-Lane Divided, Shifted North to Avoid Railroad Right-of-Way	VERY GOOD	GOOD	NEUTRAL	GOOD	GOOD	Advance
Rice-3C	4-Lane Divided, Cleveland Realigned to Bahnson with Railroad Grade Separation, I-229 Ramps Realigned	VERY GOOD	VERY GOOD	POOR	POOR	POOR	Advance

RICE STREET
PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- Rice Street (Cleveland Avenue Realignment) = Medium Priority
- Rice Street Interchange = Low Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
  - Prepare Interchange Modification Justification Report and Environmental Document
  - Develop Project Design
  - Acquire Right of Way
  - Construction

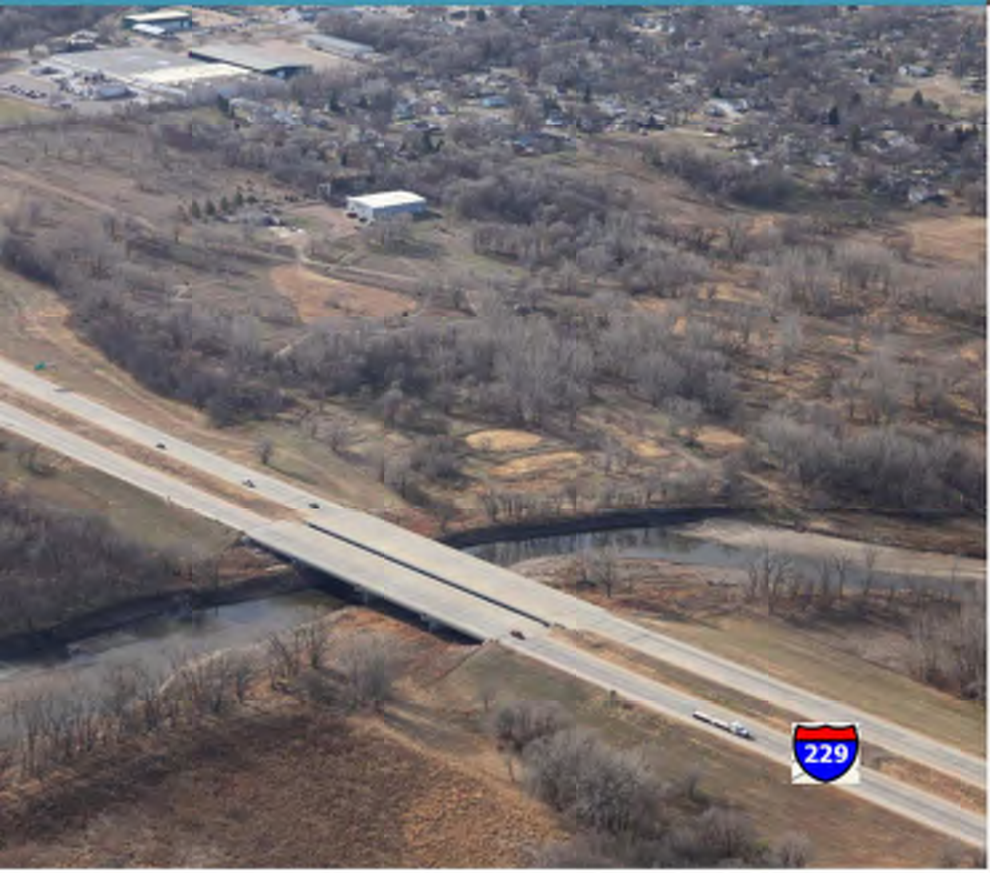
PROJECT CONTACTS:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Theo Weseman – HDR Engineering, Inc.
402-399-4801 or Theo.Weseman@hdrinc.com

Shannon Ausen – City of Sioux Falls
605-367-8607 or sausen@siouxfalls.org

Steve Gramm – SDDOT Project Development
605-773-6641 or steve.gramm@state.sd.us



INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 7 – Rice Street Sub-Study

Thanks for attending!

HDR

Minnesota Avenue

December 6th, 2016

- **Meeting Notes**
- **Sign-In Sheets**
- **PowerPoint Slides**
- **Comments (See Public Meeting #3 Appendix)**

Meeting Minutes

Project:	I-229 Major Investment Corridor Study, PL 0100(87) 3616P, PCN 044K
Subject:	Stakeholder Meeting – Sub-study 2 – Minnesota Avenue Exit 3
Date:	Tuesday, December 06, 2016
Location:	Sioux Falls Convention Center Conference Room 6
Attendees:	See Attached Sign In Sheet – 19 Participants

Stakeholder comments and questions noted:

1. When might proposed improvements on Minnesota Ave and at the I-229 interchange be constructed? Response: At least 12 to 15 years in the future.

2. What is the status of proposed improvements along 49th St to the west? Response: Not all of the right of way for widening 49th St to the west has been acquired. The widening is not currently programmed. When construction begins, it will start at the west end.

3. Access to businesses along Minnesota Ave from the back would kill the businesses.

4. Is a right turn in/out a possibility where driveway closures are shown on the concepts? Response: Yes.

5. Eliminate the proposed medians and build service roads.

6. If the southbound I-229 exist ramp terminal is shifted north to 49th St as shown on Concept Minn-9D, traffic queues on Minnesota Ave would be pushed northward to 41st St. Response: Proposed added lanes on Minnesota Ave would manage traffic queues.

7. There are no concept options that do not include a proposed median.

8. Do the I-229 bridges over Minnesota Ave need replacement? Response: The replacement of the bridges is driven by a need to widen Minnesota Ave.

9. Minnesota Ave should be widened to a six-lane section with a two-way left turn lane.

10. Existing speed on Minnesota Ave is a problem between 41st and 57th St.

11. Owner of vacant property at I-229 and Minnesota Ave (east side) – Delay in implementing proposed project discourages property improvements.

12. Property owner commented that his property has already been held hostage for ten years or more due to uncertainty about improvements and impacts along Minnesota Ave.

13. Estimated costs of implementing the proposed concepts should be made available to the public.

14. Concern about ruining businesses due to poor access or very limited access.

15. Can the proposed median be eliminated? Also discussion regarding impacts due to corridor width.

16. Can the green light be extended at 41st and Minnesota? Comments regarding timing at the interchange ramp signals and how frequently are those updated.

17. Issues turning left from Lotta St onto Minnesota Ave. Support expressed for proposed traffic signal.

18. A lot of focus on the properties east of 49th Street intersection (on either side of abandoned railroad line). Impacts from access closures/restrictions, alternate routes, changes to traffic patterns, U-turns, and control of access were all topics of discussion.

19. In favor of improved pedestrian and bike crossings of I-229. Glad this was looked at in the study.

20. Was a diverging diamond type interchange considered for Minnesota Ave? Response: Yes.

SDDOT — CITY OF SIOUX FALLS PUBLIC WORKS — Providing a Better Quality of Life for You!

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 6th, 2016 3:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Pete Longman	SDDOT – Pierre SD	773-6488	pete.longman@state.sd.us
2	Brad Remmich	SDDOT – PIERRE	773-3093	bradley.remmich@state.sd.us
3	Andy Vandel	SDDOT – Pierre	773-4421	andy.vandel@state.sd.us
4	Pat Waly	4230 S Minn	6053343845	bpwale@sio.midco.net
5	Mary Stone		605-376-6954	mstone@ g.com
6	Shelly Roger	48274 258 St Brandon SD 57005	321-3806	drogm3061@aol.com
7	Brian Frisbee	4101 S. Minnesota	338-6321	info@frisbeeinc.com
8	Lee Lewis	309 W 43rd St Ste 105	335-8805	LAL1966@basec.net
9	Mike Van Bockern	5800 S Remington Pl #100	361 8211	Mike@VBClink.com
10	Kevin R Nyberg	330 W. 41st, SF	336-6474 ~~[illegible]~~	knyberg@nybergsace.com
11	Heather Taylor	3300 S Minn Ave.	201-2841	heather@gsfw.com
12	[illegible]	405 Chapel Dr.	321-5606	grant@alvine weidenaar.com
13	Mary Montoya		332-0147	mary.montoya@sio.midco.net
14	Jason Kjenstad	6300 S. Old Village Suite 100 SF SD	977-7740	jason.kjenstad@hdrinc.com
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Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 6th, 2016 3:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Frank Howe	Brandon	5538484	franke prairiesons.com
2	Carol Twedt	4302 S Minnesota Ave SF SD 57105	940-0756	carolltwedt@sio.midco.net
3	Alex Connelly	1510 W. 57th SF, SD 57105	336-2165	alex.connelly@siouxfalls[illegible].com
4	Dave McElroy	3310 S Minn Ave SF SD 57105	338-9519	mcelroy.dave@gmail.com
5	Erik Nyberg	320 W 41st Street	728-5553	erik@cutlerlawfirm.com
6	Pam Taylor	3600 S. Minn	332-6509	
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SD DOT — City of Sioux Falls Public Works: Providing a Better Quality of Life for You!

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meeting for Minnesota Avenue Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3616P, PCN 044K **Project No.:** 207030

Meeting Date Tuesday, December 6th, 2016 3:30 PM **Meeting Location:** Sioux Falls Convention Center

Please print clearly. Thank you.

	Name	Address	Best Contact Phone	Email
1	Frisbees, Inc Berry Howe	4101 S. Minnesota Ave.	605-338-6321	berryh@frisbeesinc.com
2	Dianne Nath	4204 S. Minn Ave SF, SD 57105	605-339-2864	nath@sio.midco.net
3	Kevin Kroeze	Boen & Associates 307 W. 41st 57105	605-336-0435	KevinK@BoenAssociates.com
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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 3 – Minnesota Avenue Sub-Study

Stakeholder Meeting

December 6th, 2016
3:30 pm to 4:30 pm

HDR

HRGreen

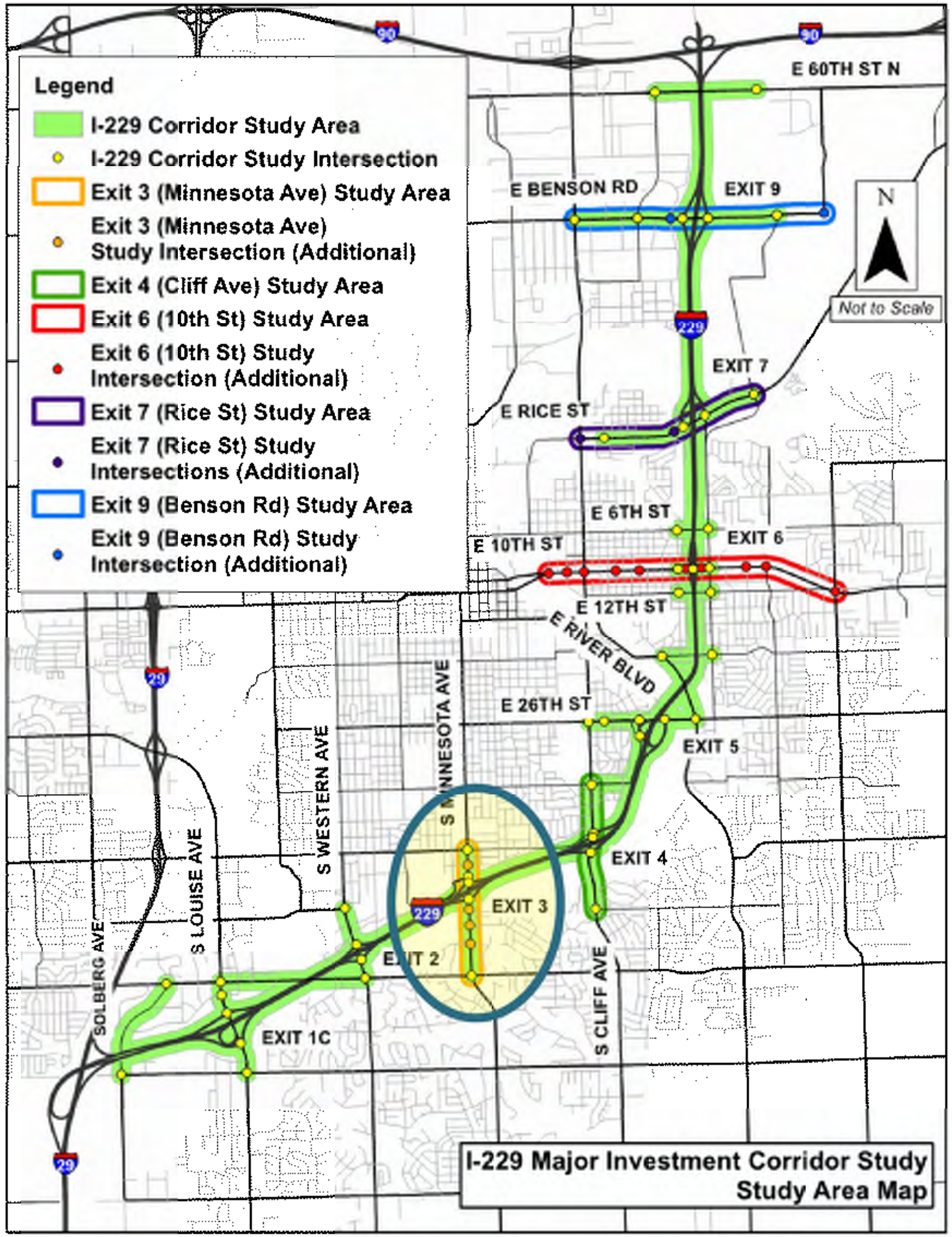
STUDY AREA MAP

I-229 Corridor Study

Solberg Avenue Overpass to 60th Street N Overpass

Meeting will focus on:

Exit 3 – Minnesota Avenue



STUDY ADVISORY PARTNERS

South Dakota Department of Transportation (SDDOT)

South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

PRESENTATION AGENDA

- Concept Evaluation Process
- Concept Evaluation Results
- Concepts Recommended for Further Consideration in Future Phases (Interchange & Corridor Improvements)
- Next Steps

CONCEPT EVALUATION PROCESS

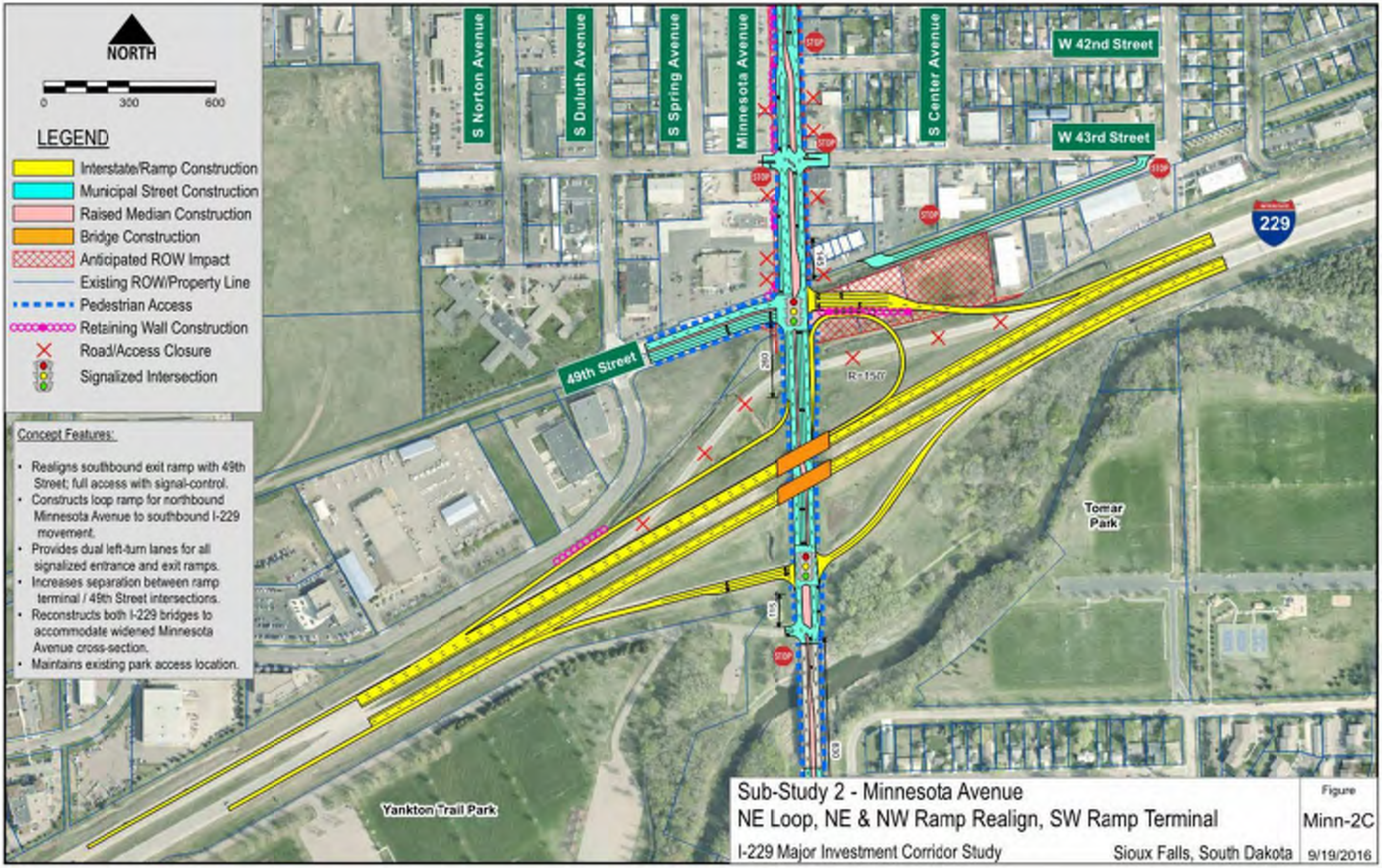
- Evaluation Factors:

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical resources, threatened and endangered species, public lands, and floodplains	Total Right of Way (ROW) Required and Acquisitions	Total Constuction Cost (including ROW)	Advance or Eliminate

- Evaluation Matrix to Compare Concepts
- Recommended Action

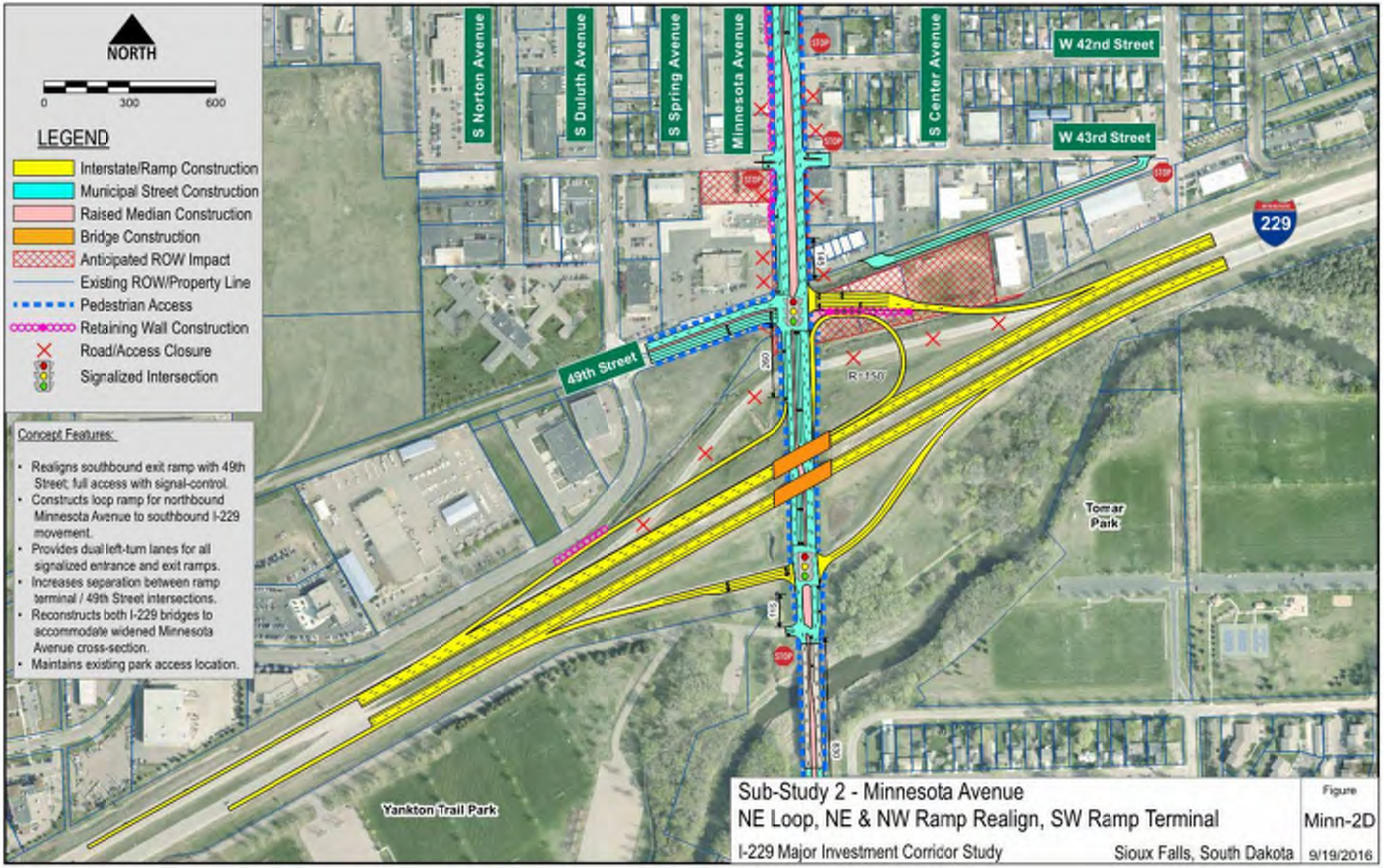
CONCEPTS FOR FURTHER CONSIDERATION

MINN-2C



CONCEPTS FOR FURTHER CONSIDERATION

MINN-2D

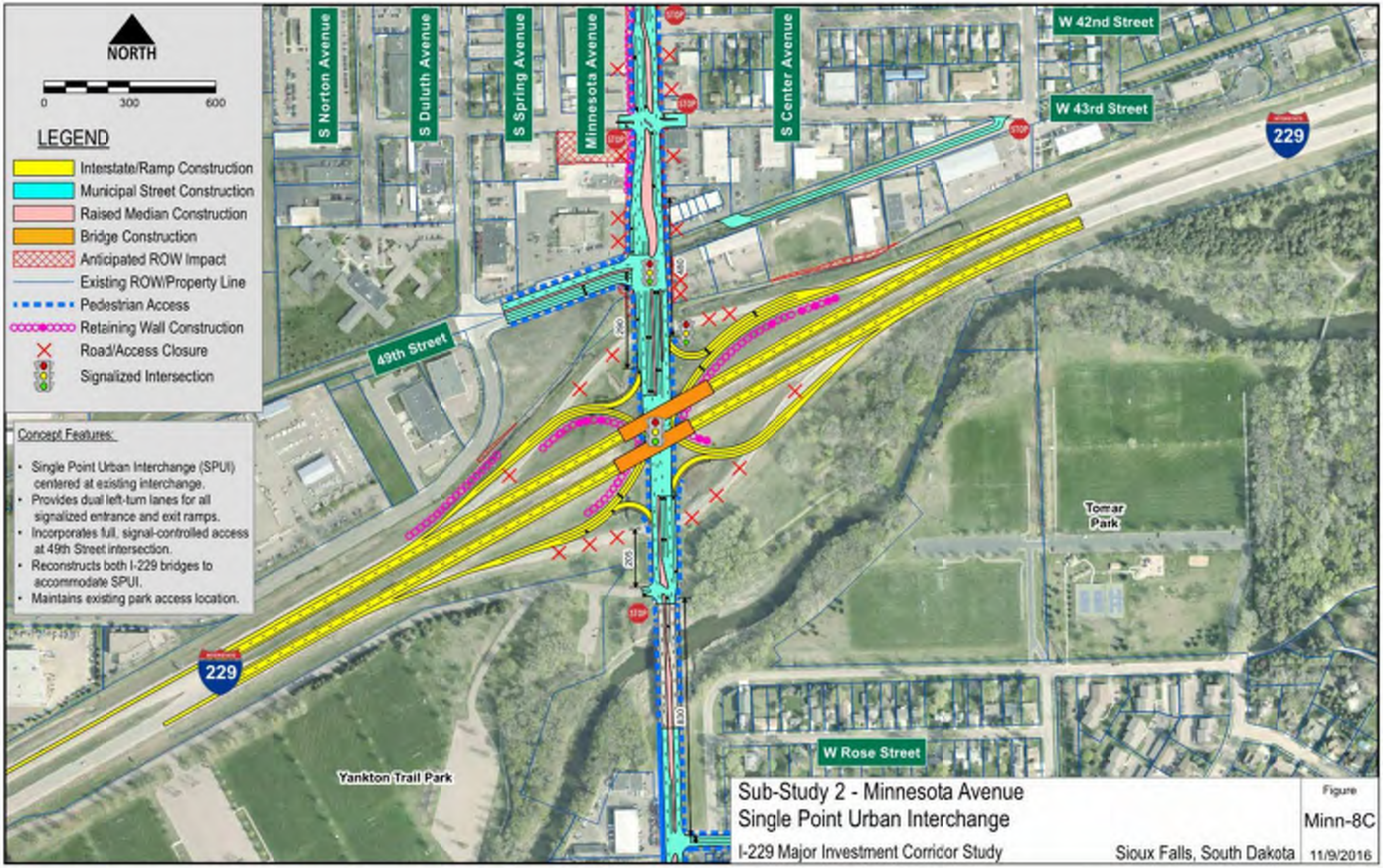


CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build	POOR	NEUTRAL	N/A	N/A	N/A	Advance
Minn-2C	Diamond with Loop, Direct Connect to 49th St, 5-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	GOOD	Advance
Minn-2D	Diamond with Loop, Direct Connect to 49th St, 6-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	GOOD	Advance
Minn-5D	Diverging Diamond Interchange, 6-Lane Big Sioux River to 41st St, 49th St Right-In Right-Out	GOOD	VERY GOOD	NEUTRAL	GOOD	GOOD	Eliminate Closure of 49th Street Access

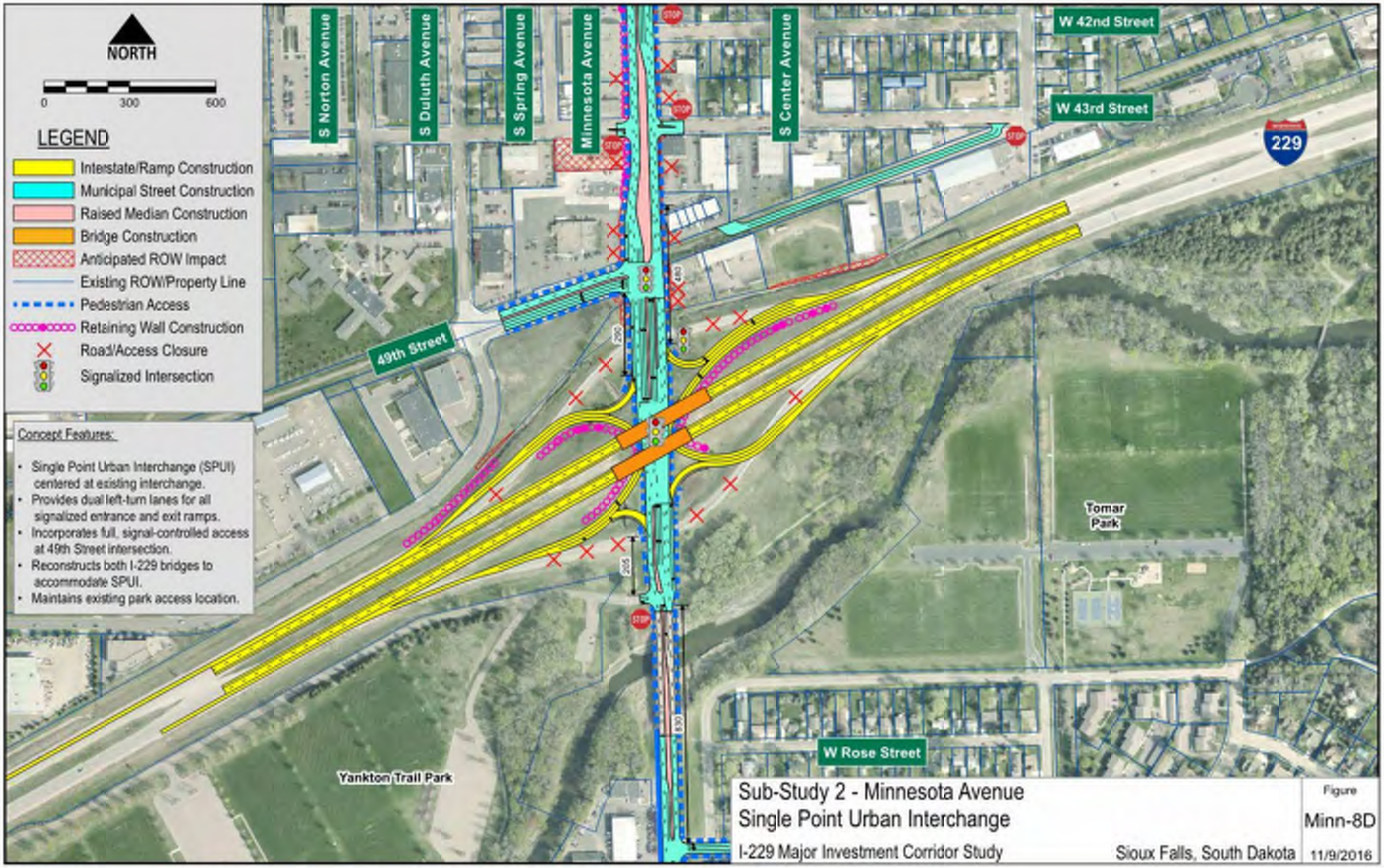
CONCEPTS FOR FURTHER CONSIDERATION

MINN-8C



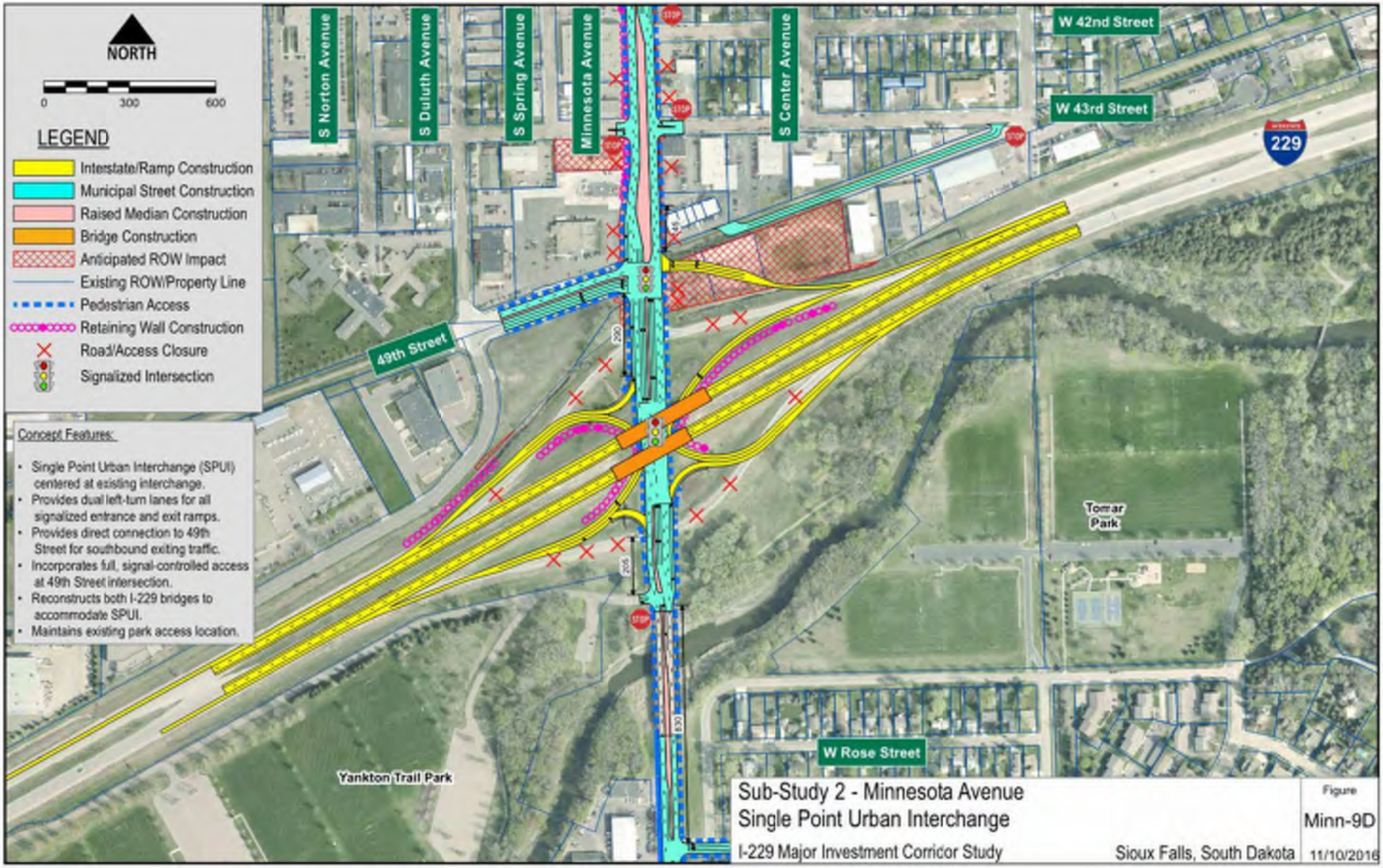
CONCEPTS FOR FURTHER CONSIDERATION

MINN-8D



CONCEPTS FOR FURTHER CONSIDERATION

MINN-9D



CONCEPT EVALUATION RESULTS (cont.)

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Minn-8C	Single Point Urban Interchange, 5-Lane Big Sioux River to 41st St, 49th St Full Access	GOOD	GOOD	NEUTRAL	GOOD	NEUTRAL	Advance
Minn-8D	Single Point Urban Interchange, 6-Lane Big Sioux River to 41st St, 49th St Full Access	GOOD	GOOD	NEUTRAL	GOOD	NEUTRAL	Advance
Minn-9D	Single Point Urban Interchange, Exit Ramp Connection to 49th St, 5-Lane Big Sioux River to 41st St	NEUTRAL	GOOD	NEUTRAL	NEUTRAL	NEUTRAL	Advance

MINNESOTA AVENUE PRELIMINARY PROJECT PRIORITY

- Priority recommendation based on existing and anticipated need and level of improvement and impacts associated with remaining concept options
- Minnesota Avenue Interchange and Corridor improvements = High Priority
- See exhibit board for additional information

NEXT STEPS

- Assemble Stakeholder and Public Comments
- Complete Study Report
- Project Development Process = 5-6 year timeline when initiated by SDDOT & City
  - Prepare Interchange Modification Justification Report and Environmental Document
  - Develop Project Design
  - Acquire Right of Way
  - Construction

PROJECT CONTACTS:

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INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 3 – Minnesota Avenue Sub-Study

Thanks for attending!

HDR

HRGreen