

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

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

Sioux Falls, South Dakota
June 2017

Table of Contents

EXECUTIVE SUMMARY **1**

CHAPTER 1 - INTRODUCTION **2**

SECTION 1.1 - INTRODUCTION 2
SECTION 1.2 - PROJECT DESCRIPTION / STUDY AREA 3
SECTION 1.3 - PURPOSE 5
SECTION 1.4 - METHODS AND ASSUMPTIONS 6

CHAPTER 2 - EXISTING AND YEAR 2035 NO-BUILD CONDITIONS **7**

SECTION 2.1 - TRAFFIC CAPACITY AND ANALYSIS METHODOLOGIES 7
SECTION 2.2 - EXISTING CONDITIONS OPERATIONAL RESULTS 7
SECTION 2.3 - YEAR 2035 NO-BUILD OPERATIONAL RESULTS 9

CHAPTER 3 - CONCEPT DEVELOPMENT AND ANALYSIS **11**

SECTION 3.1 - PRELIMINARY CONCEPT DEVELOPMENT 11
SECTION 3.2 - PRELIMINARY CONCEPT COMPARISONS 12
SECTION 3.3 - DETERMINATION OF ALTERNATIVE SCENARIOS 15
SECTION 3.4 - ANALYSIS OF ALTERNATIVE SCENARIOS 16
SECTION 3.5 - RECOMMENDATION OF ALTERNATIVES FOR FUTURE CONSIDERATION 20

CHAPTER 4 - SUMMARY AND NEXT STEPS **36**

APPENDICES **37**

The South Dakota Department of Transportation provides services without regard to race, color, gender, religion, national origin, age or disability, according to the provisions contained in SDCL 20-13, Title VI of the Civil Rights Act of 1964, the Rehabilitation Act of 1973, as amended, the Americans With Disabilities Act of 1990 and Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, 1994. To request additional information on the SDDOT's Title VI/Nondiscrimination policy or to file a discrimination complaint, please contact the Department's Civil Rights Office at 605-773-3540.

The preparation of this report has been financed in part through grant(s) from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(f)] of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

APPENDICES

APPENDIX A. METHODS AND ASSUMPTIONS FOR SUB-STUDY 3

APPENDIX B1. TRAFFIC CAPACITY ANALYSIS METHODOLOGIES

APPENDIX B2. EXISTING HCS 2010 REPORTS

APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM

APPENDIX D1. PRELIMINARY CONCEPT FIGURES

APPENDIX D2. PRELIMINARY CONCEPTS TECH MEMO

APPENDIX D3. DTA MODEL INTERCHANGE AND MODEL SUBAREAS

APPENDIX D4. ENVIRONMENTAL CONSTRAINTS MAPS

APPENDIX D5. ALTERNATIVE SCENARIO FIGURES

APPENDIX E. PREDICTIVE SAFETY ANALYSIS

APPENDIX F. YEAR OF FAILURE ANALYSIS

APPENDIX G. SUB-STUDY 3 NOISE STUDY TECHNICAL REPORT

APPENDIX H. PUBLIC INVOLVEMENT

APPENDIX I. EXISTING ACCESS CONTROL FIGURES

LIST OF FIGURES

Figure 1. I-229 MIS Study Area Map 4
Figure 2. Exit 6 (10th Street) Study Area 5
Figure 3. Existing Conditions Traffic Operations Analysis 8
Figure 4. 2035 No-Build Conditions Traffic Operations Analysis 10
Figure 5. Alternative Scenario 10th-2B 23
Figure 6. Alternative Scenario 10th-2C 24
Figure 7. Alternative Scenario 10th-5B 25
Figure 8. Alternative Scenario 10th-5C 26
Figure 9. Alternative Scenario 10th-C1 (Sheet 1 of 4) 27
Figure 10. Alternative Scenario 10th-C1 (Sheet 2 of 4) 28
Figure 11. Alternative Scenario 10th-C1 (Sheet 3 of 4) 29
Figure 12. Alternative Scenario 10th-C1 (Sheet 4 of 4) 30
Figure 13. Alternative Scenario 10th-C2 (Sheet 1 of 4) 31
Figure 14. Alternative Scenario 10th-C2 (Sheet 2 of 4) 32
Figure 15. Alternative Scenario 10th-C2 (Sheet 3 of 4) 33
Figure 16. Alternative Scenario 10th-C2 (Sheet 4 of 4) 34
Figure 17. Alternative Scenario 10th-Var 35

LIST OF TABLES

Table 1. Existing Conditions Deficient Locations Based on Operational Analysis 7
Table 2. 2035 No-Build Conditions Deficient Locations Based on Operational Analysis 9
Table 3. Preliminary Concepts Composite Comparative Assessment 14
Table 4. 10th Street Corridor 2012-2035 Predicted Build and No-Build Annual Crashes 17
Table 5. 10th Street Corridor Planning Horizon Crash Cost Savings 17
Table 6. 10th Street Corridor Year of Failure 18
Table 7. Noise Impact Summary 19
Table 8. Constructability Analysis 20
Table 9. Alternative Scenarios Evaluation Matrix 22

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 Exit 6 (10th Street) Crossroad Corridor Study is a subset of the I-229 MIS.

This study assesses existing and future conditions at the I-229 interchange at Exit 6 (10th Street) and along 10th Street from Franklin Avenue to Sycamore Avenue. The purpose of this study is to address the traffic operations and safety concerns for this corridor. Both the 10th Street/I-229 and the 10th Street/Cleveland Avenue intersections experience congestion in the peak traffic hours. By year 2035, congestion is anticipated to increase at these intersections and congestion is anticipated to occur on I-229 between Exit 5 (26th Street) and Exit 6 (10th Street).

Preliminary concepts for both the 10th Street interchange and corridor to address the existing and year 2035 transportation deficiencies have been developed. The preliminary concepts were screened to determine which interchange and corridor concepts should be selected for further development and assessment. The remaining interchange options and corridor options were combined to develop alternative scenarios. There were nine (9) alternative scenarios identified for further development. Each of the alternative scenarios was analyzed using established evaluation criteria. The analysis of the alternative scenarios was used to determine which alternative scenarios should be recommended to advance for future studies. The following are the recommended alternative scenarios to advance:

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

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 - Introduction

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 Exit 6 (10th Street) 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 corridor studies is shown in ***FIGURE 1***.

The remainder of this document details the transportation efforts entailed in the I-229 Exit 6 (10th Street) Crossroad Corridor Study.

Section 1.2 - Project Description / Study Area

This study assesses existing and future conditions at the I-229 interchange at Exit 6 (10th Street) and along 10th Street from Franklin Avenue to Sycamore Avenue. The I-229 Exit 6 interchange and adjacent 10th Street corridor is located in the eastern portion of the Sioux Falls metropolitan area, approximately 4 miles south of the I-229/I-90 system interchange. The I-229 mainline study limits include Exit 5 (26th Street) through Exit 7 (Rice Street). The 10th Street study limits include Franklin Avenue through Sycamore Avenue.

An illustration of the study area is shown in ***FIGURE 2***. There are 13 study area intersections located on 10th Street, including:

- Franklin Avenue
- Fairfax Avenue
- Cliff Avenue
- Blauvelt Avenue
- Jessica Avenue
- Lowell Avenue
- Conklin Avenue
- I-229 Single Point Ramp Terminal
- Blaine Avenue
- Cleveland Avenue
- Cambell's / Hy-Vee Parking Lot
- Bahnson Avenue
- Sycamore Avenue

Figure 1. I-229 MIS Study Area Map

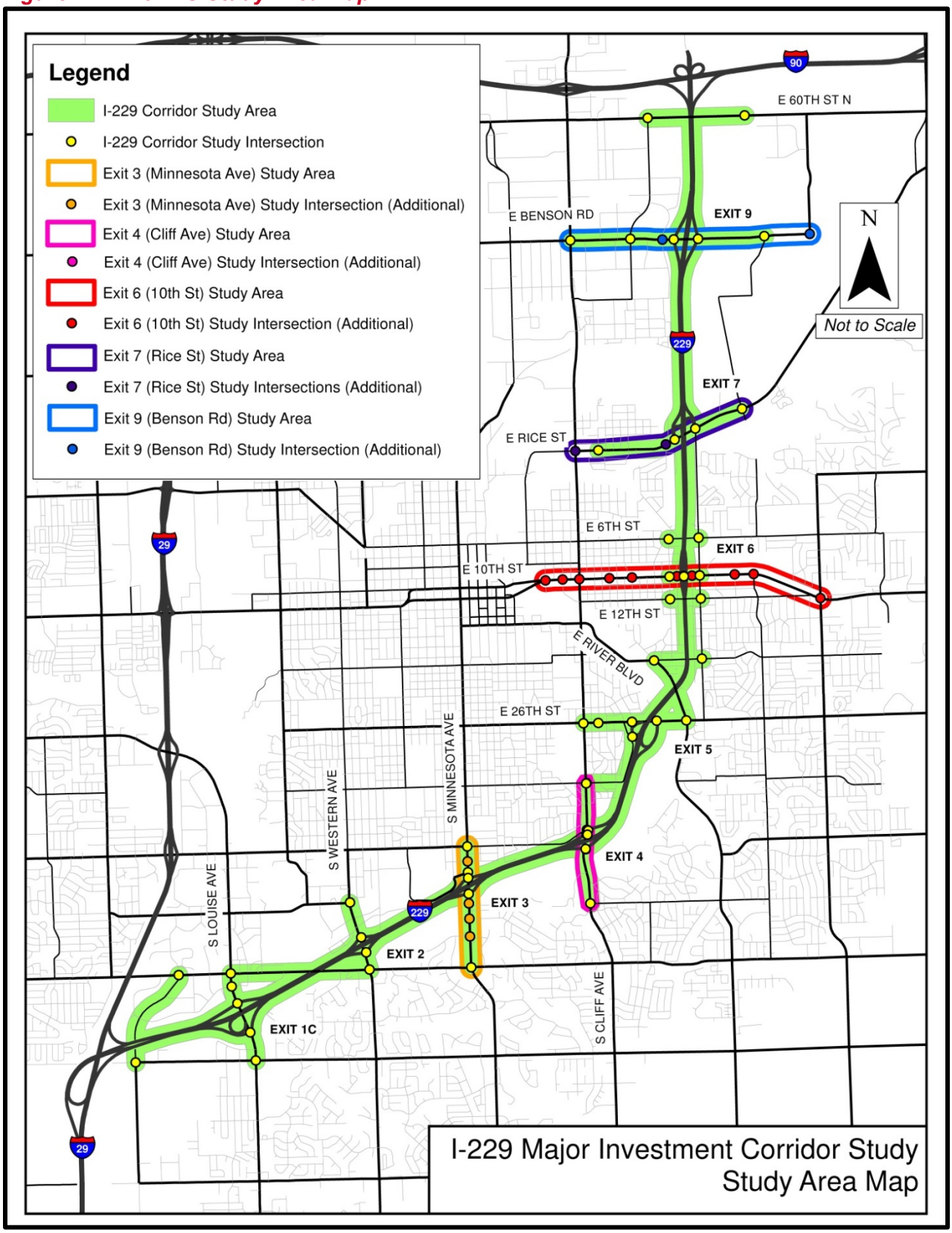
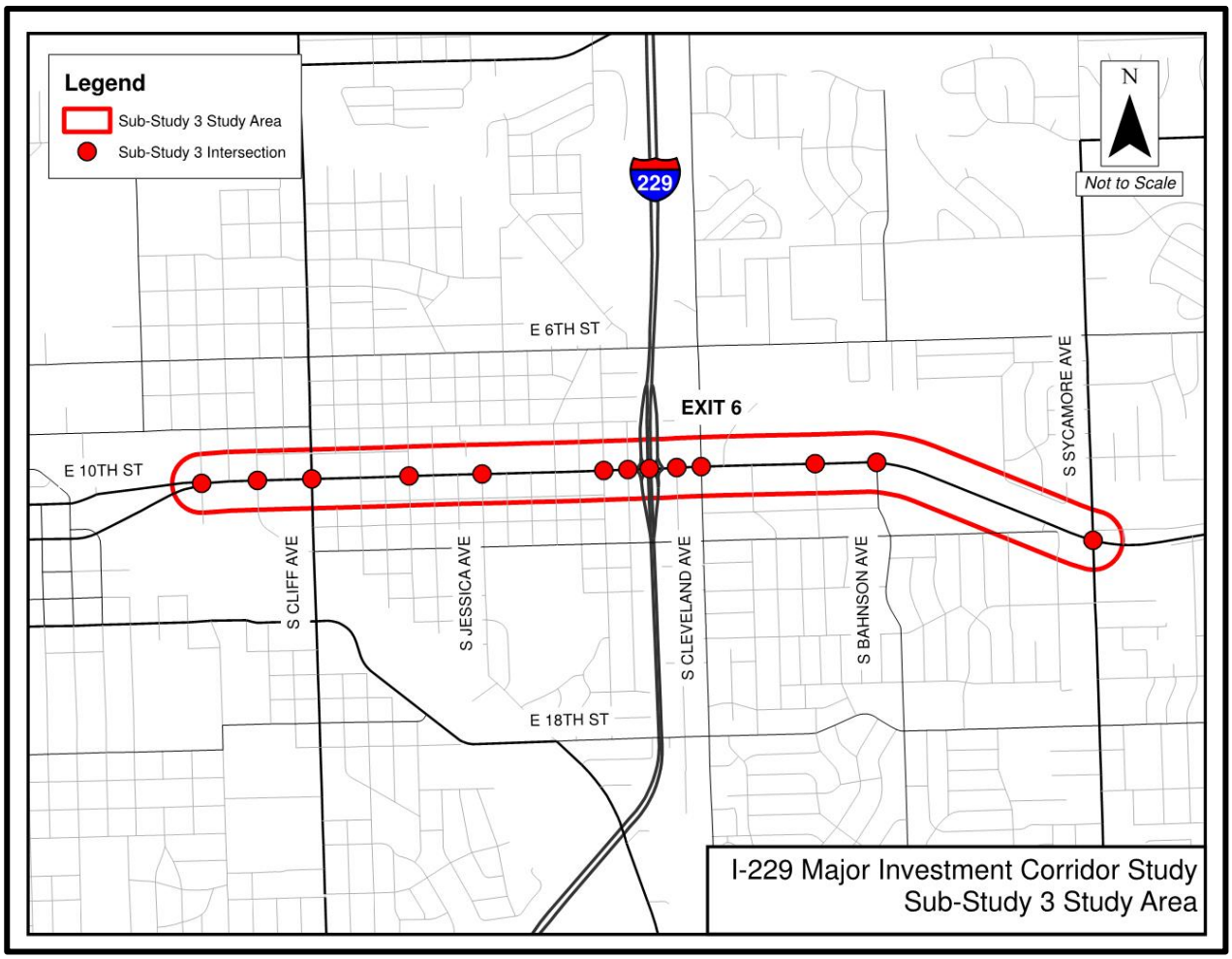


Figure 2. Exit 6 (10th Street) Study Area



Section 1.3 - Purpose

The purpose of this study is to address the traffic operations and safety concerns at the I-229/Exit 6 (10th Street) interchange and along the 10th Street corridor which serves the growing east side of Sioux Falls, South Dakota. The following is a list of specific issues/needs that were identified for this study:

- Congestion at the 10th Street / I-229 interchange and along 10th Street, east and west of I-229
- Closely spaced signals along 10th Street near the I-229 interchange
- Future growth along the 10th Street corridor
- Connection from proposed Veterans Memorial Parkway (existing SD 11/Powder House Road) to downtown area
- Improved pedestrian mobility
- Safety concerns along the 10th Street 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 level of service (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 Exit 6 (10th Street) Crossroad 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 3***.

The original Methods and Assumptions document was amended as follows:

- ***Amendment 1*** includes changes to accommodate updated schedule, Study Advisory Team (SAT) 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 analysis (safety) as discussed at the SAT meeting held on November 2, 2015.

CHAPTER 2 - EXISTING AND YEAR 2035 NO-BUILD CONDITIONS

Assessment of existing conditions and 2035 no-build conditions is based on traffic data collected and developed as part of the overall I-229 MIS. Traffic data applicable to Exit 6 (10th Street) 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 Exit 6 (10th Street) interchange and corridor study area.

Section 2.1 - Traffic Capacity and Analysis Methodologies

Existing (year 2012) and 2035 no-build conditions operational analysis included the analysis of 11 signalized intersections, 2 unsignalized intersections, 4 basic freeway segments, 2 weave segments, 2 merge areas and 2 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:

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

Analysis methodologies utilized for determining traffic capacities are outlined in ***APPENDIX B1. TRAFFIC CAPACITY ANALYSIS METHODOLOGIES***. Level of service (LOS) is based on procedures from the ***Highway Capacity Manual*** (***HCM 2010***).

Section 2.2 - Existing Conditions Operational Results

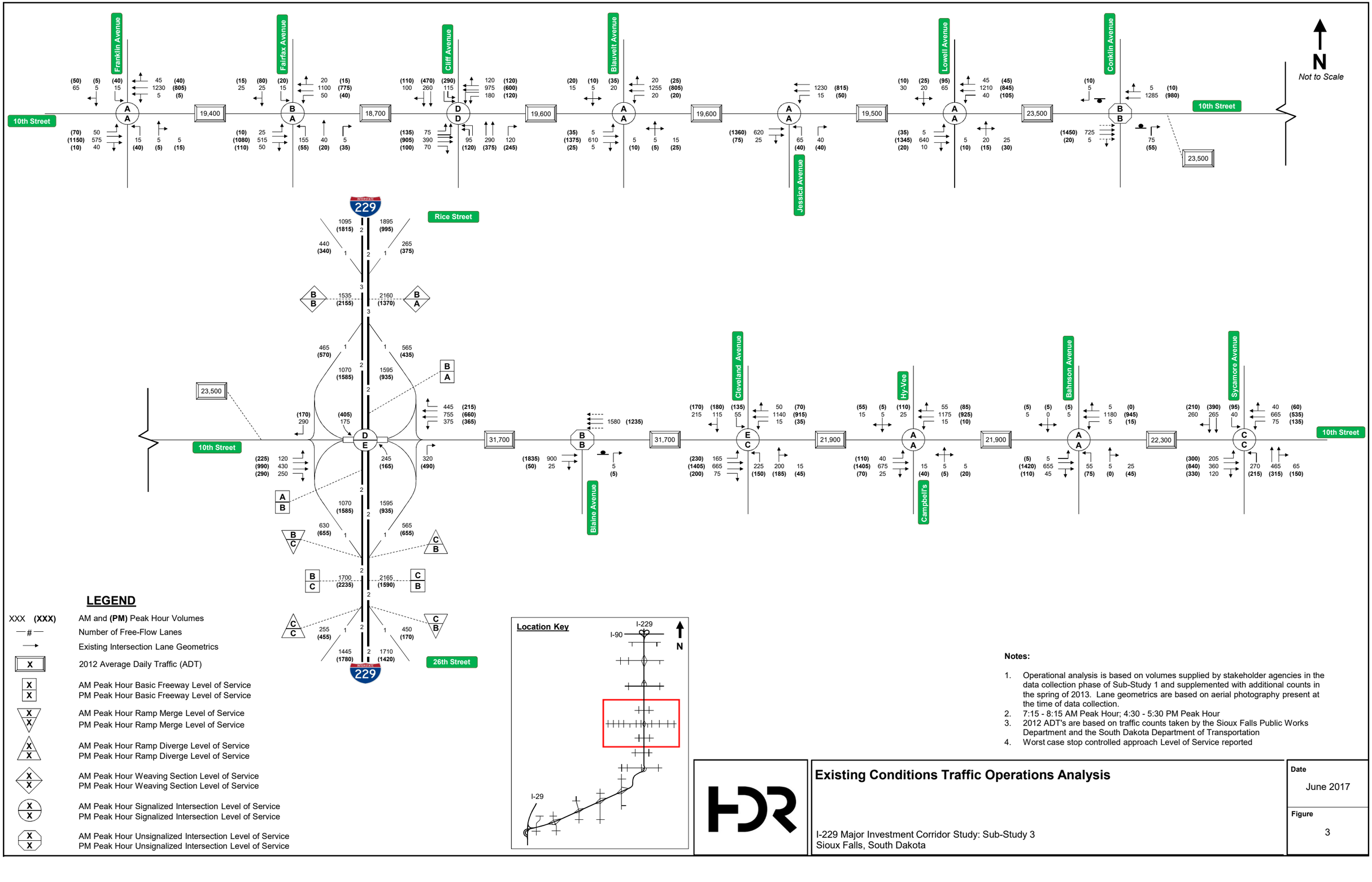
The existing conditions LOS results for all locations are depicted in ***FIGURE 3***.

This existing conditions analysis found that the freeway and ramps are operating at a desirable LOS of C or better throughout the study area. The ramp terminal intersection has degraded beyond the acceptable threshold of LOS C and one arterial intersection has 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 B2. EXISTING HCS 2010 REPORTS***.

Table 1. Existing Conditions Deficient Locations Based on Operational Analysis

LOCATION	AM	PM
10th Street & I-229 SPUI	LOS D	LOS E
10th Street & Cleveland Avenue	LOS E	

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
→	Existing Intersection Lane Geometrics
X	2012 Average Daily Traffic (ADT)
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. 2012 ADT's are based on traffic counts taken by the Sioux Falls Public Works Department and the South Dakota Department of Transportation
4. Worst case stop controlled approach Level of Service reported

Existing Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 3
Sioux Falls, South Dakota

Date
June 2017

Figure
3

Section 2.3 - 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.

A detailed report of the future No-Build operations can be found in ***APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM***.

The year 2035 conditions analysis found that portions of the freeway and ramps will operate worse than a desirable LOS C or better throughout the study area. The ramp terminal intersection will also degrade beyond the threshold of LOS C and one arterial intersection will degrade beyond the threshold of LOS D.

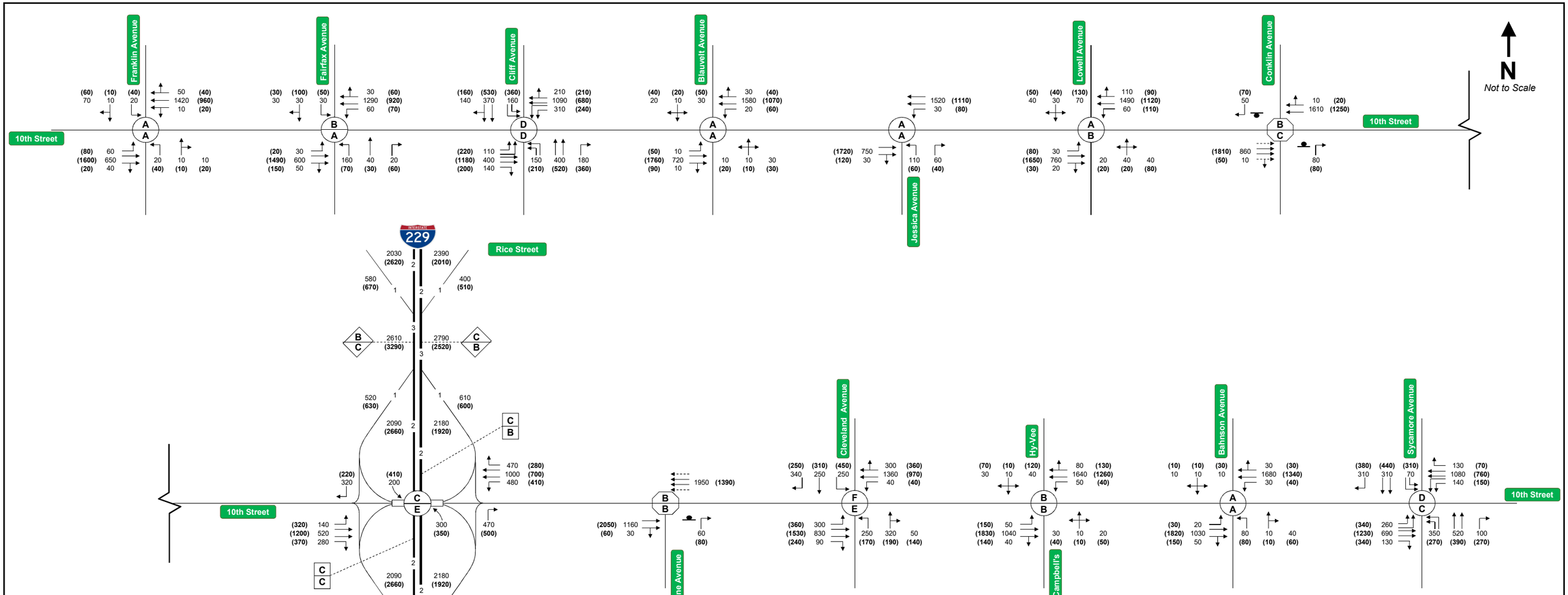
TABLE 2 highlights intersections that will not meet the project specific LOS thresholds.

Final operational analysis LOS results for year 2035 No-Build AM and PM peak hour can be found in graphical format in ***FIGURE 4*** for study intersections, as well as basic freeway, merge, diverge and weaving segments.

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

LOCATION	AM	PM
10th Street & I-229 SPUI		LOS E
10th Street & Cleveland Avenue	LOS F	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
I-229 NB Diverge to 10th Street off-ramp	LOS D	
I-229 SB Merge from 10th Street on-ramp	LOS D	LOS D

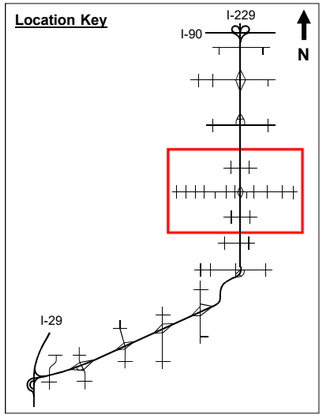
Note: Acceptable threshold is LOS D for arterial intersections and LOS C for freeway, ramps, and ramp terminal intersections.



LEGEND

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

Location Key



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 3
10th Street Corridor Study
Sioux Falls, South Dakota

Date
June 2017

Figure
4

CHAPTER 3 - 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.

Section 3.1 - Preliminary Concept Development

Prior to development of the preliminary concept, 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 Stakeholder Meeting was held on December 16th, 2014 with business and land owners within the Exit 6 (10th Street) study area to provide an update on the study and receive feedback regarding the corridor needs and considerations. A summary of the public involvement process and meeting notes can be found in ***APPENDIX H. 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. Separate concepts were developed for the Exit 6 (10th Street) interchange area and the 10th Street corridor. Preliminary concepts included:

10th Street Interchange

- ***10th-1.*** Single Point Urban Interchange (SPUI) - Broken back dual lefts, no bridge widening
- ***10th-2.*** SPUI - Single radius dual lefts, widen north and south
- ***10th-3.*** SPUI - Single radius dual lefts, widen south + I-229 profile modification
- ***10th-4.*** Tight Diamond
- ***10th-5.*** Diverging Diamond Interchange (DDI) - 20 mph conventional width
- ***10th-6.*** Partial Cloverleaf (Parclo) - Terminals at Lowell & Cleveland, no SW & NE quadrant ramps
- ***10th-7.*** Tight Split Diamond - 10th/12th
- ***10th-8.*** Tight Split Diamond - 6th/10th/12th
- ***10th-9.*** Tight Split Diamond - 6th/10th
- ***10th-10.*** Cleveland Ave Continuous Flow Intersection (CFI)

- ***10th-Var.*** Unconstrained SB Entrance & NB Exit Ramps
- ***Cleve-1.*** Dual left turns
- ***Cleve-2.*** Cleveland Ave. restricted left turns

10th Street Corridor

- ***10th-C1.*** 5-Lane Undivided with access closures
- ***10th-C2.*** 4-Lane Divided with access closures
- ***10th-C3***. 6-Lane Divided with access closures, widen north and south
- ***10th-C4***. 6-Lane Divided with access closures, widen south only

Preliminary concept figures are shown in ***APPENDIX D1. PRELIMINARY CONCEPT FIGURES***.

Section 3.2 - 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 D2. 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).

Although not included in the assessment of property impacts for the concepts, the existing access control limits along I-229 at each of the corridor sub-study interchanges were researched at the request of the SAT and are depicted in a set of figures in ***APPENDIX I. EXISTING ACCESS CONTROL FIGURES***.

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 D3. 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 D4. 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			
10th-1	SPUI - Broken back dual lefts, No bridge widening	Very Good	Good	Neutral	Medium/ potential 4(f)	$9,200,000	2.3
10th-2*	SPUI - Single radius dual lefts, Widen N & S	Very Good	Good	Neutral	Medium/ potential 4(f)	$9,800,000	2.3
10th-3*	SPUI - Single radius dual lefts, Widen S + I-229 profile modification	Very Good	Good	Neutral	Medium/ potential 4(f)	$15,220,000	3.7
10th-4	Tight Diamond	*n/a*	*n/a*	*n/a*	n/a	$12,620,000	3
10th-5	DDI - 20 mph conventional width	Very Good	Very Good	Good	Medium/ potential 4(f)	$15,620,000	5.8
10th-6	Parclo - Terminals at Lowell & Cleveland, no SW & NE quadrant ramps	*n/a*	*n/a*	*n/a*	n/a	$33,540,000	16.1
10th-7	Tight Split Diamond - 10th/12th	Good	Poor	Poor	Medium/ potential 4(f)	$23,360,000	6.4
10th-8	Tight Split Diamond - 6th/10th/12th	Good	Neutral	Neutral	High/ likely 4(f)/6(f)	$32,860,000	7.1
10th-9	Tight Split Diamond - 6th/10th	Very Good	Good	Good	High/ likely 4(f)/6(f)	$23,320,000	4.7
10th-10	Cleveland Ave CFI	*n/a*	*n/a*	*n/a*	n/a	$16,560,000	5.8
10th-Var*	Unconstrained SB Entrance & NB Exit Ramps	*n/a*	*n/a*	*n/a*	Low	$18,560,000	2.5
Cleve-1	Cleveland Ave Dual Left Turns	*n/a*	*n/a*	*n/a*	Low	$3,920,000	0.7
Cleve-2	Cleveland Ave restricted left turns	*n/a*	*n/a*	*n/a*	n/a	$15,400,000	5.7
10th-C1	5-Lane Undivided with access closures	Neutral	Neutral	Neutral	Low	$600,000	0
10th-C2	4-Lane Divided with access closures	Neutral	Neutral	Neutral	High/ likely 4(f)/6(f)	$24,120,000	3
10th-C3	6-Lane Divided with access closures, widen N & S	Poor	Poor	Neutral	High/ likely 4(f)/6(f)	$34,620,000	14.3
10th-C4	6-Lane Divided with access closures, widen S only	Poor	Poor	Neutral	High/ likely 4(f)/6(f)	$27,880,000	10.1

***Estimated construction costs for this concept do not include an allowance for retaining wall replacement.**

PRELIMINARY CONCEPT COMPARISON

The preliminary concepts and the concept evaluation were presented to the business/land owners and public through a Stakeholders Meeting and Public Open House on June 1st, 2015 and June 2nd, 2015, respectively. A summary of the public involvement process and meeting notes can be found in ***APPENDIX H. 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:

10th Street Interchange

- ***10th-1.*** SPUI - Broken back dual lefts, no bridge widening
- ***10th-2.*** SPUI - Single radius dual lefts, widen south + I-229 profile modification
- ***10th-5.*** Diverging Diamond Interchange (DDI) - 20 mph conventional width
- ***10th-9.*** Tight Split Diamond - 6th/10th
- ***10th-Var.*** Unconstrained SB Entrance & NB Exit Ramps

10th Street Corridor

- ***10th-C1.*** 5-Lane Undivided with access closures
- ***10th-C2.*** 4-Lane Divided with access closures
- ***10th-C3.*** 6-Lane Divided with access closures, widen north and south

It was determined to defer concept ***10th-C4. 6-Lane Divided with access closures, widen south only***. This option may be considered along with option ***10th-C3*** during a future environmental documentation phase.

Section 3.3 - Determination of Alternative Scenarios

The next step in the concept development and analysis process was to identify alternative scenarios by combining interchange options with corridor options.

Nine (9) alternative scenarios were identified as part of Exit 6 (10th Street) Corridor.

- ***10th-2A.*** 6-Lane Divided Corridor with SPUI Single Radius Lefts
  - Interchange Option: 10th-1 or 2
  - Corridor Option: 10th-C3
- ***10th-2B.*** 4-Lane Divided Corridor with 6-Lane SPUI Single Radius Lefts
  - Interchange Option: 10th-1 or 2

    - Corridor Option: 10th-C2
- ***10th-2C.*** 5-Lane Undivided Corridor with 6-Lane SPUI Single Radius Lefts
    - Interchange Option: 10th-1 or 2
    - Corridor Option: 10th-C1
- ***10th-5A.*** 6-Lane Divided Corridor with DDI
    - Interchange Option: 10th-5
    - Corridor Option: 10th-C3
- ***10th-5B.*** 4-Lane Divided Corridor with DDI
    - Interchange Option: 10th-5
    - Corridor Option: 10th-C2
- ***10th-5C.*** 5-Lane Undivided Corridor with DDI
    - Interchange Option: 10th-5
    - Corridor Option: 10th-C1
- ***10th-9A.*** 4-Lane Divided Corridor with Tight Split Diamond – 6th and 10th
    - Interchange Option: 10th-9
    - Corridor Option: 10th-C2
- ***10th-9B.*** 5-Lane Undivided Corridor with Tight Split Diamond – 6th and 10th
    - Interchange Option: 10th-9
    - Corridor Option: 10th-C1
- ***10th-Var.*** Unconstrained SB Entrance and NB Exit Ramps
    - Can be constructed with any of the Alternative Scenarios

Alternative scenario figures are shown in ***APPENDIX D5. ALTERNATIVE SCENARIO FIGURES***.

Section 3.4 - Analysis of Alternative Scenarios

The alternative scenarios 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
- Traffic Operations
- Year of Failure
- Noise
- Constructability

PREDICTIVE CRASH ANALYSIS

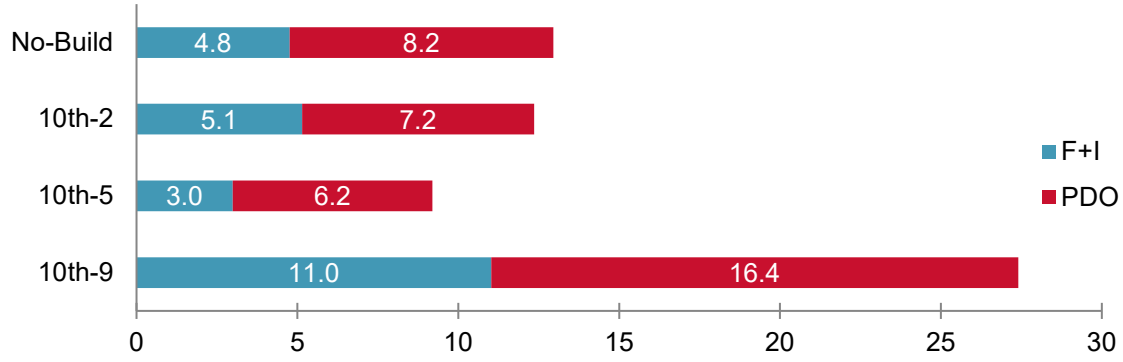
Predictive crash analysis was conducted for freeway ramps and the ramp terminal intersections. The predictive safety analysis was based on principles and methods of the ***Highway Safety Manual (HSM)***.

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 for each sub-study 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.

Since the predictive crash analysis only focused on the interchange portion of the alternative scenarios, all SPUI alternative scenarios (10th-2A, 10th-2B, 10th-2C) were combined and referred to as 10th-2, all DDI alternative scenarios (10th-5A, 10th-5B, 10th-5C) were combined and referred to as 10th-5, and all tight split diamond alternative scenarios (10th-9A, 10th-9B) were combined and referred to as 10th-9.

Table 4. 10th Street 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. 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	$ (1,900,000)
10th-5	$ 19,100,000	$ 10,900,000
10th-9	$ 67,800,000	$ (37,800,000)

[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 E. PREDICTIVE SAFETY ANALYSIS***.

TRAFFIC OPERATIONS ANALYSIS

Traffic operations were analyzed for each alternative scenario using ***Highway Capacity Software 2010 (HCS 2010) version 6.50***. A detailed report of the alternative scenario operations can be found in ***APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM***.

For all alternative scenarios, the ramp terminals operate at an acceptable LOS of C or better and the signalized arterial intersections operate at an acceptable threshold of LOS of D or better.

YEAR OF FAILURE ANALYSIS

A year of failure analysis was conducted for the alternative scenarios' interchanges 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.

Since the year of failure analysis only focused on the interchange portion of the alternative scenarios, all SPUI alternative scenarios (10th-2A, 10th-2B, 10th-2C) were combined and referred to as 10th-2, all DDI alternative scenarios (10th-5A, 10th-5B, 10th-5C) were combined and referred to as 10th-5, and all tight split diamond alternative scenarios (10th-9A, 10th-9B) were combined and referred to as 10th-9.

The resulting year of failure for the No-Build and Build alternatives is shown in ***TABLE 6***.

Table 6. 10th Street Corridor Year of Failure

ALTERNATIVE	YEAR OF FAILURE
No-Build	Already Failing
10th-2	Beyond 2065
10th-5	Beyond 2065
10th-9	Beyond 2065

Additional detail from the Year of Failure Analysis can be found in ***APPENDIX F. YEAR OF FAILURE ANALYSIS***.

NOISE ANALYSIS

A traffic noise analysis was conducted along the 10th Street corridor's area of influence for the nine 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.

TABLE 7 shows the number of traffic noise impacts predicted under each alternative.

Table 7. Noise Impact Summary

ALTERNATIVE	APPROACH/ EXCEED NAC	SUBSTANTIALLY EXCEED	TOTAL RECEPTORS AFFECTED
Existing	98	0	98
10th – 2A	165	0	165
10th– 2B	163	0	163
10th – 2C	163	0	163
10th – 5A	146	0	146
10th – 5B	136	0	136
10th – 5C	141	0	141
10th– 9A	148	0	148
10th – 9B	141	0	141
10th – Var	168	0	168

Potential noise abatement measures could be considered for all alternative scenarios. 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 G. SUB-STUDY 3 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.

CONSTRUCTABILITY

A constructability analysis was conducted for the alternative scenarios in order to assess potential construction phasing, maintenance of traffic and general timeframe.

TABLE 8 shows construction analysis results predicted for each alternative.

Table 8. Constructability Analysis

ALTERNATIVE	MAINTENANCE OF TRAFFIC COMPLEXITY	ALLOWS FOR PHASED CONSTRUCTION	ESTIMATED CONSTRUCTION TIME FRAME (MONTHS)
10th – 2A	Medium	Yes	18
10th – 2B	Medium	Yes	12
10th – 2C	Low	Yes	9
10th – 5A	Low	Yes	18
10th – 5B	Low	Yes	12
10th – 5C	Lowest	Yes	9
10th – 9A	Highest	Yes	21
10th – 9B	High	Yes	18

It is anticipated that all of the alternative scenarios will allow for phased construction. Further construction analysis would need to occur during future studies and continue through the design process.

Section 3.5 - Recommendation of Alternatives for Future Consideration

The analysis of alternative scenarios along with other evaluation criteria were used to develop an evaluation matrix to compare the alternative scenarios. The alternative scenarios were compared using the following criteria categories:

- Driver/Public Perception
- Construction Impacts
- Traffic Operations & Safety
- Property Impacts
- Environmental
- Pedestrians
- Cost

During the preliminary concept comparison stage (***SECTION 3.2***) of this study, DTA model results were utilized to assess traffic operations. As the project transitioned to the concept refinement stage, traffic operations were also assessed using HCS 2010. HCS 2010 has been developed to precisely represent the impact of detailed lane geometry and traffic signal operations on traffic flow. HCS 2010 also allows for the direct calculation of key traffic operations measures under a design volume set, which cannot be achieved using a DTA model. For these reasons, the traffic operations evaluation matrix reports MOEs summarized from HCS 2010.

The alternative scenarios evaluation matrix was reviewed with the SAT during a workshop in September 2016 to determine which alternative scenarios should be recommended to advance for future studies.

The evaluation matrix for the alternative scenarios is summarized in ***TABLE 9***.

Based on the evaluation, four (4) alternative scenarios are recommended to advance for future studies along with No-Build and 10th-Var, which is a variation of the alternatives where the southbound entrance ramp and northbound exit ramp are extended to allow for more ramp storage. 10th-Var can be incorporated into any of the alternative scenarios.

The alternative scenarios identified to advance are as follows:

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

FIGURES 5 THROUGH 17 illustrate the alternative scenarios recommended to advance.

Table 9. Alternative Scenarios Evaluation Matrix
I-229/10th Street Interchange/Corridor Construction

Sub-Study 3

Option	Description	Driver/ Public Perception	Construction Impacts		Traffic Operations & Safety											Property Impacts				Environmental	Pedestrians	Cost	Recommendation
		Driver familiarity/ expectancy	Maintenance of Traffic Complexity During Construction	Allows for phased construction	2035 Total interchange delay (Average AM/PM Peak)	Year of Failure[1]	2035 Traffic operations at northbound ramp terminal intersection		2035 Traffic operations at southbound ramp terminal intersection		2035 Traffic operations at 10th St. / Cliff Ave.		2035 Traffic operations at 10th St. / Cleveland Ave.		Planning Horizon Crash Cost Savings[1,2]	Number of closed access points	Total residential acquisitions	Total business acquisitions	Total ROW Required (Acres)	Environmental Impacts	Pedestrian accomodations on both sides	Total cost (including ROW)	
					Sec/Veh	*Year*	*LOS AM / PM*	*Intersection Delay AM / PM (sec)*	*LOS AM / PM*	*Intersection Delay AM / PM (sec)*	*LOS AM / PM*	*Intersection Delay AM / PM (sec)*	*LOS AM / PM*	*Intersection Delay AM / PM (sec)*	*M $*							*M $*	
No-Build		Good	N/A	N/A	33.9	< 2035	C / E	33.6 / 67.9	N/A	N/A	D / D	37.5 / 53.1	F / E	126.7 / 77.6	-	N/A	N/A	N/A	N/A	Low	Yes	N/A	Advance
10th-2A	SPUI + 6-lane	Good	Medium	Yes	24.3	> 2065	C / C	26.0 / 31.7	N/A	N/A	C / C	30.8 / 33.6	C / C	30.5 / 25.6	($2.0)	25	1	38	37.4	High	Yes	$72.5	Eliminate
10th-2B	SPUI + 4-lane divided	Good	Medium	Yes	26.7	> 2065	C / C	30.8 / 32.7	N/A	N/A	C / D	30.8 / 48.0	C / C	27.7 / 29.5	($2.0)	25	1	22	17.4	High	Yes	$49.3	Advance
10th-2C	SPUI + 5-lane	Good	Low	Yes	26.7	> 2065	C / C	30.8 / 32.7	N/A	N/A	C / D	30.8 / 48.0	C / C	27.7 / 29.5	($2.0)	25	1	12	8.2	Medium	Yes	$24.6	Advance
10th-5A	DDI + 6 lane	Fair	Low	Yes	24.1	> 2065	B / C	11.8 / 21.9	B / C	17.1 / 26.2	C / D	34.3 / 36.1	D / C	36.9 / 31.2	$10.9	30	6	45	40.8	High	Yes	$77.6	Eliminate
10th-5B	DDI + 4-lane divided	Fair	Low	Yes	27.0	> 2065	B / B	11.1 / 14.7	C / B	22.4 / 17	C / D	32.6 / 46.9	D / C	35.5 / 25.1	$10.9	30	6	29	20.8	High	Yes	$54.4	Advance
10th-5C	DDI + 5-lane	Fair	Lowest	Yes	27.0	> 2065	B / B	11.1 / 14.7	C / B	22.4 / 17	C / D	32.6 / 46.9	D / C	35.5 / 25.1	$10.9	30	6	19	11.7	Medium	Yes	$29.7	Advance
10th-9A	TSD + 4-lane divided	Poor	Highest	Yes	36.2	> 2065	C / C	25.6 / 21.0	B / C	19.1 / 24	C / D	33.3 / 39.9	C / C	29.8 / 25.9	($37.9)	26	13	24	24.5	High	Yes	$65.2	Eliminate
10th-9B	TSD + 5-lane	Poor	High	Yes	36.2	> 2065	C / C	25.6 / 21.0	B / C	19.1 / 24	C / D	33.3 / 39.9	C / C	29.8 / 25.9	($37.9)	26	13	14	15.4	High	Yes	$40.6	Eliminate
10th-Var																							Advance

[1]Year of Failure and Predictive Safety analysis include ramp terminal intersections and in general do not include non-ramp terminal intersections.

[2]Planning Horizon 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.

Figure 14

Matchline - See Figure 15

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Perpetuates Single Point Urban Interchange (SPUI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Widens 10th Street bridge over I-229 to the north and south to accommodate added left turn lanes.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
N Chapel Hill Road
Hyvee
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
S Blaine Ave
S Cleveland Ave
S Thompson Ave
INTERSTATE 229

Sub-Study 3: Alternative Scenario 10th-2B
4-Lane Divided Corridor with Single Point Urban Interchange

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 5

June 2017

Figure 15

Matchline - See Figure 14

Figure 10

Matchline - See Figure 11

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Perpetuates Single Point Urban Interchange (SPUI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Widens 10th Street bridge over I-229 to the north and south to accommodate added left turn lanes.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
N Chapel Hill Road
Hyvee
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
S Cleveland Ave
S Blaine Ave
S Thompson Ave
INTERSTATE 229

Sub-Study 3: Alternative Scenario 10th-2C
5-Lane Undivided Corridor with Single Point Urban Interchange

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 6

June 2017

Figure 11

Matchline - See Figure 10

Figure 14

Matchline - See Figure 15

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Replaces Single Point Urban Interchange with Diverging Diamond Interchange (DDI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Eliminates left turn movements on 10th Street by crossing 10th Street traffic to the left side between ramp terminal intersections.
- Provides opportunity to locate pedestrian/bicycle facilities between the 10th Street lanes over I-229 to allow signal control of all pedestrian/ bicycle crossings.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
S Cleveland Ave
S Blaine Ave
S Thompson Ave
N Chapel Hill Road
Hyvee
INTERSTATE 229

Sub-Study 3: Alternative Scenario 10th-5B
4-Lane Divided Corridor with Diverging Diamond Interchange

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 7

June 2017

Figure 15

Matchline - See Figure 14

Figure 10

Matchline - See Figure 11

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Replaces Single Point Urban Interchange with Diverging Diamond Interchange (DDI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Eliminates left turn movements on 10th Street by crossing 10th Street traffic to the left side between ramp terminal intersections.
- Provides opportunity to locate pedestrian/bicycle facilities between the 10th Street lanes over I-229 to allow signal control of all pedestrian/ bicycle crossings.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
N Chapel Hill Road
Hyvee
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
S Cleveland Ave
S Blaine Ave
S Thompson Ave
INTERSTATE 229

Sub-Study 3: Alternative Scenario 10th-5C
5-Lane Undivided Corridor with Diverging Diamond Interchange

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 8

June 2017

Figure 11

Matchline - See Figure 10

N

0 200' 400'

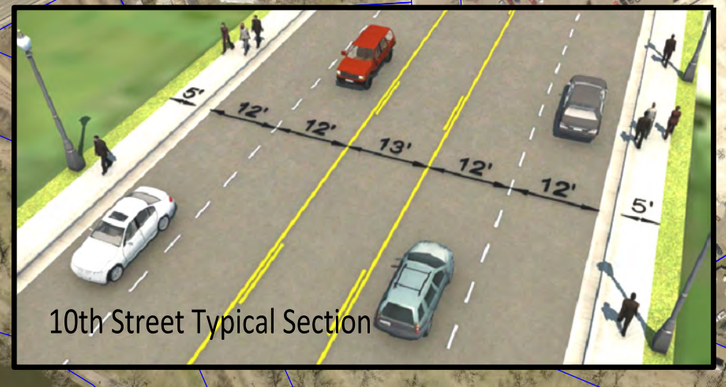
LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Maintains existing roadway section with two-way left turn lane.
- Maintains existing traffic signal locations.
- Requires no land acquisition for widening.

E 8th Street
E 9th Street
E 10th Street
E 11th Street
N Franklin Ave
N Indiana Ave
N Fairfax Ave
N French Ave
East Side Lutheran Church
Nelson Park
2 V
5 V
2



10th Street Typical Section

Matchline - See Figure 10

Sub-Study 3: Alternative Scenario 10th-C1 (Sheet 1 of 4)
5-Lane Undivided with Access Closures

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 9

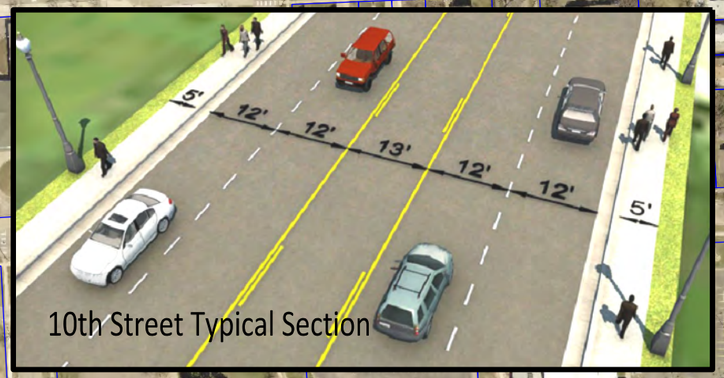
June 2017

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Maintains existing roadway section with two-way left turn lane.
- Maintains existing traffic signal locations.
- Requires no land acquisition for widening.

E Austin Street
E 8th Street
E 9th Street
E 10th Street
E Nye Street
E 11th Street
South Dakota School for the Deaf
S Van Eps Ave
S Wayland Ave
S Blauvelt Ave
S Mable Ave
S Highland Ave
S Jessica Ave
S Lewis Ave
S Chicago Ave

Matchline - See Figure 9

Matchline - See Interchange Concepts

Sub-Study 3: Alternative Scenario 10th-C1 (Sheet 2 of 4)
5-Lane Undivided with Access Closures

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 10

June 2017

Matchline - See Interchange Concepts

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

E 10th Street

Hills of Rest Memorial Park & Cemetary

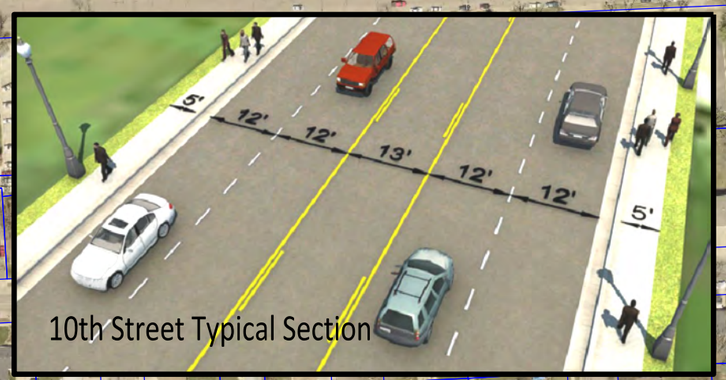
S Sneve Ave

S Bahnson Ave

E 11th Street

Kmart

E 12th Street



10th Street Typical Section

Concept Features

- Maintains existing roadway section with two-way left turn lane.
- Maintains existing traffic signal locations.
- Requires no land acquisition for widening.

Matchline - See Figure 12

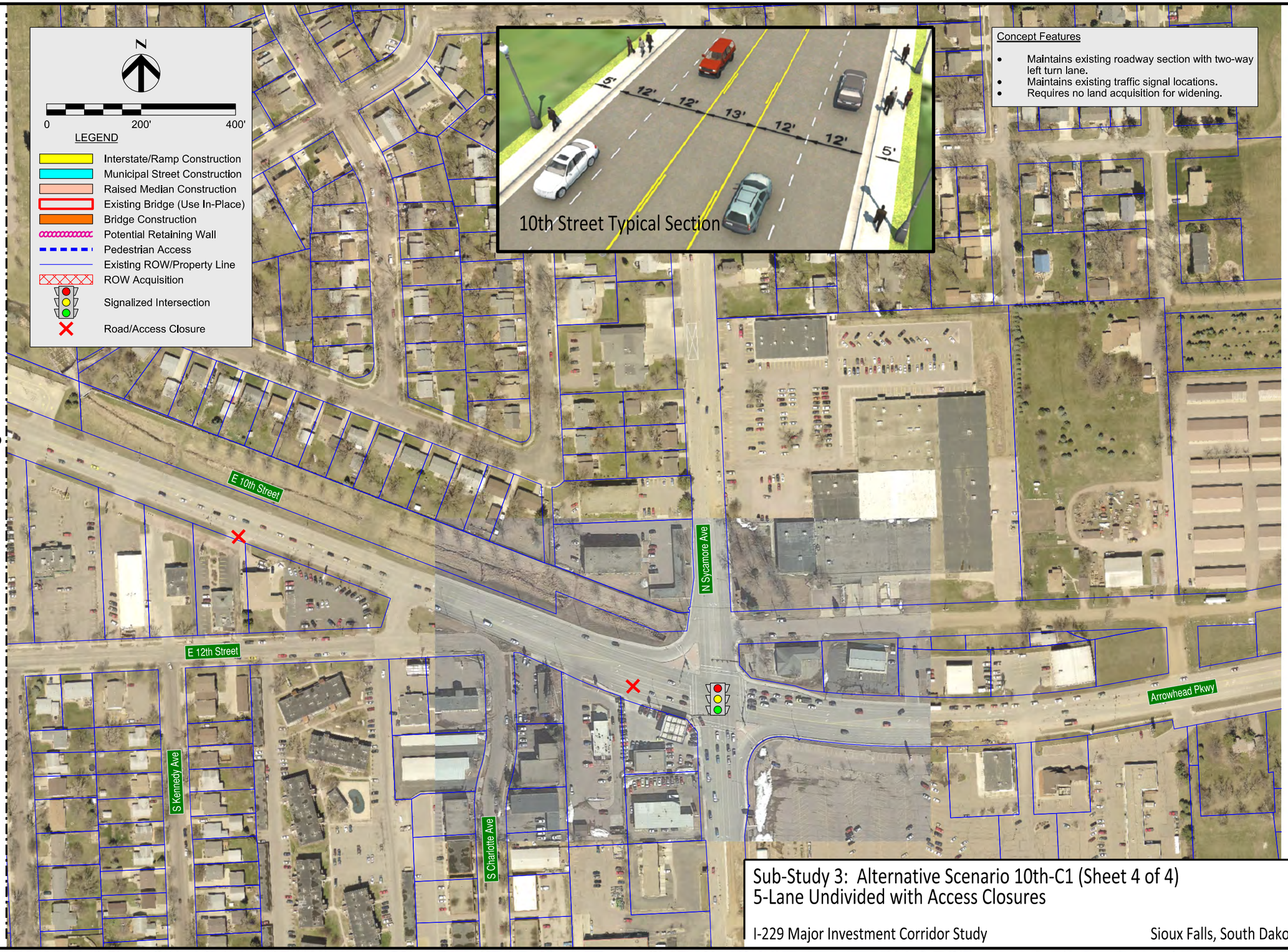
Sub-Study 3: Alternative Scenario 10th-C1 (Sheet 3 of 4)
5-Lane Undivided with Access Closures

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 11

June 2017



Sub-Study 3: Alternative Scenario 10th-C1 (Sheet 4 of 4)
5-Lane Undivided with Access Closures

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 12

June 2017

N

0 200' 400'

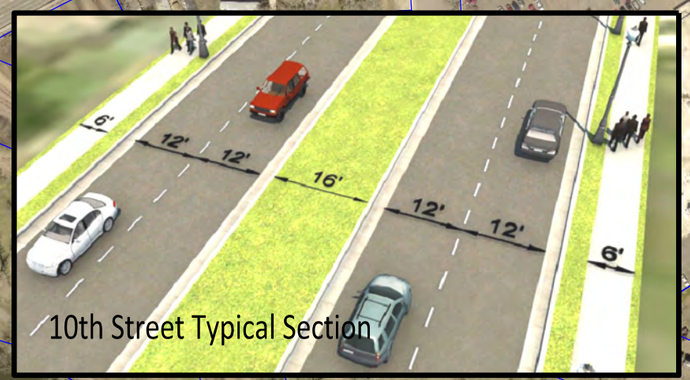
LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Rebuilds 10th Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires some land acquisition for slightly widened roadway (median).
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

E 8th Street
E 9th Street
E 10th Street
E 11th Street
N Franklin Ave
N Indiana Ave
N Fairfax Ave
N French Ave
East Side Lutheran Church
Nelson Park



10th Street Typical Section

Matchline - See Figure 14

Sub-Study 3: Alternative Scenario 10th-C2 (Sheet 1 of 4)
4-Lane Divided with Access Closures

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 13

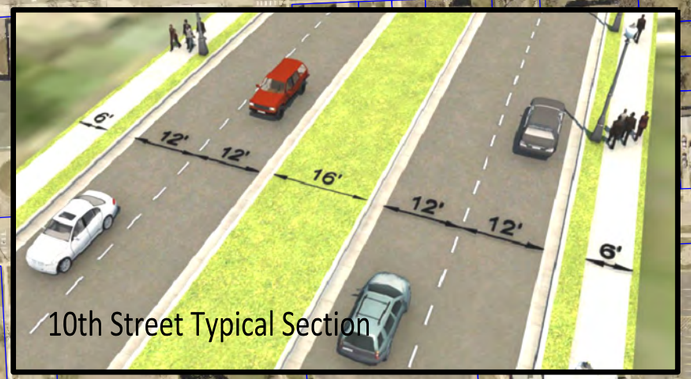
June 2017

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires some land acquisition for slightly widened roadway (median).
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

E Austin Street
E 8th Street
E 9th Street
South Dakota School for the Deaf
E 10th Street
E Nye Street
E 11th Street
S Van Eps Ave
S Wayland Ave
S Blauvelt Ave
S Mable Ave
S Highland Ave
S Jessica Ave
S Lewis Ave
S Chicago Ave
< 2
< 3
3 >
2 >

Matchline - See Figure 13

Matchline - See Interchange Concepts

Sub-Study 3: Alternative Scenario 10th-C2 (Sheet 2 of 4)
4-Lane Divided with Access Closures

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
14
June 2017

Matchline - See Interchange Concepts

Matchline - See Figure 16

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

E 10th Street

S Sneve Ave

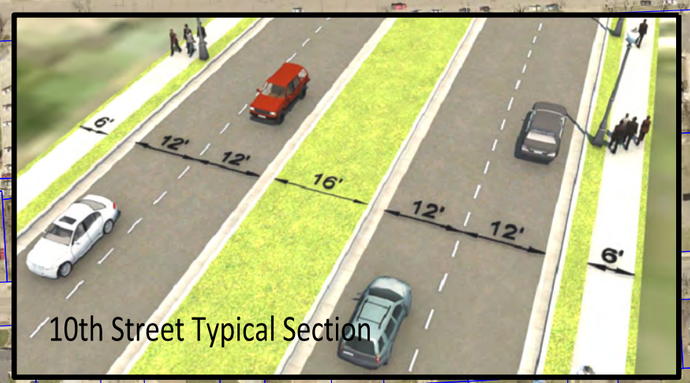
S Bahnson Ave

E 11th Street

E 12th Street

Hills of Rest Memorial Park & Cemetary

Kmart



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires some land acquisition for slightly widened roadway (median).
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

Sub-Study 3: Alternative Scenario 10th-C2 (Sheet 3 of 4)
4-Lane Divided with Access Closures

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 15

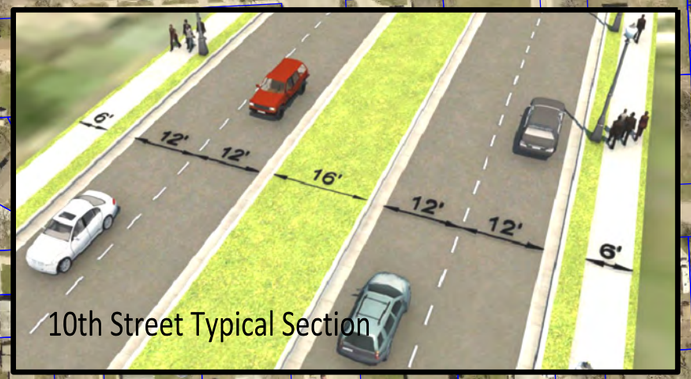
June 2017

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires some land acquisition for slightly widened roadway (median).
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

Matchline - See Figure 15

E 10th Street

E 12th Street

S Kennedy Ave

S Charlotte Ave

N Sycamore Ave

Arrowhead Pkwy

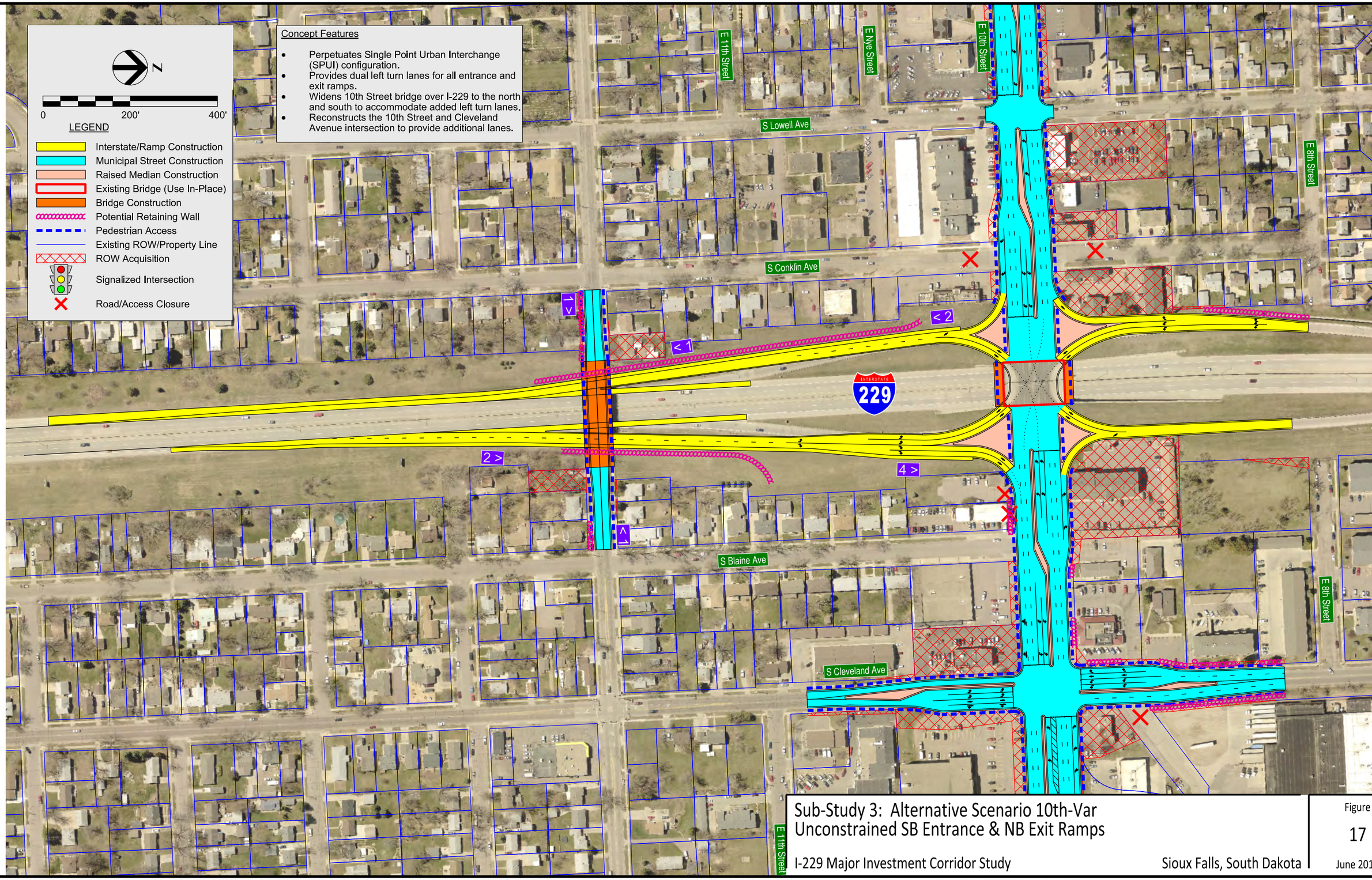
Sub-Study 3: Alternative Scenario 10th-C2 (Sheet 4 of 4)
4-Lane Divided with Access Closures

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 16

June 2017



Sub-Study 3: Alternative Scenario 10th-Var
Unconstrained SB Entrance & NB Exit Ramps

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 17

June 2017

CHAPTER 4 - SUMMARY AND NEXT STEPS

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

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

These are the anticipated next steps for the projects associated with the I-229 Exit 6 (10th Street) Crossroad Corridor Study:

- Refine the implementation timeframe and funding responsibility. Improvements to the interchange area (including intersections with Lowell Avenue and Cleveland Avenue) were identified as a high priority. All proposed interchange improvement concepts recommend providing six lanes through the interchange area. However, improvements to widen the 10th Street corridor to six lanes between Franklin Avenue and Lowell Avenue and Cleveland Avenue to Sycamore Avenue were identified as low priority improvements.
- 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 an Interchange Modification Report for the I-229/10th Street interchange.
- 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.

APPENDICES

APPENDIX A. METHODS AND ASSUMPTIONS FOR SUB-STUDY 3

APPENDIX B1. TRAFFIC CAPACITY ANALYSIS METHODOLOGIES

APPENDIX B2. EXISTING HCS 2010 REPORTS

APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM

APPENDIX D1. PRELIMINARY CONCEPT FIGURES

APPENDIX D2. PRELIMINARY CONCEPTS TECH MEMO

APPENDIX D3. DTA MODEL INTERCHANGE AND MODEL SUBAREAS

APPENDIX D4. ENVIRONMENTAL CONSTRAINTS MAPS

APPENDIX D5. ALTERNATIVE SCENARIO FIGURES

APPENDIX E. PREDICTIVE SAFETY ANALYSIS

APPENDIX F. YEAR OF FAILURE ANALYSIS

APPENDIX G. SUB-STUDY 3 NOISE STUDY TECHNICAL REPORT

APPENDIX H. PUBLIC INVOLVEMENT

APPENDIX I. EXISTING ACCESS CONTROL FIGURES

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

1. Methods and Assumptions Cover Page

I-229 Major Investment Corridor Study: Sub-Study #3-Amendment 2

To:	Study Advisory Team (SDDOT, FHWA, City of Sioux Falls)		
From:	Chris Malmberg, HDR Courtney Sokol, HDR Jon Markt, HDR	Project:	I-229 Major Investment Corridor Study
CC:	Dave Meier 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 August 28, 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 analysis (safety) 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 #3***.

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 #3*** 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 Hoffiezer – 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 Holnes, 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.

	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.

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 3 will analyze existing and future conditions at the I-229 interchange at Exit 6 (10th Street) and along 10th Street from Franklin Avenue to Sycamore Avenue. The study will conduct an interchange crossroad corridor study for the I-229 Exit 6 interchange.

Location

The I-229 Exit 6 interchange and adjacent 10th Street corridor is located in the eastern portion of the Sioux Falls metropolitan area, approximately 4 miles south of the I-229/I-90 systems interchange. The mainline interstate study limits include Exit 5 (26th Street) through Exit 7 (Rice Street). The 10th Street study limits include Franklin Avenue through Sycamore Avenue.

An illustration of the Sub-Study 3 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:

- Congestion at the 10th Street / I-229 interchange and along 10th Street, east and west of I-229.
    - This congestion exists throughout the majority of the day.
- Closely spaced signals along 10th Street near the I-229 interchange.
- Future growth along the 10th Street corridor.
- Connection from proposed Veterans Memorial Parkway (existing SD 11/Powder House Road) to downtown area.
- Improved pedestrian mobility.
- Safety concerns along the 10th Street corridor.

Study Schedule

Date	Task/Event
March 2013	Notice to Proceed, Kickoff Meeting
July 2013	**Methods & Assumptions Documentation**
July 2013- August 2013	Baseline Conditions Analysis/ Data Collection
September 2013- October 2014	**Public Meeting #1** (Project Kickoff) **(Oct 2013)** Existing Traffic and Operations Analysis Project Future Conditions (No Build)
October 2014- October 2015	Conceptual Design of Reconfiguration Options for the I-229 Exit 6 Interchange Conceptual Design of 10th Street Corridor Improvements **Public Meeting #2** (Scenario Building Stage) **(June 2015)** **MPO Meeting (Scenario Building Presentation)** Determination of Interchange and Corridor Build Scenarios Traffic and Operations Analysis of Build Scenarios
November 2015 – July 2016*	Predictive Crash Analysis of Build Scenarios Noise Analysis of Build Scenarios Constructability Analysis of Build Scenarios Recommendations
August 2016- November 2016*	Sub-Study 3 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

Modifications to the I-229 Exit 6 (10th Street) interchange and adjacent 10th Street corridor would have the potential to affect:

- The intersections on 10th Street near I-229.
- Adjacent parallel corridors of 6th Street, 12th Street and 18th Street.
- Adjacent perpendicular corridors of Cleveland Avenue, Lowell Avenue and Cliff Avenue.
- The adjacent parallel corridors providing access to I-229 at Exit 5 (26th Street) and Exit 7 (Rice Street).

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
- 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/
- Northeast Transportation Network Feasibility Study
- 2010 Decennial Interstate Corridor Study and 2000 Decennial Interstate Study
- Cleveland Avenue Study
- 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 3 was defined by the Study Advisory Team and is illustrated in this report for documentation. The study area contains 10th Street from Franklin Avenue to Sycamore Avenue. Freeway operations will be conducted during Sub-Study 1 and will also be reported in Sub-Study 3 for freeway locations from Exit 5 (26th Street) to Exit 7 (Rice Street). The following graphic shows the study area and identifies each of the study intersections.

Sub-Study 3 Study Area



10th Street Study Intersections:

- Franklin Avenue
- Fairfax Avenue
- Cliff Avenue
- Blauvelt Avenue
- Jessica Avenue
- Lowell Avenue*
- Conklin Avenue
- I-229 Single Point Ramp Terminal*
- Blaine Avenue
- Cleveland Avenue*
- Cambell's / Hy-Vee Parking Lot
- Bahnson Avenue
- Sycamore Avenue

* 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 between 26th Street (Exit 5) and 10th Street (Exit 6)
- I-229 Northbound between 10th Street (Exit 6) and Rice Street (Exit 7) [1]
- I-229 Southbound between Rice Street (Exit 7) and 10th Street (Exit 6) [1]
- I-229 Southbound between 10th Street (Exit 6) and 26th Street (Exit 5)

[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:

- I-229 Northbound merge from 26th Street (Exit 5)
- I-229 Northbound diverge to 10th Street (Exit 6)
- I-229 Southbound merge from 10th Street (Exit 6)
- I-229 Southbound diverge to 26th Street (Exit 5)

Study Mainline Freeway Areas (Crash Prediction)

- I-229 Northbound & Southbound
  - Between mile marker 5 and mile marker 7

Study Service Interchange Areas (Crash Prediction)

- Exit 6: 10th Street

Study Intersections (Crash Prediction)

- 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**

*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 Hour
- Existing Conditions (Year 2012) – PM Peak Hour

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 Hour
- Future/Design Conditions (Year 2035) – PM Peak Hour

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

Volume data will be smoothed/balanced for the Existing and Future/Design Conditions using the Cube Voyager macroscopic model, with adjustments to raw model output based on post-processing techniques, as part of Sub-Study 1.

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 available by the City of Sioux Falls at 10th Street study intersections were mostly conducted in year 2011. To capture existing conditions on an average weekday, new traffic counts were collected at the 10th Street study intersections by the City of Sioux Falls and HDR in year 2013. These counts include volume data in 15-minute intervals.

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 and then smoothed/balanced along the I-229 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

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 (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.

2. Analysis of a Diverging Diamond Interchange will follow the methodology outlined in the 'Highway Capacity Software Analysis Procedures for a Diverging Diamond Interchange (DDI)' memorandum, found in the Appendix.

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

2. Operational Analysis Results
   a. Level of Service (LOS)
      i. Signalized Ramp Terminal Intersections (SDDOT's System)
         1. Intersections where geometry is modified because of project improvements
            a. Minimum allowable LOS – LOS 'C'
               i. Individual movements will be allowed to operate at LOS 'D' but the overall intersection LOS shall be 'C' or better
         2. Other intersections (intersections within the study area that are not modified by project improvements)
            a. Minimum allowable LOS – LOS 'D'
               i. Individual movements will be allowed to operate at LOS 'E' but the overall intersection LOS shall be 'D' or better
      ii. Signalized Non-Ramp Terminal Intersections (City of Sioux Fall's System)
         1. Minimum allowable LOS – LOS 'D'
      iii. Basic Freeway, Ramp Junctions and Weave Areas
         1. Minimum allowable LOS – LOS 'C'

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.

iii. Future 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 same projected right turn on red volume for Future No-Build (Year 2035) Conditions will be used, assuming the Future Build (Year 2035) Condition geometry remain similar to the Future No-Build (Year 2035) Condition geometry.

8. Travel Forecast

Existing (Year 2012) and Future Year (Year 2035) volumes developed during Sub-Study 1 will be used for the volumes within the study area for Sub-Study 3. The methodology for Travel Forecast was documented in the Sub-Study 1 Methods and Assumptions document.

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 with the limits described in the Sub-Study 1 & Sub-Study 3 Methods and Assumptions documents. 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. Conduct an interchange crossroad corridor study for Exit 6 (10th Street).
    a. Complete a traffic level of service analysis for both existing and future (2035) conditions along 10th Street from Franklin Avenue to Sycamore Avenue.
    b. Complete a safety analysis of 10th Street from Franklin Avenue to Sycamore Avenue.
    c. Complete a predictive safety analysis of interchange Exit 6 (10th Street) for both existing and future (2035) conditions.

   d. Determine and recommend improvement options that will improve mobility and safety along the 10th Street corridor, including the I-229 Exit 6 interchange.
2. Create final products for use by the SDDOT and City of Sioux Falls which will guide them in the implementation of recommended improvements that will maximize the efficiency of the system.

To satisfy the study objectives, the following MOEs will be used to evaluate and compare the concepts:

- 10th Street Intersections: **LEVEL OF SERVICE (LOS)** and **INDIVIDUAL MOVEMENT DELAY**
- 10th Street Corridor: **LOS** and **TRAVEL SPEED**
- Ramp Terminal Intersections: **LOS** and **INDIVIDUAL MOVEMENT DELAY**
- Freeway Segments, Ramp Junctions and Weave Areas: **LOS** and **DENSITY**

These statements are made assuming that the geometric improvements identified meet all AASHTO, SDDOT, and City of Sioux Falls guidelines. It is understood that all traffic analysis reporting will be completed using HCM 2010 Methodology.

11. FHWA Interstate Access Modification Policy Points

An Interchange Modification Justification Report (IMJR) will not be developed for the I-229 Exit 6 (10th Street) interchange as part of this project.

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)
- Analysis Procedures for Diverging Diamond Interchange (DDI)
- Crash Prediction Analysis Procedures for Diverging Diamond Interchange (DDI), Single-Point Urban Interchange (SPUI), and 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

FHWA-SD
2014 SEP 5 AM 10 00

Methods & Assumptions Meeting Documentation

1. Methods and Assumptions Cover Page

I-229 Major Investment Corridor Study: Sub-Study #3- Amendment 1

To:	Study Advisory Team (SDDOT, FHWA, City of Sioux Falls)		
From:	Chris Malmberg, HDR Mike Forsberg, HDR	Project:	I-229 Major Investment Corridor Study
CC:	Dave Meier 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 August 28, 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 #3***.

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 #3*** 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

- 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 3 will analyze existing and future conditions at the I-229 interchange at Exit 6 (10th Street) and along 10th Street from Franklin Avenue to Sycamore Avenue. The study will conduct an interchange crossroad corridor study for the I-229 Exit 6 interchange.

Location

The I-229 Exit 6 interchange and adjacent 10th Street corridor is located in the eastern portion of the Sioux Falls metropolitan area, approximately 4 miles south of the I-229/I-90 systems interchange. The mainline interstate study limits include Exit 5 (26th Street) through Exit 7 (Rice Street). The 10th Street study limits include Franklin Avenue through Sycamore Avenue.

An illustration of the Sub-Study 3 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:

- Congestion at the 10th Street / I-229 interchange and along 10th Street, east and west of I-229.
  - This congestion exists throughout the majority of the day.
- Closely spaced signals along 10th Street near the I-229 interchange.
- Future growth along the 10th Street corridor.
- Connection from proposed SD 100 (existing SD 11/Powder House Road) to downtown area.
- Improved pedestrian mobility.
- Safety concerns along the 10th Street corridor.

Study Schedule

Date	Task/Event
March 2013	Notice to Proceed, Kickoff Meeting
July 2013	Methods & Assumptions Documentation
July 2013- August 2013	Baseline Conditions Analysis/ Data Collection
September 2013- October 2014	**Public Meeting #1** (Project Kickoff) **(Oct 2013)** Existing Traffic and Operations Analysis Project Future Conditions (No Build)
October 2014- May 2015	Conceptual Design of Reconfiguration Options for the I-229 Exit 6 Interchange Conceptual Design of 10th Street Corridor Improvements **Public Meeting #2** (Scenario Building Stage) **(Jan/Feb 2015)** **MPO Meeting (Scenario Building Presentation)** Determination of Interchange and Corridor Build Scenarios Traffic and Operations Analysis of Build Scenarios Noise Analysis of Build Scenarios Constructability Analysis of Build Scenarios Recommendations
May 2015- September 2015	Sub-Study 2 Report Documentation **Public Meeting #3 (Draft Report Stage)** **MPO Meeting (Final Recommendations Presentation)**

Facilities Affected by the Study

Modifications to the I-229 Exit 6 (10th Street) interchange and adjacent 10th Street corridor would have the potential to affect:

- The intersections on 10th Street near I-229.
- Adjacent parallel corridors of 6th Street, 12th Street and 18th Street.
- Adjacent perpendicular corridors of Cleveland Avenue, Lowell Avenue and Cliff Avenue.
- The adjacent parallel corridors providing access to I-229 at Exit 5 (26th Street) and Exit 7 (Rice Street).

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
- 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/
- Northeast Transportation Network Feasibility Study
- 2010 Decennial Interstate Corridor Study and 2000 Decennial Interstate Study
- Cleveland Avenue Study
- 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 3 was defined by the Study Advisory Team and is illustrated in this report for documentation. The study area contains 10th Street from Franklin Avenue to Sycamore Avenue. Freeway operations will be conducted during Sub-Study 1 and will also be reported in Sub-Study 3 for freeway locations from Exit 5 (26th Street) to Exit 7 (Rice Street). The following graphic shows the study area and identifies each of the study intersections.

Sub-Study 3 Study Area



10th Street Study Intersections:

- Franklin Avenue
- Fairfax Avenue
- Cliff Avenue
- Blauvelt Avenue
- Jessica Avenue
- Lowell Avenue
- I-229 Single Point Ramp Terminal
- Blaine Avenue
- Cleveland Avenue

- Cambell's / Hy-Vee Parking Lot
- Bahnson Avenue
- Sycamore Avenue

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 between 26th Street (Exit 5) and 10th Street (Exit 6)
- I-229 Northbound between 10th Street (Exit 6) and Rice Street (Exit 7) [1]
- I-229 Southbound between Rice Street (Exit 7) and 10th Street (Exit 6) [1]
- I-229 Southbound between 10th Street (Exit 6) and 26th Street (Exit 5)

[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:

- I-229 Northbound merge from 26th Street (Exit 5)
- I-229 Northbound diverge to 10th Street (Exit 6)
- I-229 Southbound merge from 10th Street (Exit 6)
- I-229 Southbound diverge to 26th Street (Exit 5)

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 Hour
- Existing Conditions (Year 2012) – PM Peak Hour

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 Hour
- Future/Design Conditions (Year 2035) – PM Peak Hour

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

Volume data will be smoothed/balanced for the Existing and Future/Design Conditions using the Cube Voyager macroscopic model, with adjustments to raw model output based on post-processing techniques, as part of Sub-Study 1.

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 available by the City of Sioux Falls at 10th Street study intersections were mostly conducted in year 2011. To capture existing conditions on an average weekday, new traffic counts were collected at the 10th Street study intersections by the City of Sioux Falls and HDR in year 2013. These counts include volume data in 15-minute intervals.

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 and then smoothed/balanced along the I-229 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

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 (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.
         2. Analysis of a Diverging Diamond Interchange will follow the methodology outlined in the 'Highway Capacity Software Analysis Procedures for a Diverging Diamond Interchange (DDI)' memorandum, found in the Appendix.
   b. Basic Freeway, Ramp Junctions and Weave Areas
      i. HCS Release 6.5 (2010 HCM Methodology)
2. Operational Analysis Results
   a. Level of Service (LOS)
      i. Signalized Ramp Terminal Intersections (SDDOT's System)
         1. Intersections where geometry is modified because of project improvements
            a. Minimum allowable LOS – LOS 'C'
               i. Individual movements will be allowed to operate at LOS 'D' but the overall intersection LOS shall be 'C' or better
         2. Other intersections (intersections within the study area that are not modified by project improvements)
            a. Minimum allowable LOS – LOS 'D'
               i. Individual movements will be allowed to operate at LOS 'E' but the overall intersection LOS shall be 'D' or better
      ii. Signalized Non-Ramp Terminal Intersections (City of Sioux Fall's System)
         1. Minimum allowable LOS – LOS 'D'
      iii. Basic Freeway, Ramp Junctions and Weave Areas
         1. Minimum allowable LOS – LOS 'C'
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.

iii. Future 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 same projected right turn on red volume for Future No-Build (Year 2035) Conditions will be used, assuming the Future Build (Year 2035) Condition geometry remain similar to the Future No-Build (Year 2035) Condition geometry.

8. Travel Forecast

Existing (Year 2012) and Future Year (Year 2035) volumes developed during Sub-Study 1 will be used for the volumes within the study area for Sub-Study 3. The methodology for Travel Forecast was documented in the Sub-Study 1 Methods and Assumptions document.

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. Conduct an interchange crossroad corridor study for Exit 6 (10th Street).
    a. Complete a traffic level of service analysis for both existing and future (2035) conditions along 10th Street from Franklin Avenue to Sycamore Avenue.
    b. Complete a safety analysis of 10th Street from Franklin Avenue to Sycamore Avenue.
    c. Determine and recommend improvement options that will improve mobility and safety along the 10th Street corridor, including the I-229 Exit 6 interchange.
2. Create final products for use by the SDDOT and City of Sioux Falls which will guide them in the implementation of recommended improvements that will maximize the efficiency of the system.

To satisfy the study objectives, the following MOEs will be used to evaluate and compare the concepts:

- 10th Street Intersections: **LEVEL OF SERVICE (LOS)** and **INDIVIDUAL MOVEMENT DELAY**
- 10th Street Corridor: **LOS** and **TRAVEL SPEED**
- Ramp Terminal Intersections: **LOS** and **INDIVIDUAL MOVEMENT DELAY**
- Freeway Segments, Ramp Junctions and Weave Areas: **LOS** and **DENSITY**

These statements are made assuming that the geometric improvements identified meet all AASHTO, SDDOT, and City of Sioux Falls guidelines. It is understood that all traffic analysis reporting will be completed using HCM 2010 Methodology.

11. FHWA Interstate Access Modification Policy Points

An Interchange Modification Justification Report (IMJR) will not be developed for the I-229 Exit 6 (10th Street) interchange as part of this project.

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 (August 28, 2013)
- Analysis Procedures for Diverging Diamond Interchange (DDI)

APPENDIX

HDR | ONE COMPANY *Many Solutions™*

Meeting Notes

Subject:	Study Advisory Team Meeting No. 3
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:	August 28, 2013, 1:00-3:30PM
Meeting Location:	Web Meeting: SDDOT Pierre Headquarters; SDDOT Sioux Falls Area Office; HDR Omaha & Sioux Falls; City of Sioux Falls; HR Green Des Moines & Sioux Falls
Notes by:	David Meier,

A Study Advisory Team Meeting for the I-229 Major Investment Corridor Study was held on August 28, 2013. Action items from the meeting are summarized below and discussion details follow. A list of participants and contact information is at the end of meeting notes.

Action Items

Item	Responsible
o Update M&A documents for SS 2, 3, & 4 and submit for signature.	HDR
o Revise mailing list limits per SAT comments & submit updated lists to SDDOT & City.	HDR
o Coordinate on Public Meeting room layout.	HDR/City
o Edit website as needed per additional SAT comments. Activate website 3 weeks from SAT #3.	HDR
o Determine whether a press conference will be held announcing Study/website.	SDDOT
o	
o	City
o Identify SDDOT staff for ITS interviews.	SDDOT

Comments based on the provided Agenda and PowerPoint Presentation:

1. **Introductions** (SDDOT, City, MPO, FHWA, HDR/HR Green)

2. **Draft Methods & Assumptions Documents – Sub-studies 2, 3, and 4**
   - **Sub-study 2**
     - **Section 3** - The Need for Study subsection should note the need to consider findings of the 41st Street Corridor Study (City).
     - Study Schedule table shows September 2014 for completion, is there need to officially extend the project schedule? Yes (see Schedule section of SAT notes). ***Comment applies to all Sub-studies).***
     - Previously developed interchange modification alternatives need to be considered. Interim conditions (post-49th Street Extension and Costco opening) will need to be considered and interim improvements may be needed (City). FHWA is concerned regarding proximity of 49th St connection and existing interchange ramp terminals.
     - Need to review Costco Traffic Impact Study for interim improvements noted.
     - In Study Schedule table, reference to Sub-study 3 Report Documentation should be SS 2.

- Add 41st and Grange to list of Facilities Impacted by the Study.
- **Section 5** - FHWA has comments regarding differences noted between the described approach in the SS 2 M&A and the M&A document for Exit 5 (26th Street) for Section 5 and subsequent sections. If these differences can be addressed, there will be no need for FHWA to send the M&A documents to the Resource Center for review. ***Comment applies to all Sub-studies. FHWA comments were received on 9/3/13 from SDDOT. Responses to the FHWA comments are tabulated at the end of these notes.***
- **Section 6** - Add Scheel's Expansion Study and Wal Mart Traffic Impact Study to list of previous studies. ***The additions will also be made to the Previous Studies list in Section 3.***
- **Section 7** – HDR clarified that Synchro will not be used. ***Applies to all Sub-studies.***
- **Section 10** – The City commented that the Measures of Effectiveness description needs to clarify that Level of Service "D" will be the minimum criteria for individual intersection approaches, but not an entire intersection. ***Applies to all Sub-studies. Response to this comment will be located in Section 7 of the M&A documents, per FHWA comment.***
- **Section 11** – The City asked if FHWA Regional Office comments on the previously prepared draft IJR will need to be noted in the sub-study report. FHWA replied that is unknown at this time because alternatives are yet to be identified in Sub-study 2.
- **Section 14 (Appendix)** – The Diverging Diamond Interchange analysis procedure attached are the most current version of the procedure.

- **Sub-study 3**
  - **Section 3** - The City noted that there is a serious capacity issue with the existing interchange that extends the majority of the day. The M&A will be revised to note that congestion extends through off-peak periods.
  - Add the following to the Facilities Impacted by the Study:
    - 18th Street (parallel corridor)
    - Lowell Ave (perpendicular corridor)
  - Strike the SIMPCO Incident Management Plan from the Previous Studies section. ***Comment applies to all Sub-studies.***
  - **Section 4** - Study Area figure references Sub-study 2. ***Also applies to SS4 M&A.***

- **Sub-study 4**
  - **Section 4** - Study Area description needs to be replaced with SS 4 specific narrative.
  - Add Benson Rd Feasibility Study to the Previous Studies section.

3. **Safety Analysis Technical Memorandum**
   - The slippery conditions noted in a significant number of reported crashes were mostly during winter weather (approximately 90%), but some were documented as wet pavement. This pattern was noted for the Cliff Ave to Louise Ave segment as well as the 26th Street area along I-229.
   - Enhanced driver information during inclement weather was noted as a potential mitigation measure. The ITS recommendations section of the Sub-study 1 report will provide additional details on this recommendation.
   - It was noted that the safety analysis findings may suggest review of snow removal operational procedures.
   - Crashes associated with traffic congestion were found to be mostly located on ramps. SDDOT noted that right-turning traffic on the northbound 10th St exit ramp has been shifted onto the paved shoulder with pavement markings to provide additional storage. The southbound 10th St entrance ramp has been extended to provide more merging length upstream of the ramp gore.

4. **Public Involvement Activities**
   - **Public Meeting**

- **The 1st Public meeting will be held on Wednesday October 30th from 5:30-7:00 pm at the Convention Center.**
- Press release to be placed in the Argus Leader 17 and 10 days in advance of the meeting. There will be no weekend advertisements due to substantial additional cost involved.
- Seating will be limited to about 150. Additional seating capacity may be needed for the 2nd public meeting, when mailings will include extended limits for Sub-studies 2, 3, and 4.
- The formal presentation will be kept brief and presented once. The presentation will be taped.
- HDR will coordinate with the City on the room layout for the public meeting.
- HDR Mailing list
  - Approximately 600 addressees on the current mailing list.
  - Check the ownership of the open area shown on the north side of I-229 just east of the I-29/I-229 system interchange and south of W 59th St.
  - HDR will send a coordination letter to addressees on the Exit 5 Study mailing list alerting them to the I-229 study.
  - Revise the mailing area to reduce the number of properties contacted west of Western Avenue and north of I-229.
  - Add the properties along both sides of Minnesota Ave extending south to E 57th St.
  - At 10th St, mailing list coverage will be extended to S Cliff Ave to the west and to S Sycamore Ave to the east.
  - Updated mailing lists will be sent to Steve Gramm and Shannon Ausen.
- Postcards will be used for the public meeting mailings.
- Message boards will be used to assist in advertising the public meeting. The City can provide some of the message boards to be used. FHWA does not object to placing message boards in the I-229 right of way for this purpose.

- **Draft Web site**
  - HDR has made updates to the website reflecting comments received to date. Additional comments should be sent to Jason Kjenstad.
  - SDDOT will consider conducting a press conference to announce the study and/or web site.
  - The website is to be activated at least two weeks prior to advertising for the October 30th public meeting and may be activated in three weeks from this SAT meeting (pending further SAT comments).

5. **Origin-Destination Data**
   - HDR presented an overview of the cell phone-based O-D data gathered by AirSage that focused on the following objectives:
     - External to external patterns
     - Comparison of average weekday travel patterns to average weekend day and two special events days for which data was collected.
     - Comparison of the cell phone-based O-D data to the O-D matrix generated by the Sioux Falls area model.
   - The O-D data presentation screens were provided as a part of the SAT meeting agenda file in pdf format.
   - The data collection process involved approximately 100,000 device (cell phone) sightings per day and a total of 1.5 million unique devices logged. Of that total, 146,000 devices were assumed to be area resident phones, based on observed patterns. Based on a 446,000 person population for the data collection area, the calculated sampling rate was over 32 percent. The total trips per day identified averaged around 200,000. The SAT questioned the 446,000 population figure as far in excess of the metropolitan area (approximately 225,000 population). HDR will provide an explanation of the area covered for that population. ***Response: The 446,000 population is for the entire O-D study area that includes the Sioux Falls***

metropolitan area and the surrounding buffer area (shown on Exhibit 1 from the presentation following these notes) that was used to identify external trips.

- Each day of the week was found to have a typical pattern with Fridays having the peak number of trips and Sundays having the lowest number.
- Local versus regional traffic patterns were reviewed for I-29 south of Sioux Falls, which indicated that 84 percent of trips on I-29 had an origin or destination within the Sioux Falls metro area. The SAT requested that the local/regional patterns be reported for I-29 north of Sioux Falls and for I-90 east and west of Sioux Falls. ***Response: The O-D patterns for local and regional trips for I-29 north and I-90 east and west are shown on Exhibits 2, 3, and 4 following these notes.***
- For the average weekday vs. weekend day comparison, O-D patterns between most zones showed decreases of 15 to 50 percent, with exceptions being shopping area zones and the casino.
- Both the construction incident special event day and the winter weather special event day were found to have quantities of trips similar to the average week day.
- For the construction incident day vs. the average weekday comparison, most zones had variances of +/- 10 to 50 percent trips. The SAT asked if most of the variances were more likely +/- 20 to 30 percent. ***Response: Exhibit 5 following these notes labels the variance percentages for each zone.***
- The City has not reviewed the O-D data yet, but expects that it will prove helpful in improving O-D patterns built into the model.

6. **Project Schedule**
   - HDR advised the SAT that final reports for the sub-studies will likely be issued at the end of September 2014.

7. **Next Steps**
   - HDR will coordinate with the City on the room layout for the public meeting.

8. **Other Items** – No discussion
   - SDDOT advised that data collection for the ITS assessment task will involve interviewing identified DOT staff instead of reviewing previously developed ITS planning documents.
   - A presentation by IADOT staff regarding the Tri-State Incident Management Plan for the Sioux City metropolitan area will be given on Monday September 9th from 1-3 pm in the SDDOT Area Office. Steve Gramm will be attending.

Attendees:

Pierre		
Mark Hoines - FHWA	Steve Gramm – SDDOT	Joel Gengler - SDDOT
Ron McMahon - FHWA	Kevin Goeden - SDDOT	Brad Remmich - SDDOT
Jeff Brosz – SDDOT	Dave Huft - SDDOT	Nicole Frankl - SDDOT
Scott Jansen - SDDOT	Pete Longman - SDDOT	Christina Bennett - SDDOT
Tom Lehmkuhl - SDDOT	Terry Keller - SDDOT	
Sioux Falls		
Shannon Ausen – Sioux Falls	Heath Hoftiezer – Sioux Falls	Amber Gibson - SECOG
Craig Smith - SDDOT	Paul Nikolas - SDDOT	
Consultant Team		
David Meier - HDR	Brian Ray - HDR	Courtney Sokol - HDR
Mike Forsberg- HDR	Jason Kjenstad - HDR	Ross Harris – HR Green
Rick Laughlin - HDR	Jon Weigand – HR Green	Bill Moran – HR Green
Jon Markt - HDR		

Responses to FHWA Comments on M&A Documents for Sub-studies 2, 3, and 4 Received 9/3/13

Below are responses to FHWA comments on the I-229 M&A documents. The response regarding content of the M&A documents is noted in **bold text**.

Section	Comment	Response
Section 5 – Analysis Years/Periods	Add a note regarding factoring and balancing volumes.	***A note will be added that discusses the use of balanced volumes provided by the Cube Avenue mesoscopic model that is being utilized for the project.***
Section 7 – Traffic Operations Analysis	Why is Synchro being used on 26th Street but not on this study?	Traffic operations analysis results will be based on Highway Capacity Manual (HCM) 2010 methodologies, as was stipulated in the study scope. Currently, the most accurate tool to perform operational analysis using HCM 2010 methods is Highway Capacity Software (HCS) 2010. The use of Synchro would be redundant and provide no additional operational results. ***No revisions to the analysis tools section are planned for the I-229 M&A documents.***
Section 7 – Traffic Operations Analysis	List the allowable LOS similar to the 26th Street M&A.	***Allowable LOS criteria will be listed.***
Section 7 – Traffic Operations Analysis	The I-229 M&A documents say the analysis of future year conditions will use existing PHFs rounded up to the nearest 0.05 with a maximum of 0.90. The 26th Street document said the future year analysis would use 0.9.	Using the existing PHFs rounded up to the nearest 0.05 with a maximum of 0.90 will capture locations with high peaking characteristics within a 15-30 minute time span. Since the peaking characteristics are unlikely to become much more uniform across the peak hour in future year conditions, this approach is considered more conservative than using 0.90 at all locations. ***No revisions to the PHFs section are planned for the I-229 M&A documents.***
Section 7 – Traffic Operations Analysis	The 26th Street M&A document has more details concerning phase change interval values that will be used in the analysis.	The I-229 M&A documents state the use of the methodologies presented in the ITE Traffic Engineering Handbook instead of stating the red change interval in the M&A document, as in the 26th Street document. ***No revisions to the phase change interval section are planned for the I-229 M&A documents.***
Section 7 – Traffic Operations Analysis	The I-229 M&A documents state the use of the posted speed for arterial analysis. The 26th Street M&A states the use of 3 mph	Based on discussions with the developer of HCS, McTrans. Speed limit is used to compute Base FFS. FFS is only used as an input to

	above the posted speed for the FFS.	the ratio of the speed limit and is applied to an entire corridor. This ratio is used in the stop rate calculations for determining the Auto Perception Index Score for the arterial segment, not Level of Service. ***No revisions to the speeds section are planned for the I-229 M&A documents.***
Section 10 – Selection of Measures of Effectiveness	The arterial corridor segment MOEs for 26th Street also included delay as a reported MOE.	Delay is incorporated into the travel speed MOE. Based on Chapter 17 of the HCM, the travel speed reflects the factors that influence running time along the link and the delay incurred by through vehicles at the boundary intersection. HCS reports generated will be included in appendices of analysis submittals. These reports contain additional information such as delay for those interested in the relationship between travel speed and delay. ***No revisions to the arterial MOE bullet are planned for the I-229 M&A documents.***
Section 10 – Selection of Measures of Effectiveness	The 26th Street M&A also included a bullet regarding reported MOEs at ramp terminal intersections (LOS and Individual Movement Delay).	***A bullet will be added report MOEs at ramp terminal intersections. This will include LOS and Individual Movement Delay.***

OD Study Area

EXHIBIT 1

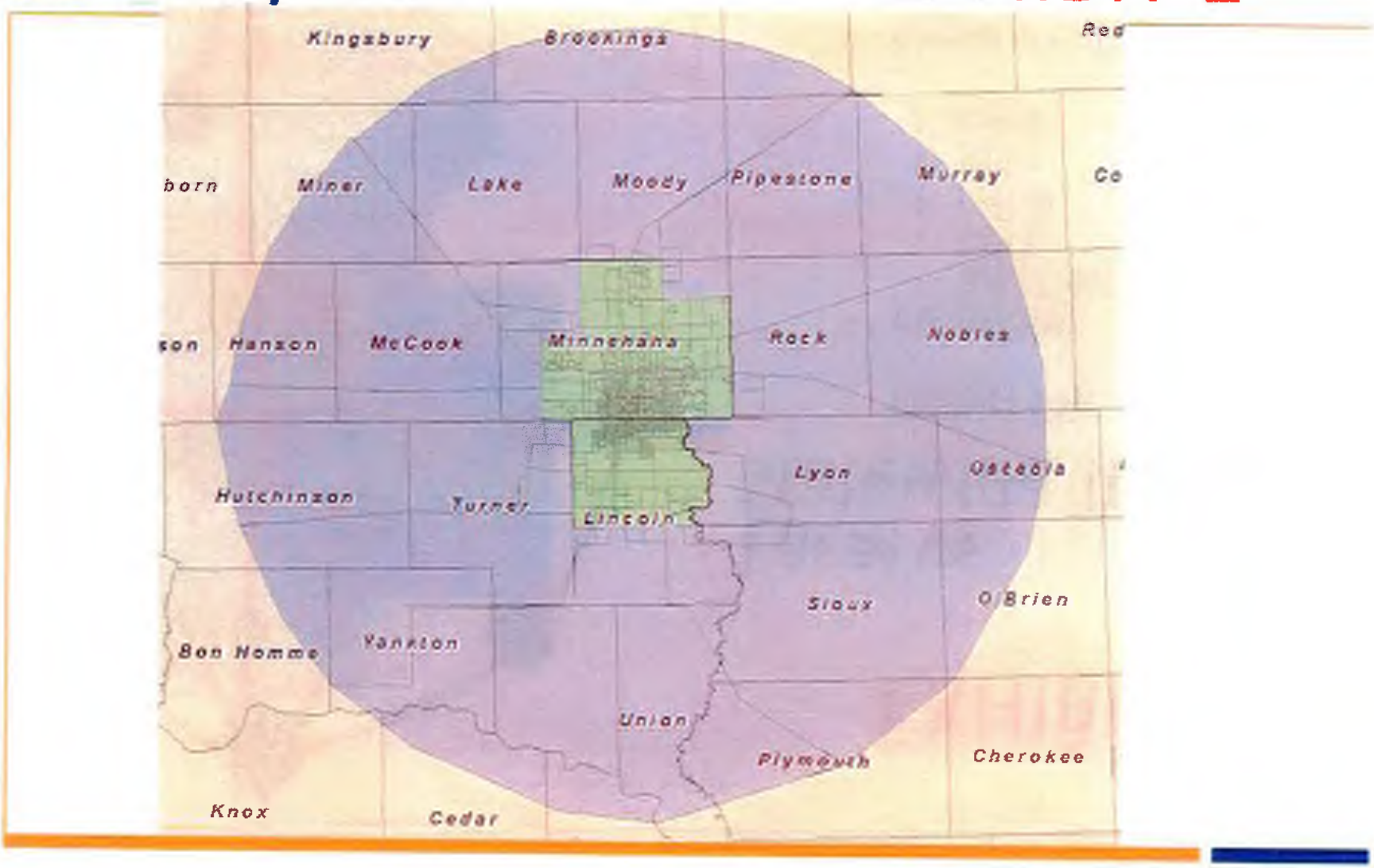
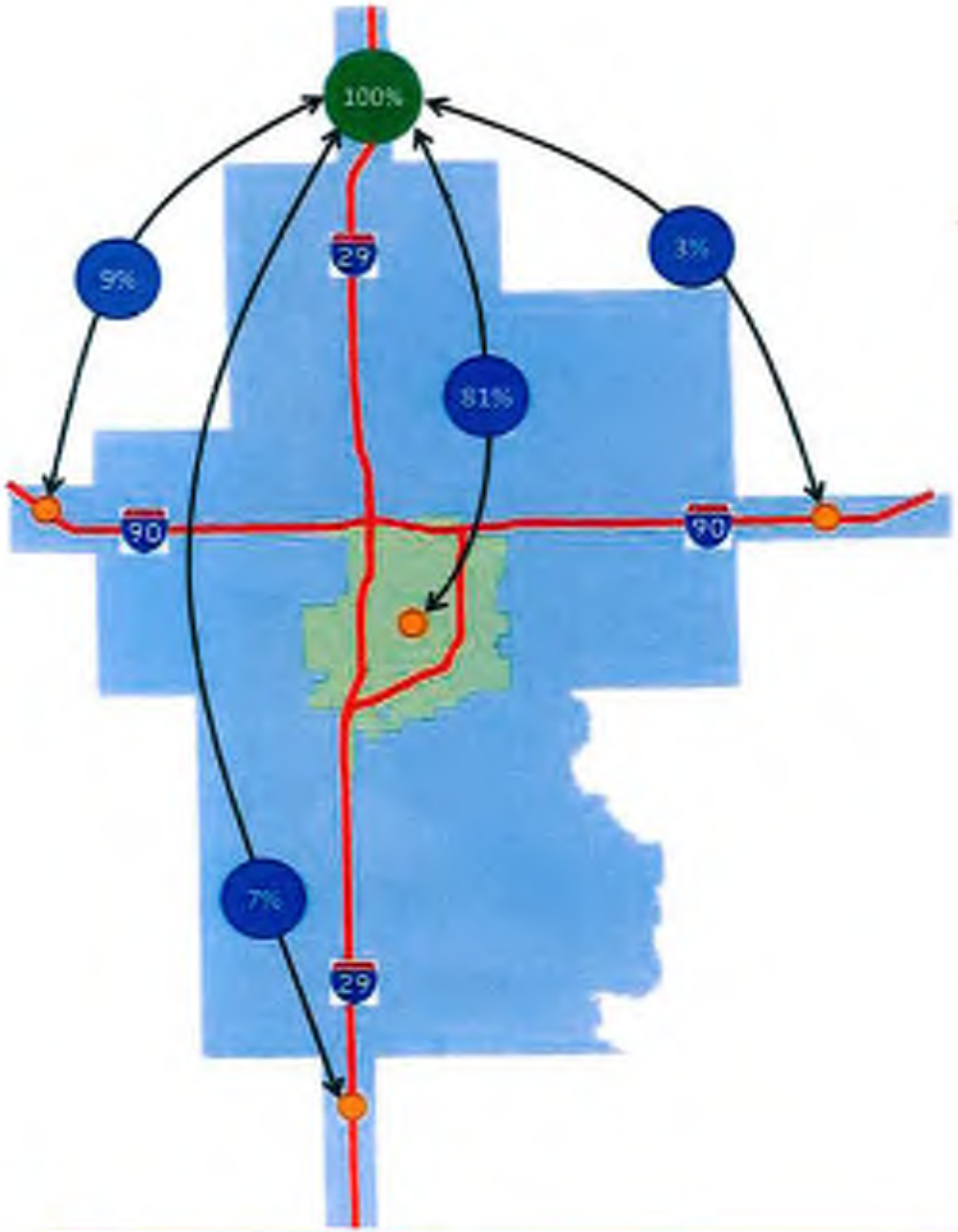


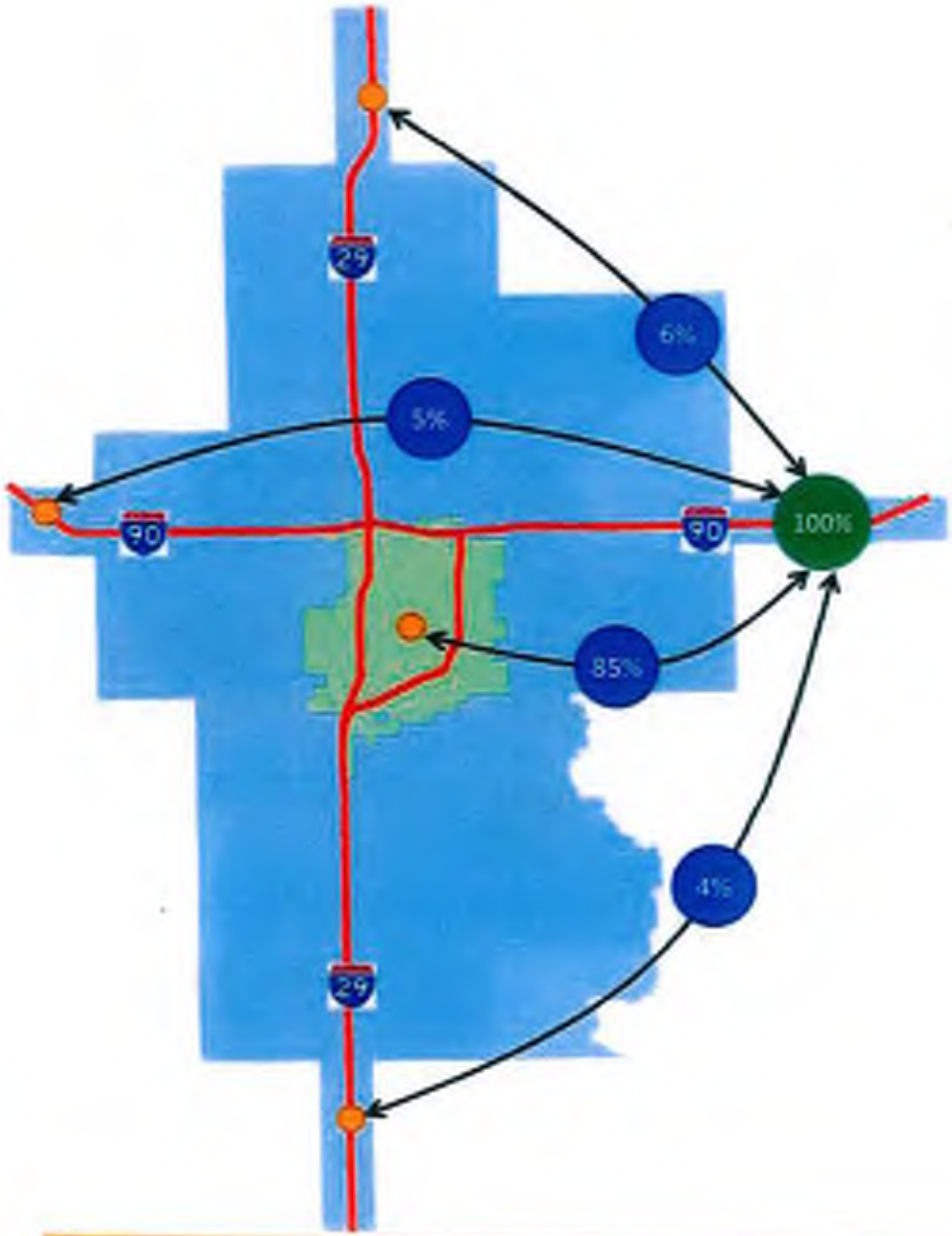
EXHIBIT 2



Local vs. Statewide Traffic

- Weekday Trips
- Trip exchange
  - Urban Core
  - I-90 E
  - I-90 W
  - I-29 S
  - I-29 N
- Average of bi-directional trips

EXHIBIT 3



Local vs. Statewide Traffic

- Weekday Trips
- Trip exchange
  - Urban Core
  - I-90 E
  - I-90 W
  - I-29 S
  - I-29 N
- Average of bi-directional trips

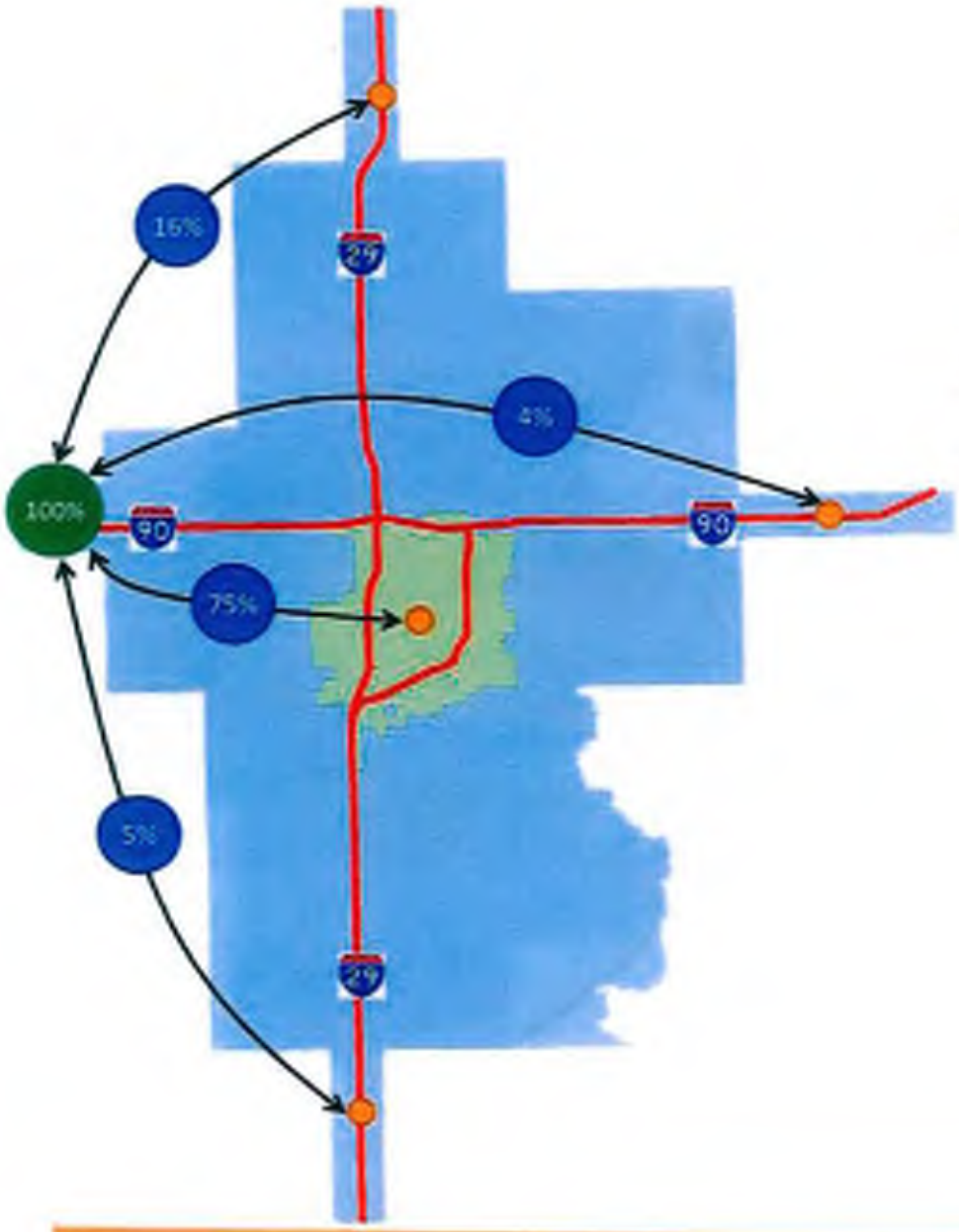


EXHIBIT 4

Local vs. Statewide Traffic

- Weekday Trips
- Trip exchange
  - Urban Core
  - I-90 E
  - I-90 W
  - I-29 S
  - I-29 N
- Average of bi-directional trips

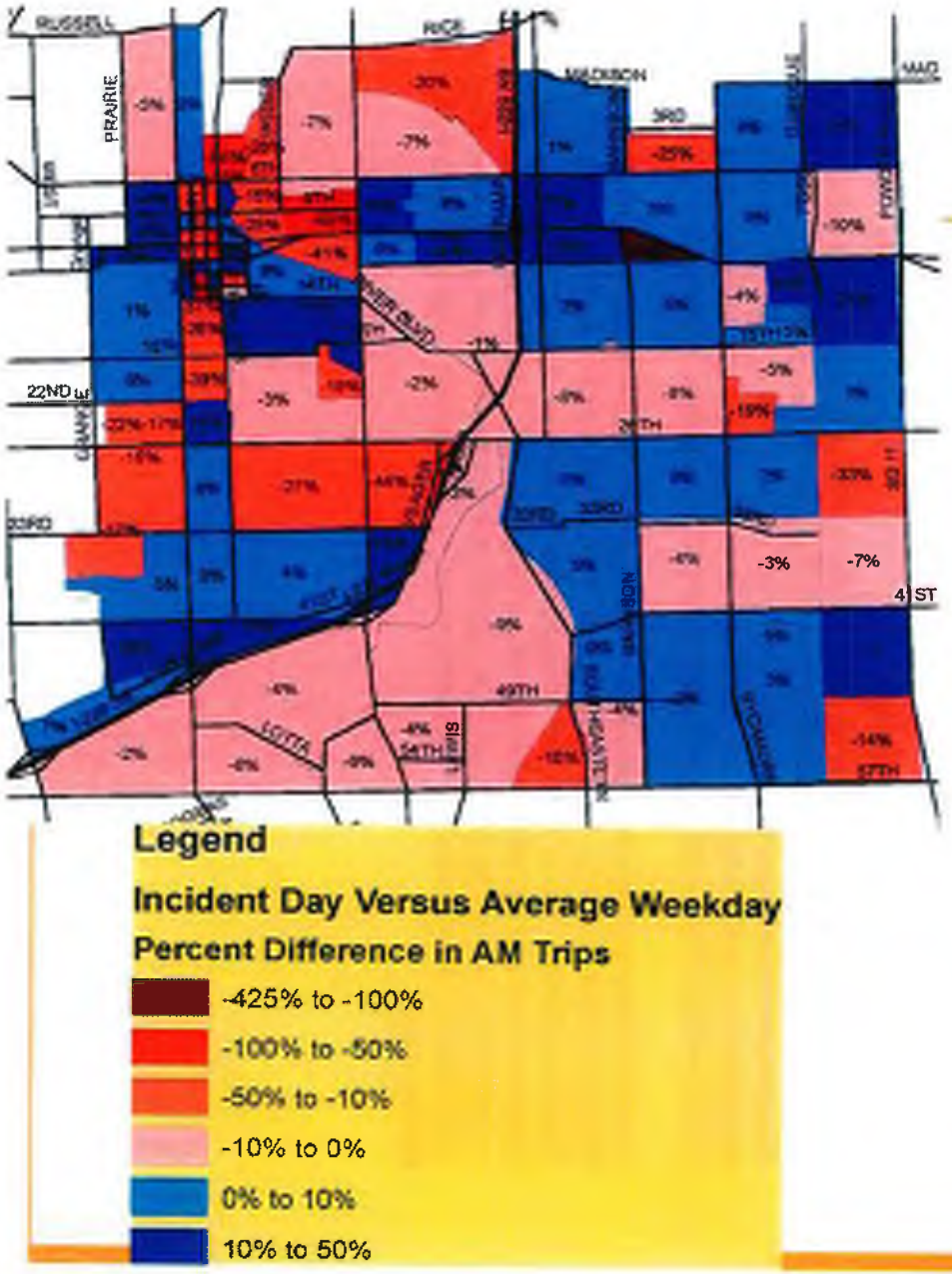


EXHIBIT 5

Incident Day vs. Weekday Trips

- SB lane closure
- Increased Activity at Exits 4 (Cliff Ave) & 6 (10th St)
- Wednesday

HDR | ONE COMPANY *Many Solutions*™

To: File	
From: Mike Forsberg, P.E.	Project: None
CC:	
Date: August 5, 2013	Job No:

RE: Highway Capacity Software Analysis Procedures for a Diverging Diamond Interchange (DDI)

Introduction

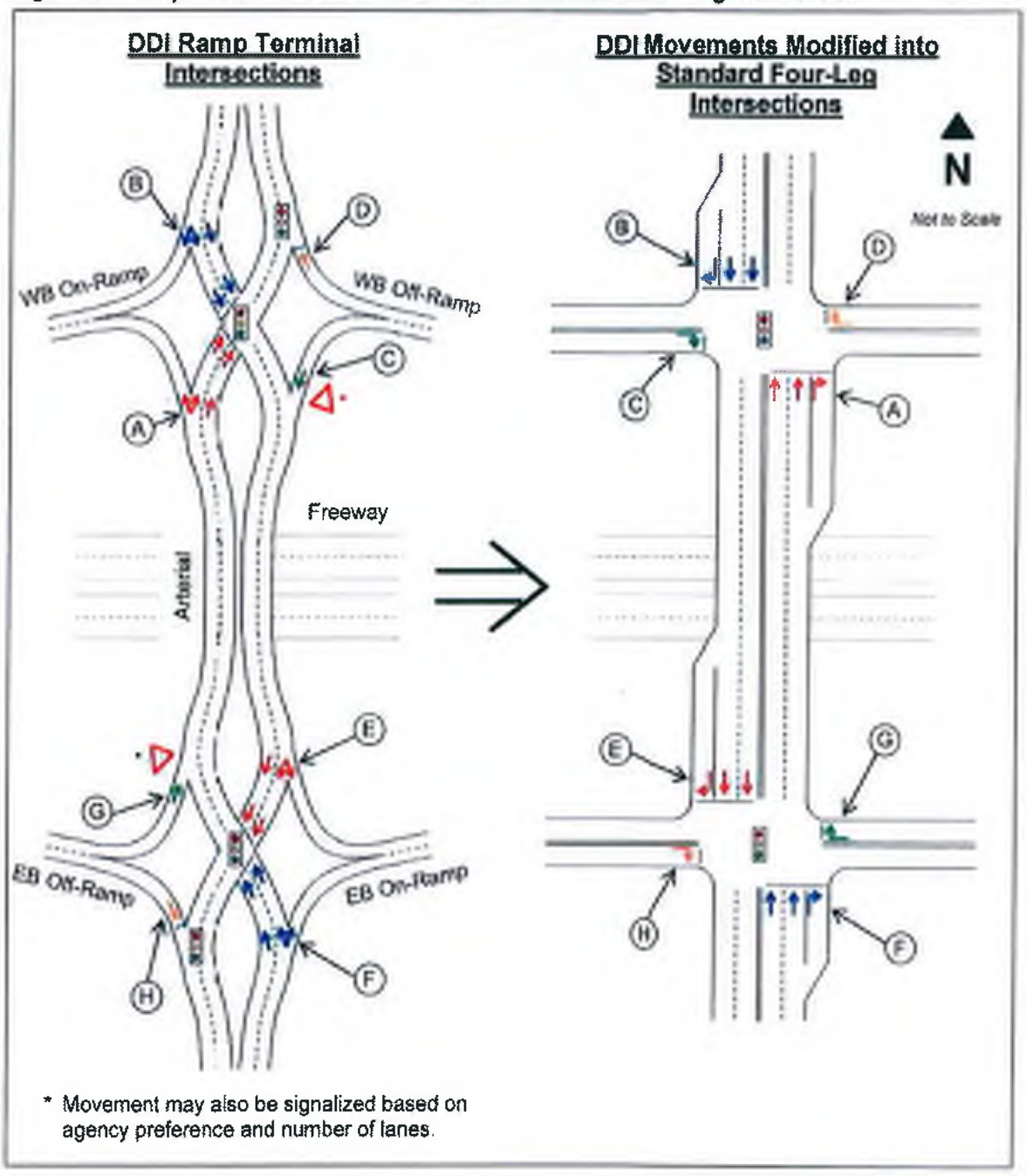
This document presents a proposed methodology for analyzing a Diverging Diamond Interchange (DDI) using Highway Capacity Software (HCS) 2010 Streets module. The Federal Highway Agency (FHWA) has indicated that HCS 2010 is the preferred traffic analysis tool for various projects within certain agencies. The procedures documented in this memorandum were developed in response to known challenges of analyzing DDIs in HCS 2010 based on discussions with the software developer, McTrans. HCS 2010 version 6.50 was utilized to develop this methodology.

Proposed DDI Analysis Methodology

The proposed analysis methodology for DDIs includes manipulation of the intersection movements at a DDI to analyze the ramp terminal intersections as standard four-leg intersections in HCS 2010. The proposed methodology involves manipulating the movements at the DDI ramp terminal intersections of the proposed DDI concept to conform to the analysis methodology of HCS 2010 while mimicking similar operational elements of the DDI ramp terminal intersection.

For simplification purposes, the methodology is presented for an arterial oriented north/south and freeway oriented east/west. The methodology for different orientations would be the same, but rotated accordingly. **Figure 1** expresses the proposed manipulation of the DDI ramp terminal movements into a format with standard four-leg intersections. The modified standard four-leg configuration shown in **Figure 1** would have split-phase operations for northbound and southbound traffic and allow for coordination of the ramp terminal intersections with signals north and south of the interchange.

Figure 1. Manipulation of DDI Movements into Standard Four-Leg Intersections



The following presents details of the proposed manipulation of intersection movements for the westbound ramp terminal intersection shown in **Figure 1** from the DDI configuration to a standard four-leg intersection configuration. Manipulation of intersection movements for the eastbound ramp terminal intersection would follow similar methodology.

- The DDI westbound ramp terminal intersection would operate as a two-phase signal. The northbound crossover movement (A) and westbound off-ramp left-turn movement (C) would

travel through the intersection during the first phase (e.g., phase 2). The southbound crossover movement (B) and westbound off-ramp right-turn movement (D) would travel through the intersection during the second phase (e.g., phase 6).

- The two-phase operations of the DDI would be modified to two-phase operations with a four-leg intersection configuration. For example, at the westbound ramp terminal intersection:
    - The northbound crossover movement (A) of the DDI would be treated as a northbound through movement in the four-leg intersection configuration.
    - The northbound left-turn movement of the DDI in advance of the crossover would be treated as a northbound right-turn movement in the four-leg intersection configuration.
        - The value for right-turn-on-red (RTOR) for the northbound right turns would be set to zero. This assumes that all northbound right turns would only be able to turn during the northbound green signal indication. This assumption is conservative since these vehicles would be able to complete this turning maneuver during a northbound red signal indication in the DDI configuration, while the northbound queue of the crossover movement does not extend to the turning movement location. However, due to the unknown percentage of time that the northbound through movement would extend beyond the turning movement location, it is assumed that no vehicles would be able to turn right on red.
    - The southbound crossover movement (B) of the DDI would be treated as a southbound through movement in the four-leg intersection configuration.
    - The southbound right-turn movement of the DDI in advance of the crossover would be treated as a southbound right-turn movement in the four-leg intersection configuration.
        - The value for right-turn-on-red (RTOR) for the southbound right turns would be set to zero. This assumes that all southbound right turns would only be able to turn during the southbound green signal indication. This assumption is conservative since these vehicles would be able to complete this turning maneuver during a southbound red signal indication in the DDI configuration, while the southbound queue of the crossover movement does not extend to the turning movement location. However, due to the unknown percentage of time that the southbound through movement would extend beyond the turning movement location, it was assumed that no vehicles would be able to turn right on red.
    - The westbound off-ramp left-turn movement (C) of the DDI would be treated as an eastbound right-turn movement in the four-leg intersection configuration.
        - This movement would be treated as an eastbound right-turn movement at a signal with RTOR allowed. The value of RTOR would be based on the 'RTOR Reduction' factor shown in the HCM 2000 report obtained from Synchro traffic analysis software (Synchro would be used to code the modified four-leg configuration and obtain the RTOR value for this movement).
    - The westbound off-ramp right-turn movement (D) of the DDI would be treated as a westbound right-turn movement in the four-leg intersection configuration.

- RTOR for the westbound right-turn movement would likely be restricted in the DDI configuration for safety purposes; therefore, the RTOR of the westbound right-turn movement four-leg configuration would be set to '0'. For locations where the controlling agency would operate the westbound off-ramp right-turn movement (D) of the DDI with RTOR allowed, the value of RTOR would be based on the 'RTOR Reduction' factor shown in the HCM 2000 report obtained from Synchro.
  - In the modified version of the four-leg intersection the northbound (A) and eastbound (C) movements would travel through the intersection during the same phase (e.g., phase 2). This would be consistent with the overlapping northbound crossover movement (A) and westbound off-ramp left-turn movement (C) of the DDI.
  - In the modified version of the four-leg intersection the southbound (B) and westbound (D) movements would travel through the intersection during the same phase (e.g., phase 6). This would be consistent with the overlapping southbound crossover movement (B) and westbound off-ramp right-turn movement (D) of the DDI.

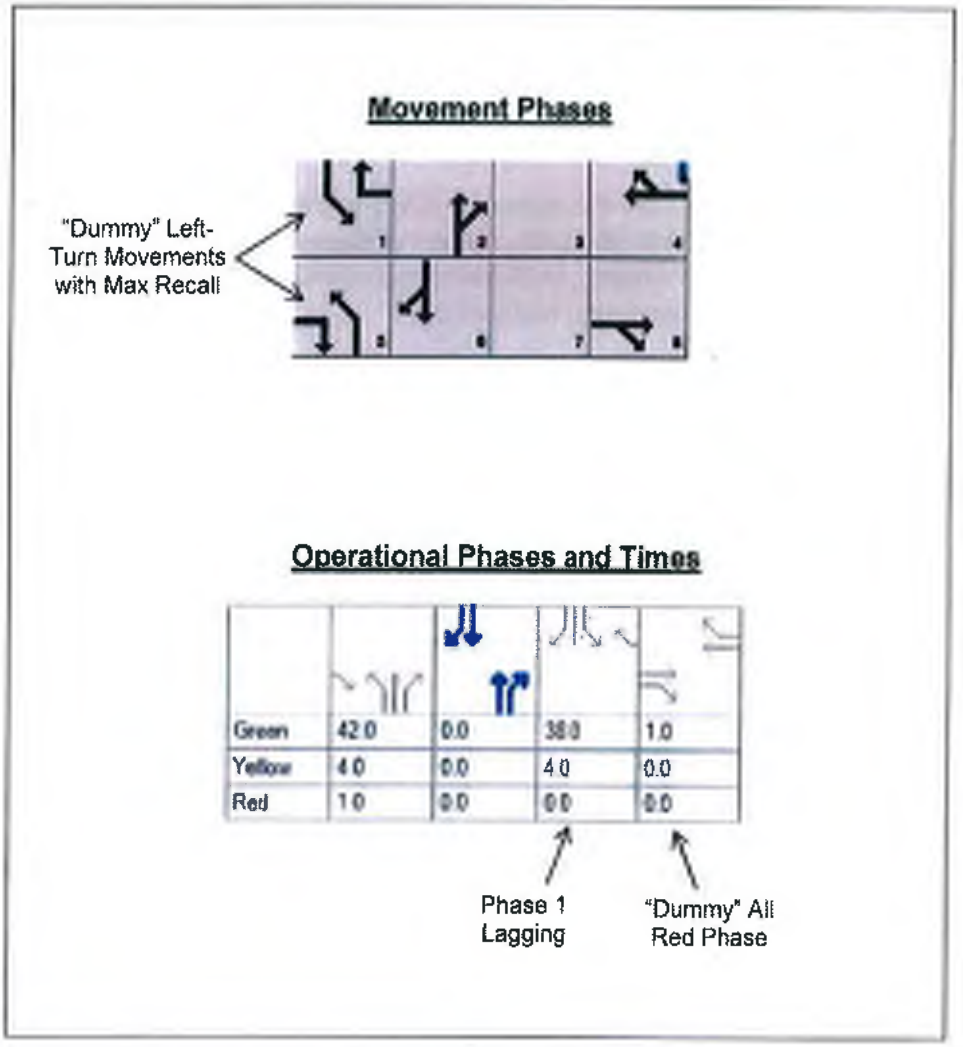
The following presents specific details of coding elements in HCS 2010 Streets to model the westbound ramp terminal intersection shown in **Figure 1** as a standard four-leg intersection of the DDI intersection. Manipulation of intersection movements for the eastbound ramp terminal intersection would follow similar methodology.

- To model split-phase operations for the arterial street (northbound and southbound movements) in HCS 2010 Streets, the following coding elements would be needed. Additionally, the diagrams shown in **Figure 2** supplement the coding elements listed below.
  - Artificial ("dummy") northbound and southbound left-turn movements would be added with protected phasing. These movements would not serve any of the DDI traffic. The added left-turn phases would be phase 5 for the northbound left-turn movement and phase 1 for the southbound left-turn movement (based on the previously mentioned example phasing of phases 2 and 6 for the northbound and southbound through movements, respectively).
  - The eastbound and westbound right-turn movements would be overlapped with the northbound and southbound left-turn movements.
  - The southbound left-turn movement would be set to a lagging left-turn phase so that the northbound and southbound left-turn movements would not need to have a green signal indication simultaneously.
  - The Recall Mode for the northbound and southbound left-turn movements would be set to 'Max'.
  - Eastbound and westbound phases (phases 8 and 4, respectively) would be required to be included to meet the criteria for signal timings in HCS 2010 Streets. This would include eastbound and westbound through movements with zero volume. These phases would have a green signal indication simultaneously for 1 second (the minimum time allowed for a phase). This effectively serves as the Red time for the previous split that serves southbound traffic. This 1 second phase for the eastbound and westbound approaches is labeled as "Dummy" All Red Phase in **Figure 2**. To counter the additional 1 second of green time given to the eastbound and westbound right-turn movements, each of these movements would be given an additional 0.5

seconds of "Start-Up Lost Time". Each of these right-turn movements would experience the extra 0.5 seconds of "Start-Up Lost Time" during the "Dummy" All Red Phase and during their normal phase of operation (Phase 1 or 5), totaling 1 second of additional "Start-Up Lost Time" over the course of 1 signal cycle for the eastbound and westbound right-turn movements.

- The Demand for the northbound and southbound left-turn movements would be set to '1' in order for phases 1 and 5 to be given a green signal indication (otherwise, all of the time would be given to the phase where northbound and southbound traffic travel through the intersection simultaneously).

Figure 2. Sample HCS 2010 Streets Phasing for the Westbound Ramp Terminal Intersection



- The following coding elements would also be included in HCS 2010 Streets to mimic the movements of the DDI.
  - The Arrival Type for the eastbound and westbound right-turn movements would be '3', representing random arrivals from the freeway. The Arrival Type for the

northbound and southbound approaches would be '4', representing coordination of signals. However, the arrival patterns of the northbound and southbound movements would be dictated by the signal timings at upstream intersections and the coded Arrival Type for the northbound and southbound approaches would not have any impact on the operations at these intersections.

- Phase 5 would operate with 4 seconds of yellow and 1 second of all red.
- Phase 1 would operate with 4 seconds of yellow and 0 seconds of all red (the all red time would be effectively given by the "Dummy" All Red Phase shown in **Figure 2**).
- The Phase Split time for the northbound left-turn movement (phases 5) would be set to the optimum phase split time for the northbound movement. The Phase Split time for the southbound left-turn movement (phases 5) would be set to the optimum phase split time for the northbound movement minus 1 second (to account for the 1 second "Dummy" All Red Phase). The combined split times for the northbound left-turn movement (phase 5), southbound left-turn movement (phase 1) and eastbound/westbound movements (phases 8/4) would equal the cycle length of the signal, leaving no remaining time for the overlapping phase where northbound and southbound through traffic would travel through the intersection simultaneously.
- The speed limit would be set to 25 mph to account for lower speeds through the crossover and channelized turn movements. The exception to this would be for the southbound approach that arrives from outside of the DDI and would be set to the speed limit of the Arterial Street.
- The Interchanges feature within HCS Streets would be used to update the Turning Radius for the turn movements based on the concept/design. This would account for the larger radii at the turning locations of the DDI. The Interchange Type within the Interchanges section does not include DDI as an option and would be set to Diamond.

As mentioned previously, the modified standard four-leg configuration would have split-phase operations at the ramp terminal intersections for northbound and southbound traffic and allow for coordination of the ramp terminal intersections with signals north and south of the interchange. The signal offset values at the ramp terminals would be based on the turn patterns at each intersection to maximize platooning of traffic through the two signals. Signal offsets at intersections adjacent to the ramp terminals would be based on the offsets established at the ramp terminal intersections.

Original M & A

HDR | ONE COMPANY *Many Solutions*™

Methods & Assumptions Meeting Documentation

1. Methods and Assumptions Cover Page

I-229 Major Investment Corridor Study: Sub-Study #3

To:	Study Advisory Team (SDDOT, FHWA, City of Sioux Falls)		
From:	Chris Malmberg, HDR Mike Forsberg, HDR	Project:	I-229 Major Investment Corridor Study
CC:	Dave Meier File		
Date:	October 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 August 28, 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 #3***.

2. Stakeholder Acceptance Page

The undersigned parties concur with the Methods and Assumptions for the ***I-229 Major Investment Corridor Study: Sub-Study #3*** as presented in this document.

SDDOT:

Signature

Data Analysis Engineer

Title

10-9-2013

Date

FHWA:

Signature

Planning/Civil Rights Specialist

Title

10-11-2013

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 #3*** 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 3 will analyze existing and future conditions at the I-229 interchange at Exit 6 (10th Street) and along 10th Street from Franklin Avenue to Sycamore Avenue. The study will conduct an interchange crossroad corridor study for the I-229 Exit 6 interchange.

Location

The I-229 Exit 6 interchange and adjacent 10th Street corridor is located in the eastern portion of the Sioux Falls metropolitan area, approximately 4 miles south of the I-229/I-90 systems interchange. The mainline interstate study limits include Exit 5 (26th Street) through Exit 7 (Rice Street). The 10th Street study limits include Franklin Avenue through Sycamore Avenue.

An illustration of the Sub-Study 3 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:

- Congestion at the 10th Street / I-229 interchange and along 10th Street, east and west of I-229.
    - This congestion exists throughout the majority of the day.
- Closely spaced signals along 10th Street near the I-229 interchange.
- Future growth along the 10th Street corridor.
- Connection from proposed SD 100 (existing SD 11/Powder House Road) to downtown area.
- Improved pedestrian mobility.
- Safety concerns along the 10th Street corridor.

Study Schedule

Date	Task/Event
March 2013	Notice to Proceed, Kickoff Meeting
June 2013	Methods & Assumptions Documentation
June 2013- August 2013	Baseline Conditions Analysis/ Data Collection
September 2013- October 2013	Existing Traffic and Operations Analysis Project Future Conditions (No Build)
November 2013- March 2014 [1]	Conceptual Design of Reconfiguration Options for the I-229 Exit 6 Interchange Conceptual Design of 10th Street Corridor Improvements **Public Meeting #2** (Scenario Building Stage) **(Jan/Feb 2014)** **MPO Meeting (Scenario Building Presentation)** Determination of Corridor Build Scenarios Traffic and Operations Analysis of Build Scenarios Noise Analysis of Build Scenarios Constructability Analysis of Build Scenarios Recommendations
April 2014- September 2014 [1]	Sub-Study 3 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.*
Note: The Study Schedule for Sub-Study 3 after August is expected to coincide with the Study Schedule for Sub-Study 1.

Facilities Affected by the Study

Modifications to the I-229 Exit 6 (10th Street) interchange and adjacent 10th Street corridor would have the potential to affect:

- The intersections on 10th Street near I-229.
- Adjacent parallel corridors of 6th Street, 12th Street and 18th Street.
- Adjacent perpendicular corridors of Cleveland Avenue, Lowell Avenue and Cliff Avenue.
- The adjacent parallel corridors providing access to I-229 at Exit 5 (26th Street) and Exit 7 (Rice Street).

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
- 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/
- Northeast Transportation Network Feasibility Study
- 2010 Decennial Interstate Corridor Study and 2000 Decennial Interstate Study
- Cleveland Avenue Study
- 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
Nicole Frankl	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 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
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 3 was defined by the Study Advisory Team and is illustrated in this report for documentation. The study area contains 10th Street from Franklin Avenue to Sycamore Avenue. Freeway operations will be conducted during Sub-Study 1 and will also be reported in Sub-Study 3 for freeway locations from Exit 5 (26th Street) to Exit 7 (Rice Street). The following graphic shows the study area and identifies each of the study intersections.

Sub-Study 3 Study Area



10th Street Study Intersections:

- Franklin Avenue
- Fairfax Avenue
- Cliff Avenue
- Blauvelt Avenue
- Jessica Avenue
- Lowell Avenue
- I-229 Single Point Ramp Terminal
- Blaine Avenue
- Cleveland Avenue

- Cambell's / Hy-Vee Parking Lot
- Bahnson Avenue
- Sycamore Avenue

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 between 26th Street (Exit 5) and 10th Street (Exit 6)
- I-229 Northbound between 10th Street (Exit 6) and Rice Street (Exit 7) [1]
- I-229 Southbound between Rice Street (Exit 7) and 10th Street (Exit 6) [1]
- I-229 Southbound between 10th Street (Exit 6) and 26th Street (Exit 5)

[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:

- I-229 Northbound merge from 26th Street (Exit 5)
- I-229 Northbound diverge to 10th Street (Exit 6)
- I-229 Southbound merge from 10th Street (Exit 6)
- I-229 Southbound diverge to 26th Street (Exit 5)

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 Hour
- Existing Conditions (Year 2012) – PM Peak Hour

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 Hour
- Future/Design Conditions (Year 2035) – PM Peak Hour

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

Volume data will be smoothed/balanced for the Existing and Future/Design Conditions using the Cube Avenue mesoscopic model.

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 available by the City of Sioux Falls at 10th Street study intersections were mostly conducted in year 2011. To capture existing conditions on an average weekday, new traffic counts were collected at the 10th Street study intersections by the City of Sioux Falls and HDR in year 2013. These counts include volume data in 15-minute intervals.

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 and then smoothed/balanced along the I-229 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

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 (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.
         2. Analysis of a Diverging Diamond Interchange will follow the methodology outlined in the 'Highway Capacity Software Analysis Procedures for a Diverging Diamond Interchange (DDI)' memorandum, found in the Appendix.
   b. Basic Freeway, Ramp Junctions and Weave Areas
      i. HCS Release 6.5 (2010 HCM Methodology)
2. Operational Analysis Results
   a. Level of Service (LOS)
      i. Signalized Ramp Terminal Intersections (SDDOT's System)
         1. Intersections where geometry is modified because of project improvements
            a. Minimum allowable LOS – LOS 'C'
               i. Individual movements will be allowed to operate at LOS 'D' but the overall intersection LOS shall be 'C' or better
         2. Other intersections (intersections within the study area that are not modified by project improvements)
            a. Minimum allowable LOS – LOS 'D'
               i. Individual movements will be allowed to operate at LOS 'E' but the overall intersection LOS shall be 'D' or better
      ii. Signalized Non-Ramp Terminal Intersections (City of Sioux Fall's System)
         1. Minimum allowable LOS – LOS 'D'
      iii. Basic Freeway, Ramp Junctions and Weave Areas
         1. Minimum allowable LOS – LOS 'C'
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.

i. 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

Existing (Year 2012) and Future Year (Year 2035) volumes developed during Sub-Study 1 will be used for the volumes within the study area for Sub-Study 3. The methodology for Travel Forecast was documented in the Sub-Study 1 Methods and Assumptions document.

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. Conduct an interchange crossroad corridor study for Exit 6 (10th Street).
    a. Complete a traffic level of service analysis for both existing and future (2035) conditions along 10th Street from Franklin Avenue to Sycamore Avenue.
    b. Complete a safety analysis of 10th Street from Franklin Avenue to Sycamore Avenue.
    c. Determine and recommend improvement options that will improve mobility and safety along the 10th Street corridor, including the I-229 Exit 6 interchange.
2. Create final products for use by the SDDOT and City of Sioux Falls which will guide them in the implementation of recommended improvements that will maximize the efficiency of the system.

To satisfy the study objectives, the following MOEs will be used to evaluate and compare the concepts:

- 10th Street Intersections: **LEVEL OF SERVICE (LOS)** and **INDIVIDUAL MOVEMENT DELAY**
- 10th Street Corridor: **LOS** and **TRAVEL SPEED**
- Ramp Terminal Intersections: **LOS** and **INDIVIDUAL MOVEMENT DELAY**
- Freeway Segments, Ramp Junctions and Weave Areas: **LOS** and **DENSITY**

These statements are made assuming that the geometric improvements identified meet all AASHTO, SDDOT, and City of Sioux Falls guidelines. It is understood that all traffic analysis reporting will be completed using HCM 2010 Methodology.

11. FHWA Interstate Access Modification Policy Points

An Interchange Modification Justification Report (IMJR) will not be developed for the I-229 Exit 6 (10th Street) interchange as part of this project.

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 (August 28, 2013)
- Analysis Procedures for Diverging Diamond Interchange (DDI)

APPENDIX

HDR | ONE COMPANY *Many Solutions*™

Meeting Notes

Subject:	Study Advisory Team Meeting No. 3
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:	August 28, 2013, 1:00-3:30PM
Meeting Location:	Web Meeting: SDDOT Pierre Headquarters; SDDOT Sioux Falls Area Office; HDR Omaha & Sioux Falls; City of Sioux Falls; HR Green Des Moines & Sioux Falls
Notes by:	David Meier,

A Study Advisory Team Meeting for the I-229 Major Investment Corridor Study was held on August 28, 2013. Action items from the meeting are summarized below and discussion details follow. A list of participants and contact information is at the end of meeting notes.

Action Items

Item	Responsible
o Update M&A documents for SS 2, 3, & 4 and submit for signature.	HDR
o Revise mailing list limits per SAT comments & submit updated lists to SDDOT & City.	HDR
o Coordinate on Public Meeting room layout.	HDR/City
o Edit website as needed per additional SAT comments. Activate website 3 weeks from SAT #3.	HDR
o Determine whether a press conference will be held announcing Study/website.	SDDOT
o	
o	City
o Identify SDDOT staff for ITS interviews.	SDDOT

Comments based on the provided Agenda and PowerPoint Presentation:

1. **Introductions** (SDDOT, City, MPO, FHWA, HDR/HR Green)

2. **Draft Methods & Assumptions Documents – Sub-studies 2, 3, and 4**
   - **Sub-study 2**
     - **Section 3** - The Need for Study subsection should note the need to consider findings of the 41st Street Corridor Study (City).
     - Study Schedule table shows September 2014 for completion, is there need to officially extend the project schedule? Yes (see Schedule section of SAT notes). ***Comment applies to all Sub-studies).***
     - Previously developed interchange modification alternatives need to be considered. Interim conditions (post-49th Street Extension and Costco opening) will need to be considered and interim improvements may be needed (City). FHWA is concerned regarding proximity of 49th St connection and existing interchange ramp terminals.
     - Need to review Costco Traffic Impact Study for interim improvements noted.
     - In Study Schedule table, reference to Sub-study 3 Report Documentation should be SS 2.

Original M & A

- Add 41st and Grange to list of Facilities Impacted by the Study.
- **Section 5** - FHWA has comments regarding differences noted between the described approach in the SS 2 M&A and the M&A document for Exit 5 (26th Street) for Section 5 and subsequent sections. If these differences can be addressed, there will be no need for FHWA to send the M&A documents to the Resource Center for review. ***Comment applies to all Sub-studies. FHWA comments were received on 9/3/13 from SDDOT. Responses to the FHWA comments are tabulated at the end of these notes.***
- **Section 6** - Add Scheel's Expansion Study and Wal Mart Traffic Impact Study to list of previous studies. ***The additions will also be made to the Previous Studies list in Section 3.***
- **Section 7** – HDR clarified that Synchro will not be used. ***Applies to all Sub-studies.***
- **Section 10** – The City commented that the Measures of Effectiveness description needs to clarify that Level of Service "D" will be the minimum criteria for individual intersection approaches, but not an entire intersection. ***Applies to all Sub-studies. Response to this comment will be located in Section 7 of the M&A documents, per FHWA comment.***
- **Section 11** – The City asked if FHWA Regional Office comments on the previously prepared draft IJR will need to be noted in the sub-study report. FHWA replied that is unknown at this time because alternatives are yet to be identified in Sub-study 2.
- **Section 14 (Appendix)** – The Diverging Diamond Interchange analysis procedure attached are the most current version of the procedure.

- **Sub-study 3**
  - **Section 3** - The City noted that there is a serious capacity issue with the existing interchange that extends the majority of the day. The M&A will be revised to note that congestion extends through off-peak periods.
  - Add the following to the Facilities Impacted by the Study:
    - 18th Street (parallel corridor)
    - Lowell Ave (perpendicular corridor)
  - Strike the SIMPCO Incident Management Plan from the Previous Studies section. ***Comment applies to all Sub-studies.***
  - **Section 4** - Study Area figure references Sub-study 2. ***Also applies to SS4 M&A.***

- **Sub-study 4**
  - **Section 4** - Study Area description needs to be replaced with SS 4 specific narrative.
  - Add Benson Rd Feasibility Study to the Previous Studies section.

3. **Safety Analysis Technical Memorandum**
   - The slippery conditions noted in a significant number of reported crashes were mostly during winter weather (approximately 90%), but some were documented as wet pavement. This pattern was noted for the Cliff Ave to Louise Ave segment as well as the 26th Street area along I-229.
   - Enhanced driver information during inclement weather was noted as a potential mitigation measure. The ITS recommendations section of the Sub-study 1 report will provide additional details on this recommendation.
   - It was noted that the safety analysis findings may suggest review of snow removal operational procedures.
   - Crashes associated with traffic congestion were found to be mostly located on ramps. SDDOT noted that right-turning traffic on the northbound 10th St exit ramp has been shifted onto the paved shoulder with pavement markings to provide additional storage. The southbound 10th St entrance ramp has been extended to provide more merging length upstream of the ramp gore.

4. **Public Involvement Activities**
   - **Public Meeting**

Original M & A

- **The 1st Public meeting will be held on Wednesday October 30th from 5:30-7:00 pm at the Convention Center.**
- Press release to be placed in the Argus Leader 17 and 10 days in advance of the meeting. There will be no weekend advertisements due to substantial additional cost involved.
- Seating will be limited to about 150. Additional seating capacity may be needed for the 2nd public meeting, when mailings will include extended limits for Sub-studies 2, 3, and 4.
- The formal presentation will be kept brief and presented once. The presentation will be taped.
- HDR will coordinate with the City on the room layout for the public meeting.
- HDR Mailing list
  - Approximately 600 addressees on the current mailing list.
  - Check the ownership of the open area shown on the north side of I-229 just east of the I-29/I-229 system interchange and south of W 59th St.
  - HDR will send a coordination letter to addressees on the Exit 5 Study mailing list alerting them to the I-229 study.
  - Revise the mailing area to reduce the number of properties contacted west of Western Avenue and north of I-229.
  - Add the properties along both sides of Minnesota Ave extending south to E 57th St.
  - At 10th St, mailing list coverage will be extended to S Cliff Ave to the west and to S Sycamore Ave to the east.
  - Updated mailing lists will be sent to Steve Gramm and Shannon Ausen.
- Postcards will be used for the public meeting mailings.
- Message boards will be used to assist in advertising the public meeting. The City can provide some of the message boards to be used. FHWA does not object to placing message boards in the I-229 right of way for this purpose.

- **Draft Web site**
  - HDR has made updates to the website reflecting comments received to date. Additional comments should be sent to Jason Kjenstad.
  - SDDOT will consider conducting a press conference to announce the study and/or web site.
  - The website is to be activated at least two weeks prior to advertising for the October 30th public meeting and may be activated in three weeks from this SAT meeting (pending further SAT comments).

5. **Origin-Destination Data**
   - HDR presented an overview of the cell phone-based O-D data gathered by AirSage that focused on the following objectives:
     - External to external patterns
     - Comparison of average weekday travel patterns to average weekend day and two special events days for which data was collected.
     - Comparison of the cell phone-based O-D data to the O-D matrix generated by the Sioux Falls area model.
   - The O-D data presentation screens were provided as a part of the SAT meeting agenda file in pdf format.
   - The data collection process involved approximately 100,000 device (cell phone) sightings per day and a total of 1.5 million unique devices logged. Of that total, 146,000 devices were assumed to be area resident phones, based on observed patterns. Based on a 446,000 person population for the data collection area, the calculated sampling rate was over 32 percent. The total trips per day identified averaged around 200,000. The SAT questioned the 446,000 population figure as far in excess of the metropolitan area (approximately 225,000 population). HDR will provide an explanation of the area covered for that population. ***Response: The 446,000 population is for the entire O-D study area that includes the Sioux Falls***

Original M & A

metropolitan area and the surrounding buffer area (shown on Exhibit 1 from the presentation following these notes) that was used to identify external trips.

- Each day of the week was found to have a typical pattern with Fridays having the peak number of trips and Sundays having the lowest number.
- Local versus regional traffic patterns were reviewed for I-29 south of Sioux Falls, which indicated that 84 percent of trips on I-29 had an origin or destination within the Sioux Falls metro area. The SAT requested that the local/regional patterns be reported for I-29 north of Sioux Falls and for I-90 east and west of Sioux Falls. ***Response: The O-D patterns for local and regional trips for I-29 north and I-90 east and west are shown on Exhibits 2, 3, and 4 following these notes.***
- For the average weekday vs. weekend day comparison, O-D patterns between most zones showed decreases of 15 to 50 percent, with exceptions being shopping area zones and the casino.
- Both the construction incident special event day and the winter weather special event day were found to have quantities of trips similar to the average week day.
- For the construction incident day vs. the average weekday comparison, most zones had variances of +/- 10 to 50 percent trips. The SAT asked if most of the variances were more likely +/- 20 to 30 percent. ***Response: Exhibit 5 following these notes labels the variance percentages for each zone.***
- The City has not reviewed the O-D data yet, but expects that it will prove helpful in improving O-D patterns built into the model.

6. **Project Schedule**
   - HDR advised the SAT that final reports for the sub-studies will likely be issued at the end of September 2014.

7. **Next Steps**
   - HDR will coordinate with the City on the room layout for the public meeting.

8. **Other Items** – No discussion
   - SDDOT advised that data collection for the ITS assessment task will involve interviewing identified DOT staff instead of reviewing previously developed ITS planning documents.
   - A presentation by IADOT staff regarding the Tri-State Incident Management Plan for the Sioux City metropolitan area will be given on Monday September 9th from 1-3 pm in the SDDOT Area Office. Steve Gramm will be attending.

Attendees:

Pierre		
Mark Hoines - FHWA	Steve Gramm – SDDOT	Joel Gengler - SDDOT
Ron McMahon - FHWA	Kevin Goeden - SDDOT	Brad Remmich - SDDOT
Jeff Brosz – SDDOT	Dave Huft - SDDOT	Nicole Frankl - SDDOT
Scott Jansen - SDDOT	Pete Longman - SDDOT	Christina Bennett - SDDOT
Tom Lehmkuhl - SDDOT	Terry Keller - SDDOT	
Sioux Falls		
Shannon Ausen – Sioux Falls	Heath Hoftiezer – Sioux Falls	Amber Gibson - SECOG
Craig Smith - SDDOT	Paul Nikolas - SDDOT	
Consultant Team		
David Meier - HDR	Brian Ray - HDR	Courtney Sokol - HDR
Mike Forsberg- HDR	Jason Kjenstad - HDR	Ross Harris – HR Green
Rick Laughlin - HDR	Jon Weigand – HR Green	Bill Moran – HR Green
Jon Markt - HDR		

I-229 MI Corridor Study SAT Meeting #3
August 28, 2013

Responses to FHWA Comments on M&A Documents for Sub-studies 2, 3, and 4 Received 9/3/13

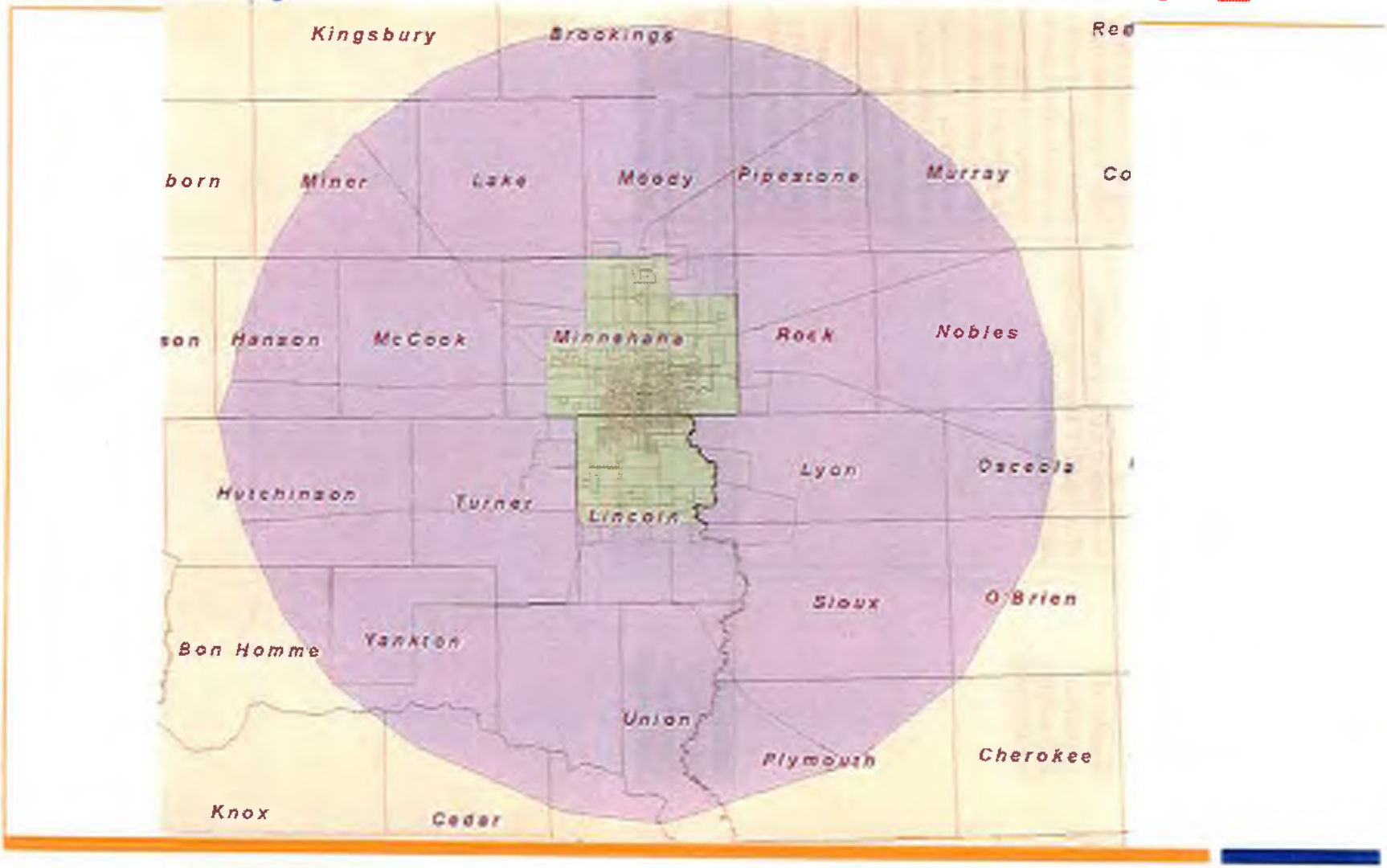
Below are responses to FHWA comments on the I-229 M&A documents. The response regarding content of the M&A documents is noted in **bold text**.

Section	Comment	Response
Section 6 – Analysis Years/Periods	Add a note regarding factoring and balancing volumes.	***A note will be added that discusses the use of balanced volumes provided by the Cube Avenue mesoscopic model that is being utilized for the project.***
Section 7 – Traffic Operations Analysis	Why is Synchro being used on 26th Street but not on this study?	Traffic operations analysis results will be based on Highway Capacity Manual (HCM) 2010 methodologies, as was stipulated in the study scope. Currently, the most accurate tool to perform operational analysis using HCM 2010 methods is Highway Capacity Software (HCS) 2010. The use of Synchro would be redundant and provide no additional operational results. ***No revisions to the analysis tools section are planned for the I-229 M&A documents.***
Section 7 – Traffic Operations Analysis	List the allowable LOS similar to the 26th Street M&A.	***Allowable LOS criteria will be listed.***
Section 7 – Traffic Operations Analysis	The I-229 M&A documents say the analysis of future year conditions will use existing PHFs rounded up to the nearest 0.05 with a maximum of 0.90. The 26th Street document said the future year analysis would use 0.9.	Using the existing PHFs rounded up to the nearest 0.05 with a maximum of 0.90 will capture locations with high peaking characteristics within a 15-30 minute time span. Since the peaking characteristics are unlikely to become much more uniform across the peak hour in future year conditions, this approach is considered more conservative than using 0.90 at all locations. ***No revisions to the PHFs section are planned for the I-229 M&A documents.***
Section 7 – Traffic Operations Analysis	The 26th Street M&A document has more details concerning phase change interval values that will be used in the analysis.	The I-229 M&A documents state the use of the methodologies presented in the ITE Traffic Engineering Handbook instead of stating the red change interval in the M&A document, as in the 26th Street document. ***No revisions to the phase change interval section are planned for the I-229 M&A documents.***
Section 7 – Traffic Operations Analysis	The I-229 M&A documents state the use of the posted speed for arterial analysis. The 26th Street M&A states the use of 3 mph	Based on discussions with the developer of HCS, McTrans. Speed limit is used to compute Base FFS. FFS is only used as an input to

	above the posted speed for the FFS.	the ratio of the speed limit and is applied to an entire corridor. This ratio is used in the stop rate calculations for determining the Auto Perception Index Score for the arterial segment, not Level of Service. ***No revisions to the speeds section are planned for the I-229 M&A documents.***
Section 10 – Selection of Measures of Effectiveness	The arterial corridor segment MOEs for 26th Street also included delay as a reported MOE.	Delay is incorporated into the travel speed MOE. Based on Chapter 17 of the HCM, the travel speed reflects the factors that influence running time along the link and the delay incurred by through vehicles at the boundary intersection. HCS reports generated will be included in appendices of analysis submittals. These reports contain additional information such as delay for those interested in the relationship between travel speed and delay. ***No revisions to the arterial MOE bullet are planned for the I-229 M&A documents.***
Section 10 – Selection of Measures of Effectiveness	The 26th Street M&A also included a bullet regarding reported MOEs at ramp terminal intersections (LOS and Individual Movement Delay).	***A bullet will be added report MOEs at ramp terminal intersections. This will include LOS and Individual Movement Delay.***

OD Study Area

EXHIBIT 1



Original M & A

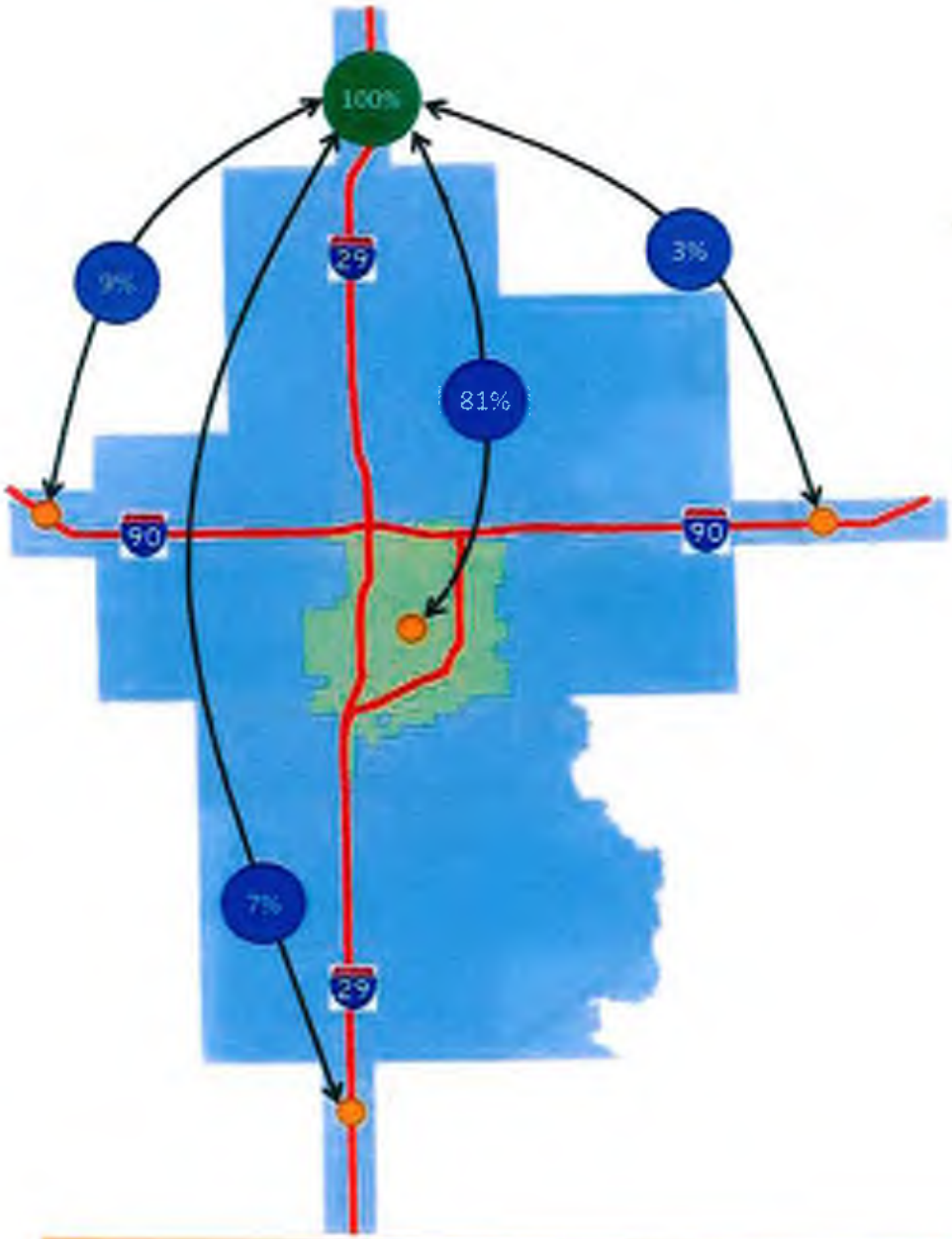


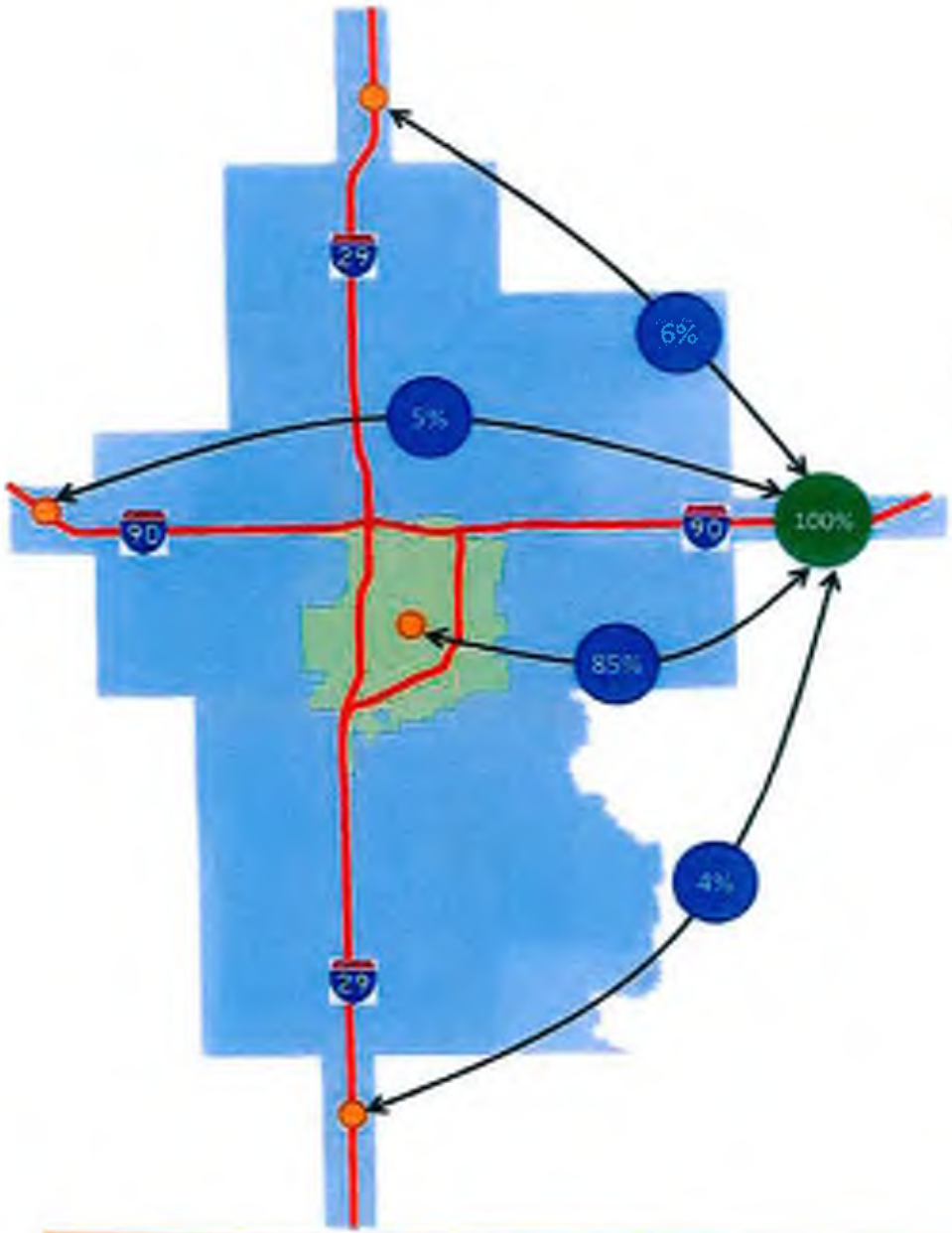
EXHIBIT 2

Local vs. Statewide Traffic

- Weekday Trips
- Trip exchange
  - Urban Core
  - I-90 E
  - I-90 W
  - I-29 S
  - I-29 N
- Average of bi-directional trips

Original M & A

EXHIBIT 3

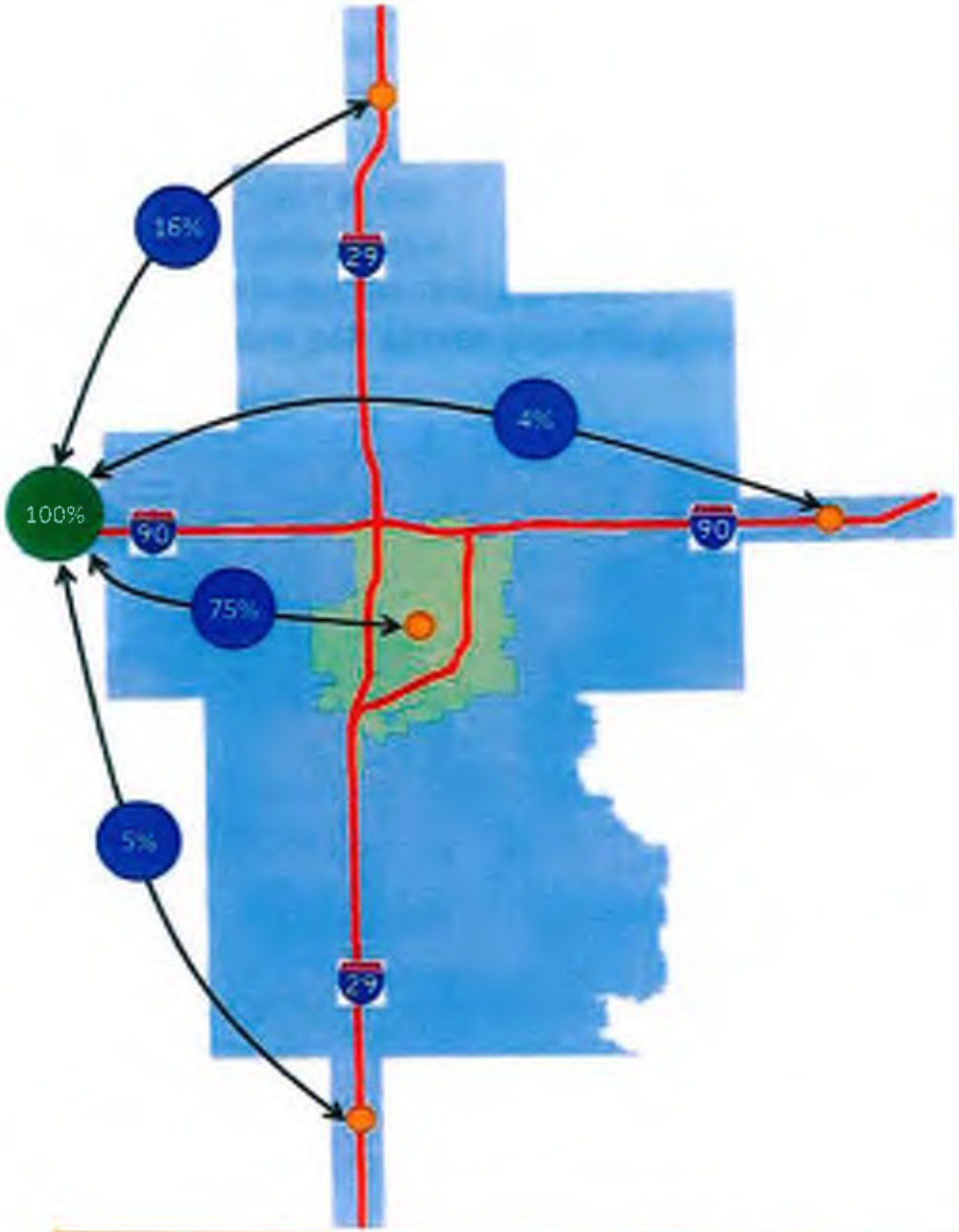


Local vs. Statewide Traffic

- Weekday Trips
- Trip exchange
  - Urban Core
  - I-90 E
  - I-90 W
  - I-29 S
  - I-29 N
- Average of bi-directional trips

Original M & A

EXHIBIT 4



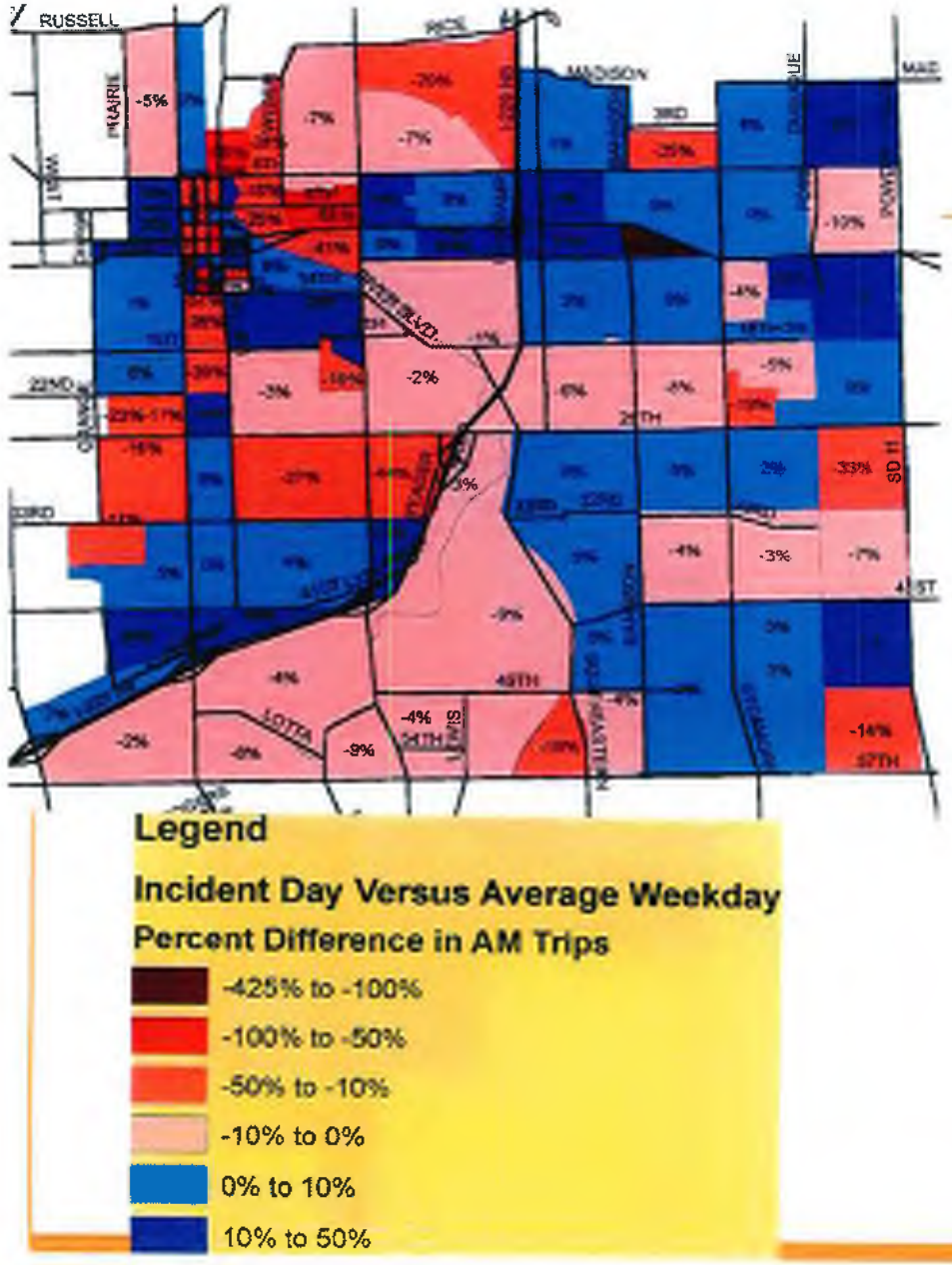
Local vs. Statewide Traffic

- Weekday Trips
- Trip exchange
  - Urban Core
  - I-90 E
  - I-90 W
  - I-29 S
  - I-29 N
- Average of bi-directional trips

Original M & A

EXHIBIT 5

Incident Day vs. Weekday Trips



- SB lane closure
- Increased Activity at Exits 4 (Cliff Ave) & 6 (10th St)
- Wednesday

Original M & A

HDR | ONE COMPANY *Many Solutions*℠

To: File	
From: Mike Forsberg, P.E.	Project: None
CC:	
Date: August 5, 2013	Job No:

RE: Highway Capacity Software Analysis Procedures for a Diverging Diamond Interchange (DDI)

Introduction

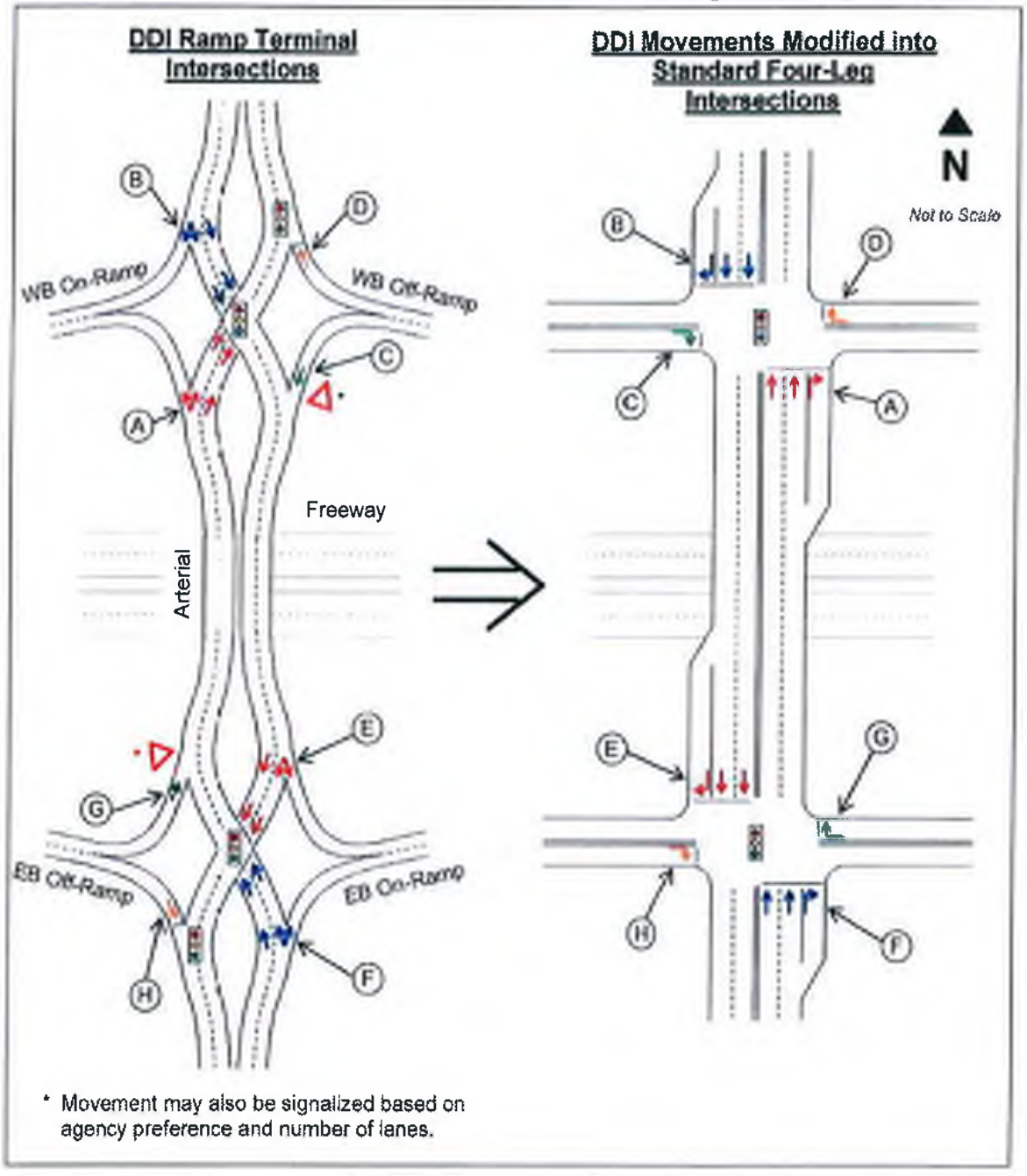
This document presents a proposed methodology for analyzing a Diverging Diamond Interchange (DDI) using Highway Capacity Software (HCS) 2010 Streets module. The Federal Highway Agency (FHWA) has indicated that HCS 2010 is the preferred traffic analysis tool for various projects within certain agencies. The procedures documented in this memorandum were developed in response to known challenges of analyzing DDIs in HCS 2010 based on discussions with the software developer, McTrans. HCS 2010 version 6.50 was utilized to develop this methodology.

Proposed DDI Analysis Methodology

The proposed analysis methodology for DDIs includes manipulation of the intersection movements at a DDI to analyze the ramp terminal intersections as standard four-leg intersections in HCS 2010. The proposed methodology involves manipulating the movements at the DDI ramp terminal intersections of the proposed DDI concept to conform to the analysis methodology of HCS 2010 while mimicking similar operational elements of the DDI ramp terminal intersection.

For simplification purposes, the methodology is presented for an arterial oriented north/south and freeway oriented east/west. The methodology for different orientations would be the same, but rotated accordingly. **Figure 1** expresses the proposed manipulation of the DDI ramp terminal movements into a format with standard four-leg intersections. The modified standard four-leg configuration shown in **Figure 1** would have split-phase operations for northbound and southbound traffic and allow for coordination of the ramp terminal intersections with signals north and south of the interchange.

Figure 1. Manipulation of DDI Movements into Standard Four-Leg Intersections



The following presents details of the proposed manipulation of intersection movements for the westbound ramp terminal intersection shown in **Figure 1** from the DDI configuration to a standard four-leg intersection configuration. Manipulation of intersection movements for the eastbound ramp terminal intersection would follow similar methodology.

- The DDI westbound ramp terminal intersection would operate as a two-phase signal. The northbound crossover movement (A) and westbound off-ramp left-turn movement (C) would

travel through the intersection during the first phase (e.g., phase 2). The southbound crossover movement (B) and westbound off-ramp right-turn movement (D) would travel through the intersection during the second phase (e.g., phase 6).

- The two-phase operations of the DDI would be modified to two-phase operations with a four-leg intersection configuration. For example, at the westbound ramp terminal intersection:
  - The northbound crossover movement (A) of the DDI would be treated as a northbound through movement in the four-leg intersection configuration.
  - The northbound left-turn movement of the DDI in advance of the crossover would be treated as a northbound right-turn movement in the four-leg intersection configuration.
    - The value for right-turn-on-red (RTOR) for the northbound right turns would be set to zero. This assumes that all northbound right turns would only be able to turn during the northbound green signal indication. This assumption is conservative since these vehicles would be able to complete this turning maneuver during a northbound red signal indication in the DDI configuration, while the northbound queue of the crossover movement does not extend to the turning movement location. However, due to the unknown percentage of time that the northbound through movement would extend beyond the turning movement location, it is assumed that no vehicles would be able to turn right on red.
  - The southbound crossover movement (B) of the DDI would be treated as a southbound through movement in the four-leg intersection configuration.
  - The southbound right-turn movement of the DDI in advance of the crossover would be treated as a southbound right-turn movement in the four-leg intersection configuration.
    - The value for right-turn-on-red (RTOR) for the southbound right turns would be set to zero. This assumes that all southbound right turns would only be able to turn during the southbound green signal indication. This assumption is conservative since these vehicles would be able to complete this turning maneuver during a southbound red signal indication in the DDI configuration, while the southbound queue of the crossover movement does not extend to the turning movement location. However, due to the unknown percentage of time that the southbound through movement would extend beyond the turning movement location, it was assumed that no vehicles would be able to turn right on red.
  - The westbound off-ramp left-turn movement (C) of the DDI would be treated as an eastbound right-turn movement in the four-leg intersection configuration.
    - This movement would be treated as an eastbound right-turn movement at a signal with RTOR allowed. The value of RTOR would be based on the 'RTOR Reduction' factor shown in the HCM 2000 report obtained from Synchro traffic analysis software (Synchro would be used to code the modified four-leg configuration and obtain the RTOR value for this movement).
  - The westbound off-ramp right-turn movement (D) of the DDI would be treated as a westbound right-turn movement in the four-leg intersection configuration.

- RTOR for the westbound right-turn movement would likely be restricted in the DDI configuration for safety purposes; therefore, the RTOR of the westbound right-turn movement four-leg configuration would be set to '0'. For locations where the controlling agency would operate the westbound off-ramp right-turn movement (D) of the DDI with RTOR allowed, the value of RTOR would be based on the 'RTOR Reduction' factor shown in the HCM 2000 report obtained from Synchro.

- In the modified version of the four-leg intersection the northbound (A) and eastbound (C) movements would travel through the intersection during the same phase (e.g., phase 2). This would be consistent with the overlapping northbound crossover movement (A) and westbound off-ramp left-turn movement (C) of the DDI.
- In the modified version of the four-leg intersection the southbound (B) and westbound (D) movements would travel through the intersection during the same phase (e.g., phase 6). This would be consistent with the overlapping southbound crossover movement (B) and westbound off-ramp right-turn movement (D) of the DDI.

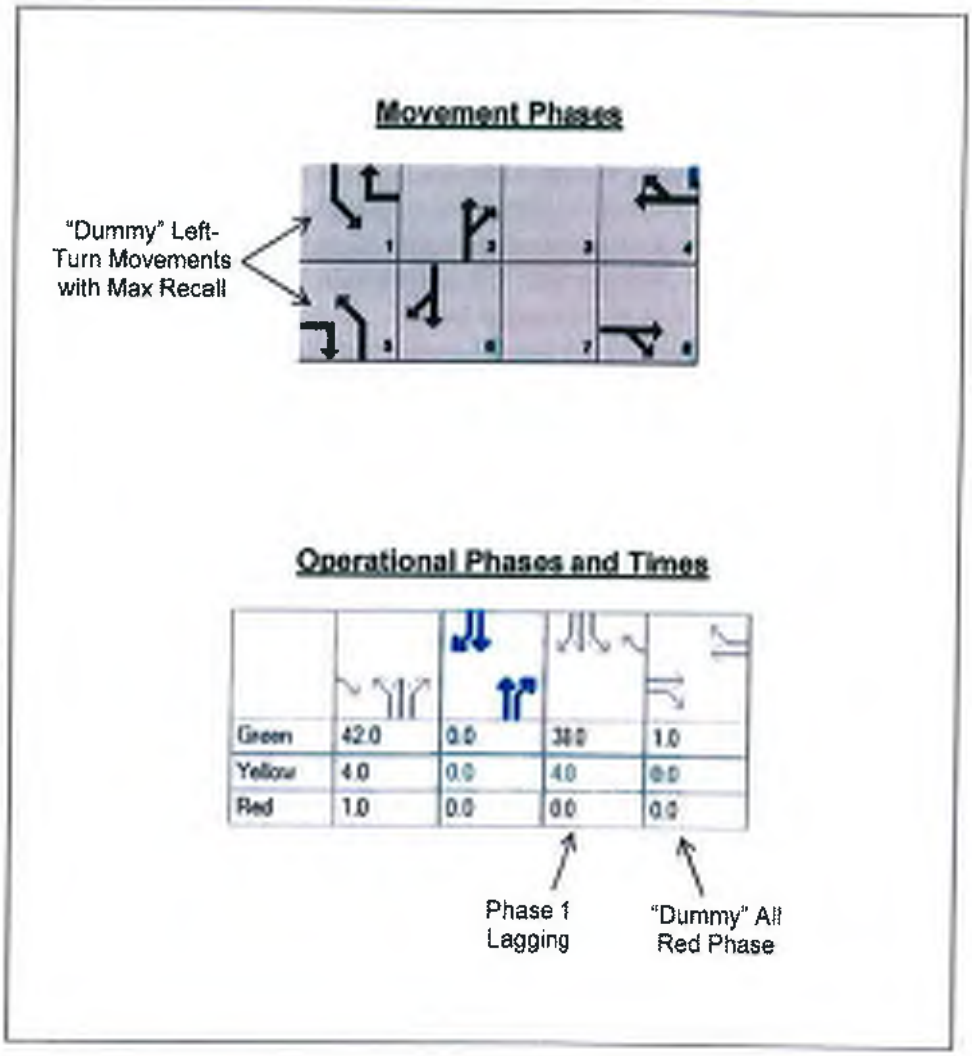
The following presents specific details of coding elements in HCS 2010 Streets to model the westbound ramp terminal intersection shown in **Figure 1** as a standard four-leg intersection of the DDI intersection. Manipulation of intersection movements for the eastbound ramp terminal intersection would follow similar methodology.

- To model split-phase operations for the arterial street (northbound and southbound movements) in HCS 2010 Streets, the following coding elements would be needed. Additionally, the diagrams shown in **Figure 2** supplement the coding elements listed below.
  - Artificial ("dummy") northbound and southbound left-turn movements would be added with protected phasing. These movements would not serve any of the DDI traffic. The added left-turn phases would be phase 5 for the northbound left-turn movement and phase 1 for the southbound left-turn movement (based on the previously mentioned example phasing of phases 2 and 6 for the northbound and southbound through movements, respectively).
  - The eastbound and westbound right-turn movements would be overlapped with the northbound and southbound left-turn movements.
  - The southbound left-turn movement would be set to a lagging left-turn phase so that the northbound and southbound left-turn movements would not need to have a green signal indication simultaneously.
  - The Recall Mode for the northbound and southbound left-turn movements would be set to 'Max'.
  - Eastbound and westbound phases (phases 8 and 4, respectively) would be required to be included to meet the criteria for signal timings in HCS 2010 Streets. This would include eastbound and westbound through movements with zero volume. These phases would have a green signal indication simultaneously for 1 second (the minimum time allowed for a phase). This effectively serves as the Red time for the previous split that serves southbound traffic. This 1 second phase for the eastbound and westbound approaches is labeled as "Dummy" All Red Phase in **Figure 2**. To counter the additional 1 second of green time given to the eastbound and westbound right-turn movements, each of these movements would be given an additional 0.5

seconds of "Start-Up Lost Time". Each of these right-turn movements would experience the extra 0.5 seconds of "Start-Up Lost Time" during the "Dummy" All Red Phase and during their normal phase of operation (Phase 1 or 5), totaling 1 second of additional "Start-Up Lost Time" over the course of 1 signal cycle for the eastbound and westbound right-turn movements.

- The Demand for the northbound and southbound left-turn movements would be set to '1' in order for phases 1 and 5 to be given a green signal indication (otherwise, all of the time would be given to the phase where northbound and southbound traffic travel through the intersection simultaneously).

Figure 2. Sample HCS 2010 Streets Phasing for the Westbound Ramp Terminal Intersection



- The following coding elements would also be included in HCS 2010 Streets to mimic the movements of the DDI.
  - The Arrival Type for the eastbound and westbound right-turn movements would be '3', representing random arrivals from the freeway. The Arrival Type for the

northbound and southbound approaches would be '4', representing coordination of signals. However, the arrival patterns of the northbound and southbound movements would be dictated by the signal timings at upstream intersections and the coded Arrival Type for the northbound and southbound approaches would not have any impact on the operations at these intersections.

- Phase 5 would operate with 4 seconds of yellow and 1 second of all red.
- Phase 1 would operate with 4 seconds of yellow and 0 seconds of all red (the all red time would be effectively given by the "Dummy" All Red Phase shown in **Figure 2**).
- The Phase Split time for the northbound left-turn movement (phases 5) would be set to the optimum phase split time for the northbound movement. The Phase Split time for the southbound left-turn movement (phases 5) would be set to the optimum phase split time for the northbound movement minus 1 second (to account for the 1 second "Dummy" All Red Phase). The combined split times for the northbound left-turn movement (phase 5), southbound left-turn movement (phase 1) and eastbound/westbound movements (phases 8/4) would equal the cycle length of the signal, leaving no remaining time for the overlapping phase where northbound and southbound through traffic would travel through the intersection simultaneously.
- The speed limit would be set to 25 mph to account for lower speeds through the crossover and channelized turn movements. The exception to this would be for the southbound approach that arrives from outside of the DDI and would be set to the speed limit of the Arterial Street.
- The Interchanges feature within HCS Streets would be used to update the Turning Radius for the turn movements based on the concept/design. This would account for the larger radii at the turning locations of the DDI. The Interchange Type within the Interchanges section does not include DDI as an option and would be set to Diamond.

As mentioned previously, the modified standard four-leg configuration would have split-phase operations at the ramp terminal intersections for northbound and southbound traffic and allow for coordination of the ramp terminal intersections with signals north and south of the interchange. The signal offset values at the ramp terminals would be based on the turn patterns at each intersection to maximize platooning of traffic through the two signals. Signal offsets at intersections adjacent to the ramp terminals would be based on the offsets established at the ramp terminal intersections.

APPENDIX B1. 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*

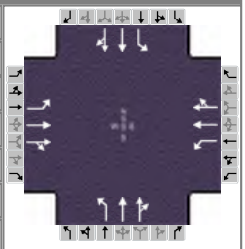
LOS 'C' is typically preferred for the average intersection operations during the peak period traffic conditions of a project horizon year (beyond 20 years from existing), though LOS 'D' has generally been considered acceptable. For this study, LOS 'D' was used as the worst allowable LOS for future year intersection operations when identifying proposed improvements.

APPENDIX B2 -

EXISTING HCS 2010 REPORTS

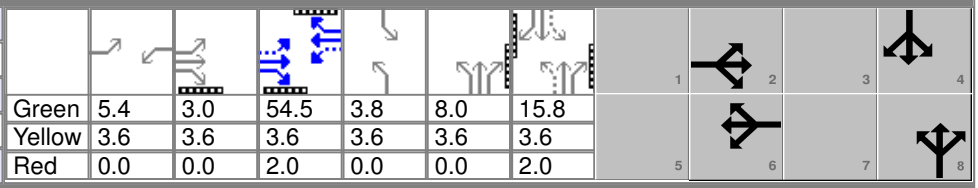
HCS 2010 Signalized Intersection Results Summary

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

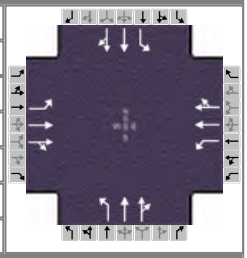
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	259	311	288	94	444	436	338	336	324	48	330	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1553	1617	1698	1665	1681	1765	1691	1681	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

Copyright © 2016 University of Florida, All Rights Reserved.

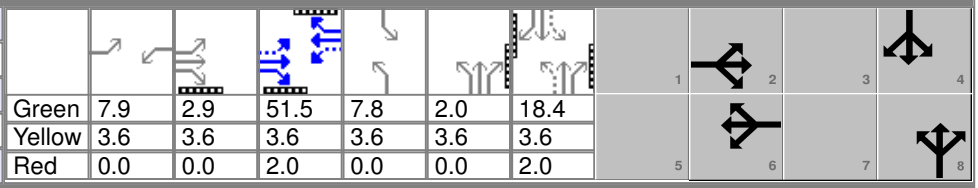
HCS 2010 Signalized Intersection Results Summary

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, ($Y+R_c$), 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	13.3		7.6		15.1	18.1	7.9	15.0
Green Extension Time (g_e), 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

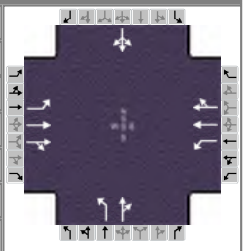
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	306	628	570	145	324	314	229	262	240	104	422	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1534	1617	1698	1638	1681	1765	1572	1681	1765	0
Queue Service Time (g_s), 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 (g_c), 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 (c_a), 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 (d_1), 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 (d_2), 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 (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	14.6	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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	93.3	11.5	0.0	0.0	0.0	0.0	5	6	7	8
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

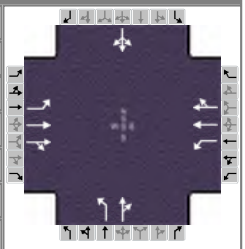
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	8	442	432	7	742	741	71	39			15	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	341	1698	1660	608	1698	1695	1402	1541			1301	
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	91.4	13.4	0.0	0.0	0.0	0.0	5	6	7	8
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

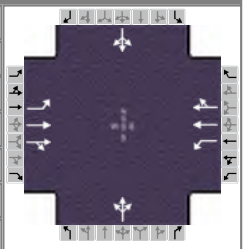
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	5	789	776	17	1014	0	82	46			14	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	533	1698	1655	315	1698	0	1401	1496			1445	
Queue Service Time (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	
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

Copyright © 2016 University of Florida, All Rights Reserved.

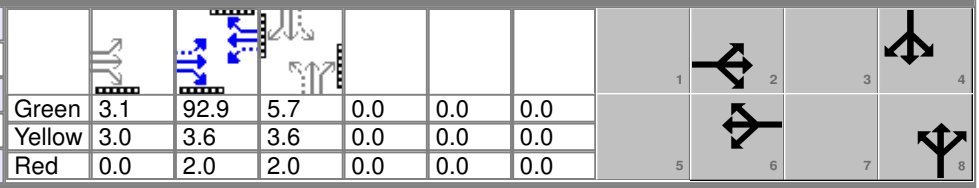
HCS 2010 Signalized Intersection Results Summary

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

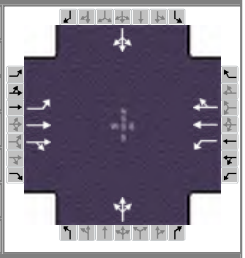
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	48	440	434	16	773	765		31			55	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1676	608	1698	1670		1589			1568	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

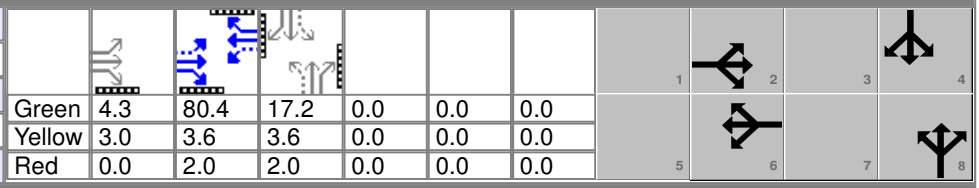
HCS 2010 Signalized Intersection Results Summary

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

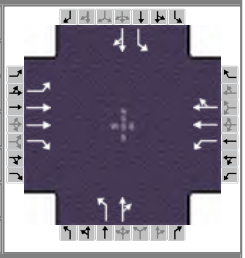
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	111	755	746	13	552	535		69			181	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1669	335	1698	1647		1373			1406	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

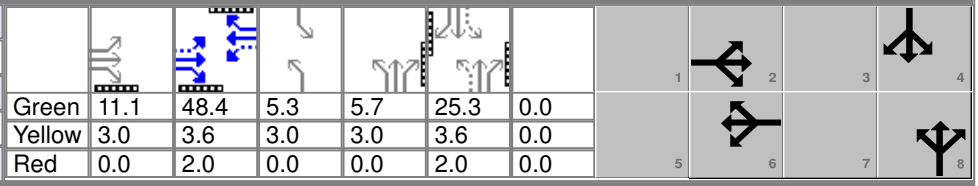
HCS 2010 Signalized Intersection Results Summary

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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	11.1	48.4	5.3	5.7	25.3	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	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

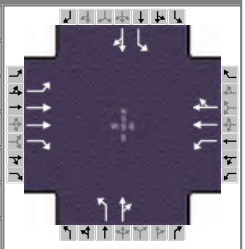
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	205	833	71	16	745	737	281	263		71	323	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	632	1698	1673	1681	1751		1681	1603	
Queue 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

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

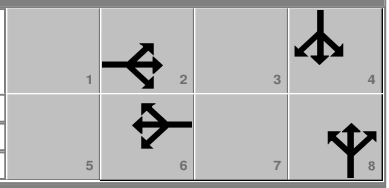
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	JKM	Analysis Date	Nov 12, 2013	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cleveland Ave	Analysis Year	2013	Analysis Period	1> 4:30
File Name	Existing_10th_St_PM_New.xus				
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

Copyright © 2016 University of Florida, All Rights Reserved.

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 & 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) 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	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	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		

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 & 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				

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 & 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		Movement 5	
	V(t)	V(l,prot)	V(t)	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) 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	8	9	10	11	12
	L	T	R	L	T	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

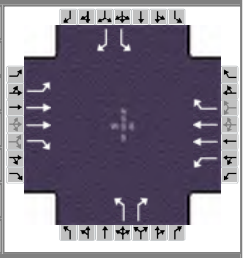
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					4			
C(m) (vph)					561			
v/c					0.01			
95% queue length					0.02			
Control Delay					11.5			
LOS					B			
Approach Delay				11.5				
Approach LOS				B				

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		

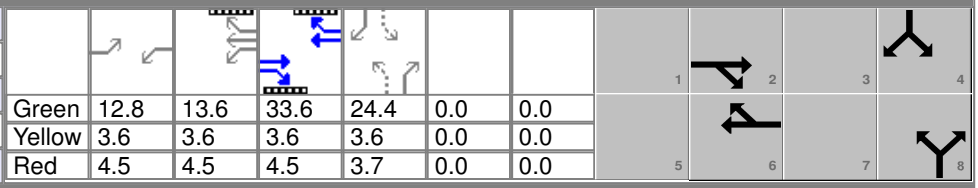
HCS 2010 Signalized Intersection Results Summary

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

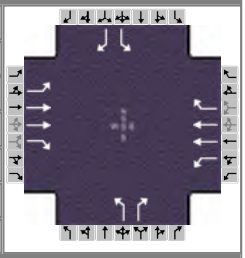
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	149	535	0	447	895	0	306		0	219		0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

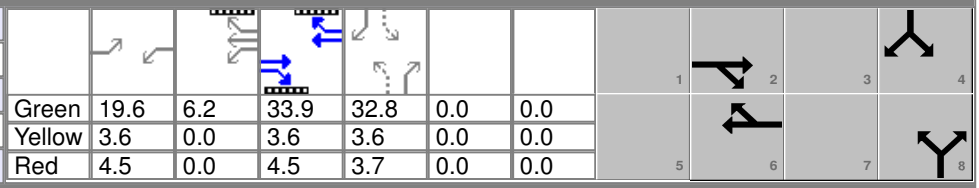
HCS 2010 Signalized Intersection Results Summary

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

Copyright © 2016 University of Florida, All Rights Reserved.

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	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
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	8	9	10	11	12
	L	T	R	L	T	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) 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 L	4 L	7 L	8 T	9 R	10 L	11 T	12 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	8	9	10	11	12
	L	T	R	L	T	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 L	8 T	9 R	10 L	11 T	12 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		

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	

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 L	2 T	3 R	4 L	5 T	6 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 L	8 T	9 R	10 L	11 T	12 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) 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	8	9	10	11	12
	L	T	R	L	T	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

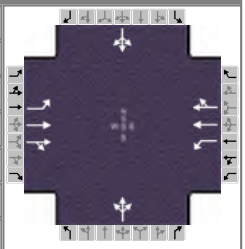
Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					59			11
C(m) (vph)					634			757
v/c					0.09			0.01
95% queue length					0.31			0.04
Control Delay					11.3			9.8
LOS					B			A
Approach Delay				11.3			9.8	
Approach LOS				B			A	

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				

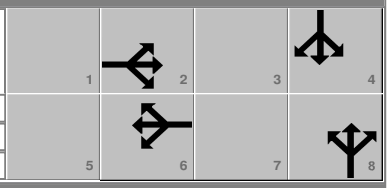


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	6	642	8	38	1208	44	6	19	25	63	19	31

Signal Information			
Cycle, s	116.0	Reference Phase	6
Offset, s	102	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.1	85.1	13.7	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		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

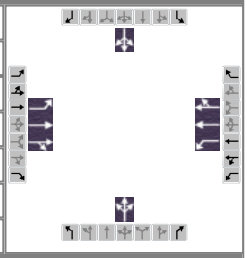
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	8	407	405	46	762	755		63			141	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	330	1698	1691	1617	1698	1677		1627			1438	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

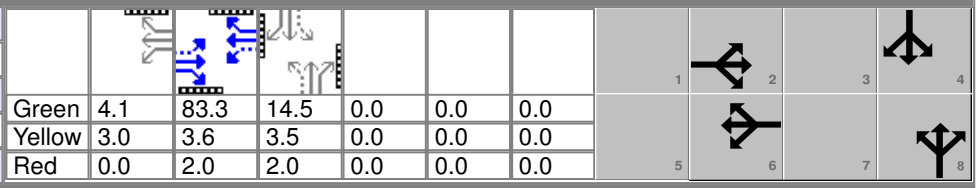
HCS 2010 Signalized Intersection Results Summary

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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.1	83.3	14.5	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		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

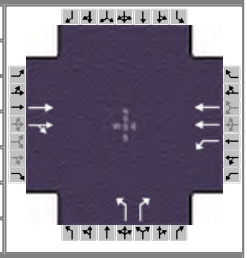
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	735	732	112	481	472		60			145	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	564	1698	1689	1617	1698	1669		1612			1379	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

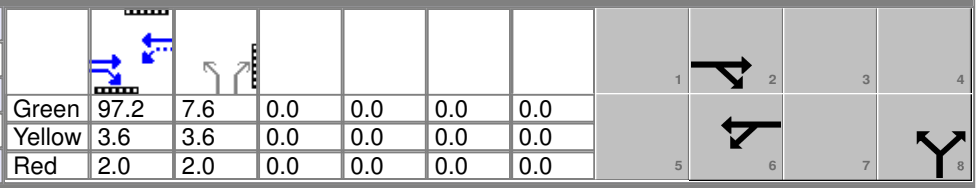
HCS 2010 Signalized Intersection Results Summary

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		

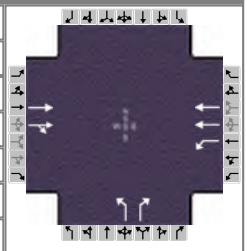
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		404	399	16	1495		79		48			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1675	650	1617		1681		1496			
Queue Service Time (g_s), s		17.3	4.7	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		

Copyright © 2016 University of Florida, All Rights Reserved.

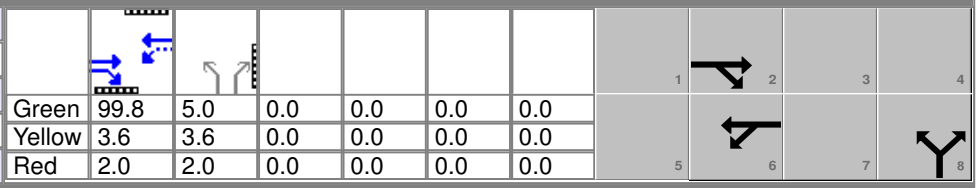
HCS 2010 Signalized Intersection Results Summary

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		

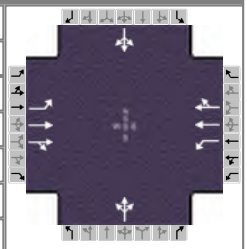
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		777	767	54	878		41		41			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1666	321	1617		1681		1496			
Queue Service Time (g_s), s		31.9	14.3	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			
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		

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	99.7	5.1	0.0	0.0	0.0	0.0	5	6	7	8
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

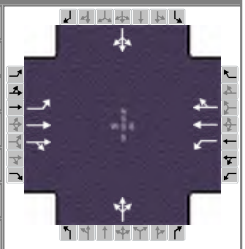
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	9	386	384	23	776	774		31			48	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	320	1698	1692	670	1698	1689		1633			1584	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	97.5	7.3	0.0	0.0	0.0	0.0	5	6	7	8
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

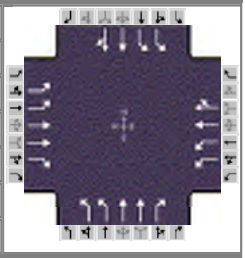
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	756	752	24	450	445		46			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	596	1698	1686	333	1698	1678		1584			1547	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

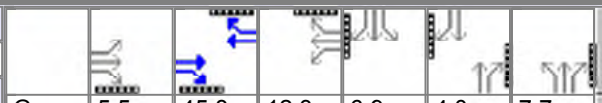
HCS 2010 Signalized Intersection Results Summary

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				

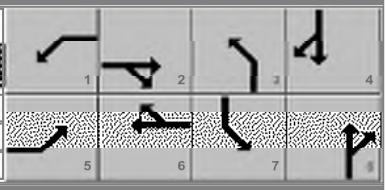


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	76	390	69	182	974	120	94	289	120	113	258	101

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

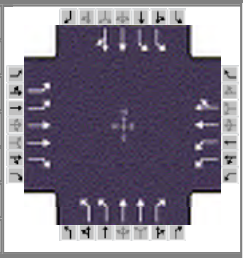
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	95	488	0	221	663	643	118	361	0	141	203	194
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1642	1616	1664	1481	1616	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

Copyright © 2016 University of Florida, All Rights Reserved.

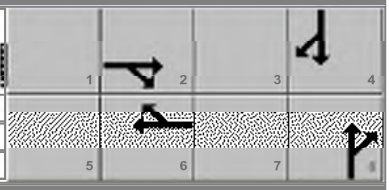
HCS 2010 Signalized Intersection Results Summary

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					EB			WB			NB			SB		
Cycle, s	116.0	Reference Phase	2													
Offset, s	114	Reference Point	Begin	Green	7.8	40.8		6.9	13.5		4.7	8.5				
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6		3.6	3.6		3.6	3.6				
Force Mode	Fixed	Simult. Gap N/S	On	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

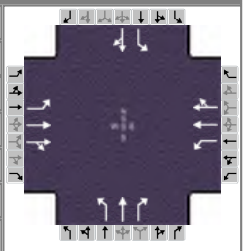
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	145	971	0	129	396	375	129	403	0	310	308	293
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1601	1616	1664	1481	1616	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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	81.7	23.1	0.0	0.0	0.0	0.0	5	6	7	8
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

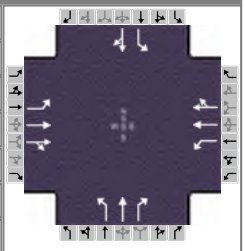
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	33	359	349	61	685	681	195	48	8	16	63	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	381	1698	1645	710	1698	1688	1334	1765	1496	1352	1619	
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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	90.4	14.4	0.0	0.0	0.0	0.0	5	6	7	8
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, ($Y+R_c$), 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						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

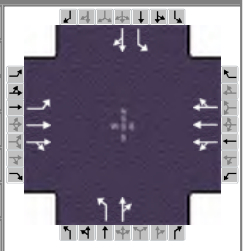
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	13	650	631	41	426	423	59	24	35	24	104	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	622	1698	1643	414	1698	1688	1285	1765	1496	1382	1714	
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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	94.7	10.1	0.0	0.0	0.0	0.0	5	6	7	8
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

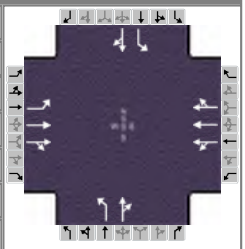
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	63	386	378	558	510	501	16	15		16	86	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	316	1698	1661	1688	1545	1516	1306	1619		1393	1516	
Queue 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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	94.7	10.1	0.0	0.0	0.0	0.0	5	6	7	8
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

Copyright © 2016 University of Florida, All Rights Reserved.

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		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: 900	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	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	

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	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)

Copyright © 2013 University of Florida, All Rights Reserved

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		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: 900	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	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	

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	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)

Copyright © 2013 University of Florida, All Rights Reserved

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	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 10-10, 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	

Copyright © 2013 University of Florida, All Rights Reserved

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	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 10-10, 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	

Copyright © 2013 University of Florida, All Rights Reserved

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		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: 2163	
	Ramp Volume, V_R: 566	
	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 x f_{HV} x 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)

Copyright © 2013 University of Florida, All Rights Reserved

HCS2010™ Version 6.50 Generated: 1/10/2017 10:43 AM

RAMPS AND RAMP JUNCTIONS WORKSHEET

General 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

Site Information

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)

Copyright © 2013 University of Florida, All Rights Reserved

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	

Copyright © 2013 University of Florida, All Rights Reserved

BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*JKM*	Highway/Direction of Travel	*I-229 Northbound*
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	*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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	5110ft	Freeway maximum capacity, C_{IFL}	2350
Freeway free-flow speed, FFS	67 mph	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}	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	Minimum weaving lane changes, LC_{MIN}	999 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1423 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2567 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3990 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	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 intensity factor, W	0.186
Weaving segment capacity, c_w	6448 veh/h	Weaving segment speed, S	56.5 mph
Weaving segment v/c ratio	0.416	Average weaving speed, S_W	58.8 mph
Weaving segment density, D	16.6 pc/mi/ln	Average non-weaving speed, S_{NW}	55.3 mph
Level of Service, LOS	B	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".

Copyright © 2013 University of Florida, All Rights Reserved

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	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	5110ft	Freeway maximum capacity, C_{IFL}	2350
Freeway free-flow speed, FFS	67 mph	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	Minimum weaving lane changes, LC_{MIN}	878 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1302 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2327 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3629 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	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 intensity factor, W	0.173
Weaving segment capacity, c_w	3961 veh/h	Weaving segment speed, S	58.9 mph
Weaving segment v/c ratio	0.366	Average weaving speed, S_W	59.3 mph
Weaving segment density, D	8.7 pc/mi/ln	Average non-weaving speed, S_{NW}	58.2 mph
Level of Service, LOS	A	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".

Copyright © 2013 University of Florida, All Rights Reserved

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	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	4840ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	69 mph	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	Minimum weaving lane changes, LC_{MIN}	1140 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1552 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2223 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3775 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	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 intensity factor, W	0.186
Weaving segment capacity, c_w	3980 veh/h	Weaving segment speed, S	59.2 mph
Weaving segment v/c ratio	0.475	Average weaving speed, S_W	60.5 mph
Weaving segment density, D	11.3 pc/mi/ln	Average non-weaving speed, S_{NW}	57.6 mph
Level of Service, LOS	B	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".

Copyright © 2013 University of Florida, All Rights Reserved

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	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	4840ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	69 mph	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}	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	Minimum weaving lane changes, LC_{MIN}	989 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1401 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2339 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3740 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	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 intensity factor, W	0.184
Weaving segment capacity, c_w	5579 veh/h	Weaving segment speed, S	59.0 mph
Weaving segment v/c ratio	0.412	Average weaving speed, S_W	60.6 mph
Weaving segment density, D	13.6 pc/mi/ln	Average non-weaving speed, S_{NW}	58.0 mph
Level of Service, LOS	B	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".

Copyright © 2013 University of Florida, All Rights Reserved

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 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	*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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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 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	*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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A	575	☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	1072	V_D =	veh/h
		Ramp Volume, V_R	629		
		Freeway Free-Flow Speed, S_{FF}	67.0		
		Ramp Free-Flow Speed, S_{FR}	57.0		

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	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)

Copyright © 2013 University of Florida, All Rights Reserved

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		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: 575	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	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	

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)

Copyright © 2013 University of Florida, All Rights Reserved

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 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)	*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	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 10-10, 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	

Copyright © 2013 University of Florida, All Rights Reserved

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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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		Freeway Number of Lanes, N	2	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes	☐ On
☑ No	☐ Off	Acceleration Lane Length, L_A		☑ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D	400	L_{down} =	ft
V_u =	veh/h	Freeway Volume, V_F	1701	V_D =	veh/h
		Ramp Volume, V_R	257		
		Freeway Free-Flow Speed, S_{FF}	67.0		
		Ramp Free-Flow Speed, S_{FR}	35.0		

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	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)

Copyright © 2013 University of Florida, All Rights Reserved

HCS2010™ Version 6.50 Generated: 1/10/2017 10:47 AM

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 x f_{HV} x 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)

Copyright © 2013 University of Florida, All Rights Reserved

APPENDIX C. 2035 NO-BUILD AND BUILD OPERATIONAL ANALYSIS TECHNICAL MEMORANDUM

Year 2035 Sub-Study 3 No Build conditions operational analysis included the analysis of 11 signalized intersections, 2 unsignalized intersections, 4 basic freeway segments, 2 weave segments, 2 merge areas, and 2 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.

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.

No-Build "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 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
10th Street & I-229 SPUI		LOS E
10th Street & Cleveland Avenue	LOS F	LOS F
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
I-229 NB Diverge to 10th Street off-ramp	LOS D	
I-229 SB Merge from 10th Street on-ramp	LOS D	LOS D

Note: Acceptable Threshold is LOS D for intersections, and LOS C for freeway and ramps.

No-Build "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.

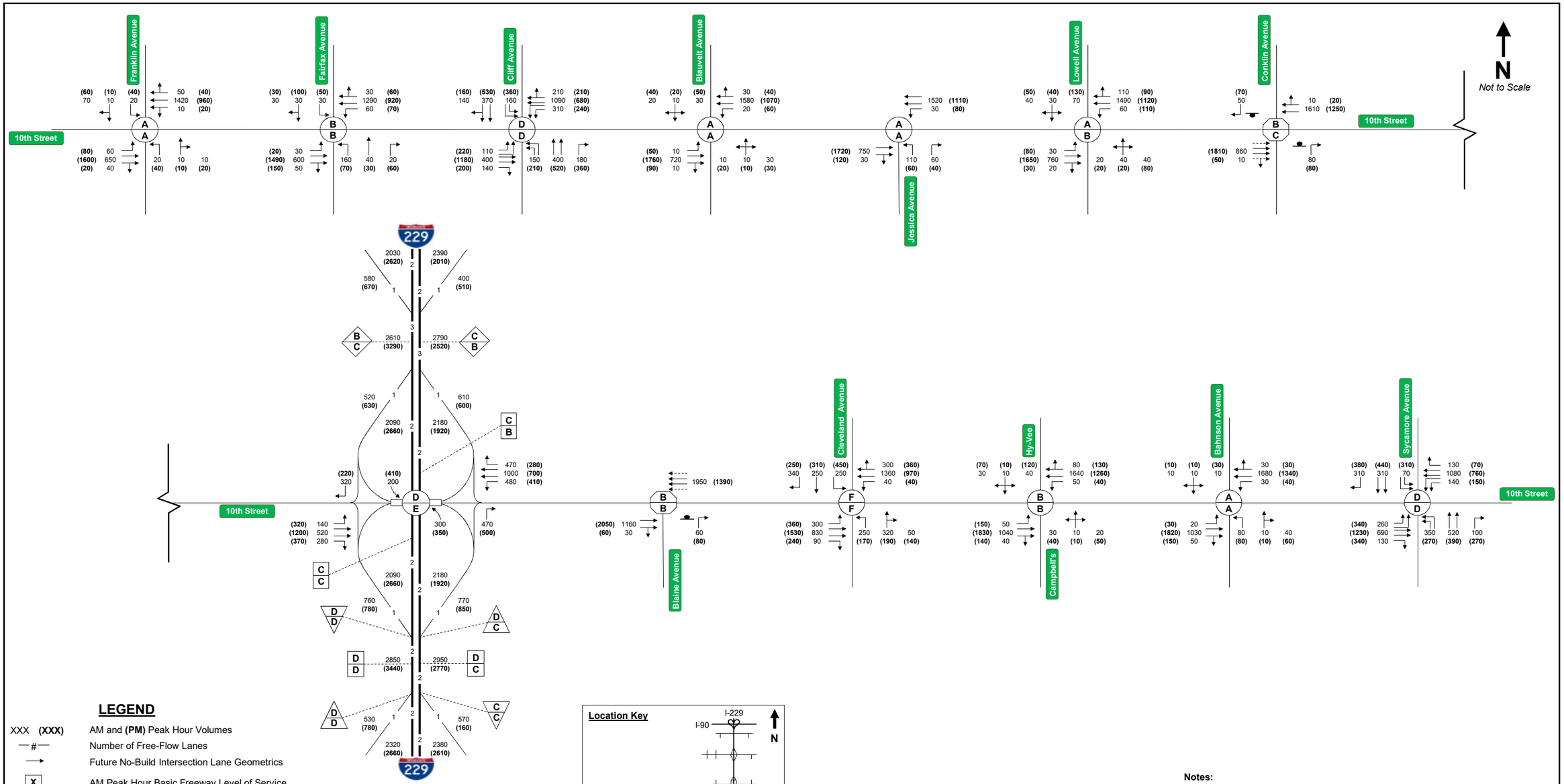
Table 2. LOS Differences between 2035 No-Build "Worst Case" and "Best Case" Scenarios

LOCATION	AM Peak		PM Peak	
	"Worst Case" LOS	"Best Case" LOS	"Worst Case" LOS	"Best Case" LOS
10th & Fairfax			B	A
10th & I-229 SPUI	D	C		
10th & Cleveland			F	E
10th & Sycamore			D	C

No-Build "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 ***FIGURE 1***. The 2035 No-Build "Worst Case" HCS 2010 Reports can be found in the ***APPENDIX***.

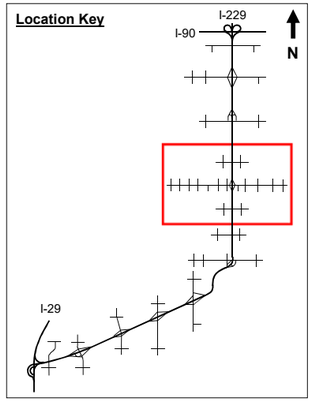
The 2035 no-build "Best Case" lane geometrics and LOS results for all locations are shown in ***FIGURE 2***. The 2035 No-Build "Best Case" HCS 2010 Reports can be found in the ***APPENDIX***.



LEGEND

XXX (XXX)	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X / X	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

Location Key



Notes:

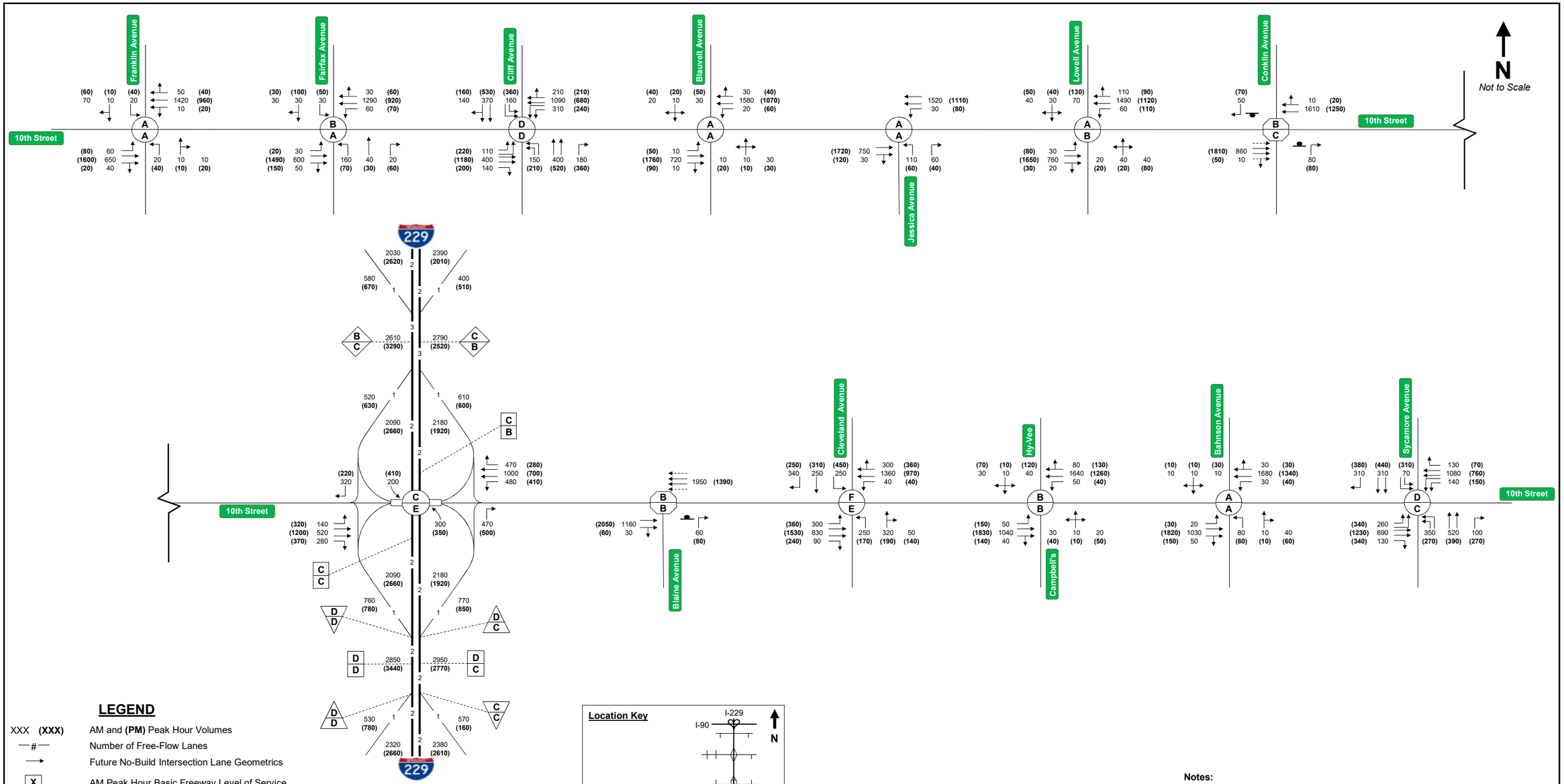
1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 3
10th Street Corridor Study
Sioux Falls, South Dakota

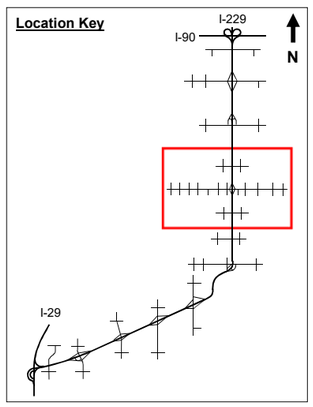
Date
11/5/2014

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

2035 No-Build "Best Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 3
10th Street Corridor Study
Sioux Falls, South Dakota

Date
2/12/2015

Figure
2

Build Conditions Analysis Results

The 2035 Build condition used the same volumes as the 2035 No-Build condition. The 2035 build alternative scenarios were analyzed using HCS 2010 for the AM and PM peak hours. The alternative scenarios analyzed are as follows:

- ***10th-2A.*** SPUI + 6-Lane Divided
- ***10th-2B.*** SPUI + 4-Lane Divided
- ***10th-2C.*** SPUI + 5-Lane
- ***10th-5A.*** DDI + 6-Lane Divided
- ***10th-5B.*** DDI + 4-Lane Divided
- ***10th-5C.*** DDI + 5-Lane
- ***10th-9A.*** Tight Split Diamond (6th/10th) + 4-Lane Divided
- ***10th-9B.*** Tight Split Diamond (6th/10th) + 5-Lane Undivided

The following alternative scenarios were analyzed together because the lane configurations are the same: 10th-2B and 10th-2C, 10th-5B and 10th-5C, and 10th-9A and 10th-9B. See ***TABLE 3*** for the 2035 Build LOS results for the alternative scenarios.

Table 3. 2035 Build LOS Results for Alternative Scenarios

Alternative Scenario	Intersection (AM LOS/PM LOS)											
	10th & Franklin	10th & Fairfax	10th & Cliff	10th & Blauvelt	10th & Jessica	10th & Lowell	10th & I-229 SB Ramps	10th & I-229 NB Ramps	10th & Cleveland	10th & Hy-Vee / Campbell's	10th & Bahnson	10th & Sycamore
10th-2A	A / A	A / A	C / C	A / A	A / A	B / B	C / C		C / C	A / B	A / B	D / D
10th-2B / 10th-2C	A / A	B / B	C / D	A / A	A / A	A / B	C / C		C / C	B / B	A / A	D / D
10th-5A	A / A	B / B	C / D	A / B	A / A	B / C	B / B	B / B	D / C	A / B	A / B	D / D
10th-5B / 10th-5C	A / A	B / B	C / D	A / B	A / A	A / B	C / B	B / B	D / C	A / B	A / A	D / D
10th-9A / 10th-9B	A / A	B / B	C / D	A / A	A / A	B / B	B / C	C / C	C / C	A / B	A / A	C / D

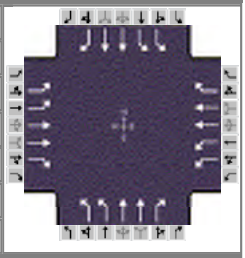
For all alternative scenarios, the ramp terminals operate at an acceptable LOS of C or better and the signalized arterial intersections operate at an acceptable threshold of LOS of D or better. The 2035 Build HCS 2010 Reports can be found in the ***APPENDIX***.

APPENDIX -

2035 NO-BUILD "WORST CASE" HCS 2010 REPORTS

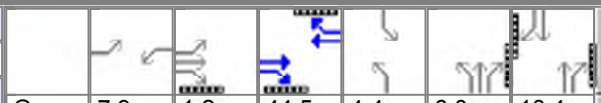
HCS 2010 Signalized Intersection Results Summary

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				

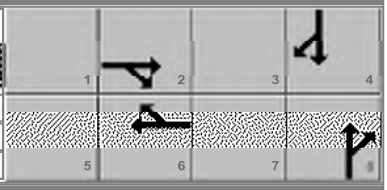


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	260	690	130	140	1080	130	350	520	100	70	310	310

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

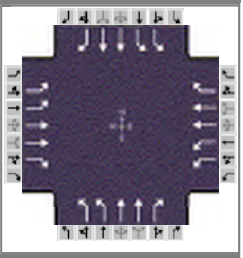
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	304	808	129	165	1271	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1496	1632	1680	1496	1632	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

Copyright © 2016 University of Florida, All Rights Reserved.

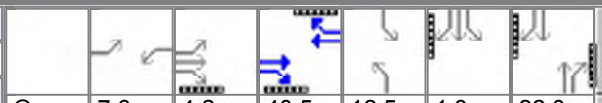
HCS 2010 Signalized Intersection Results Summary

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				

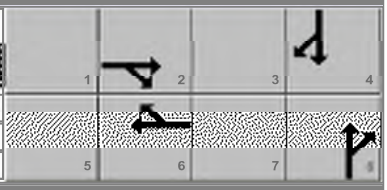


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	340	1230	340	150	760	70	270	390	270	310	440	380

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, ($Y+R_c$), 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	13.8		7.5		11.4	19.0	12.8	15.7
Green Extension Time (g_e), 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

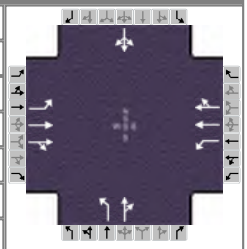
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	350	1267	311	161	817	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), 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 (g_c), 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 (c_a), 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 (d_1), 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 (d_2), 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 (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	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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	81.9	11.9	0.0	0.0	0.0	0.0	5	6	7	8
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

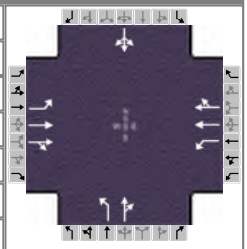
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	23	637	627	35	1006	1006	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	204	1698	1670	420	1698	1687	1382	1543			1512	
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	84.7	14.1	0.0	0.0	0.0	0.0	5	6	7	8
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

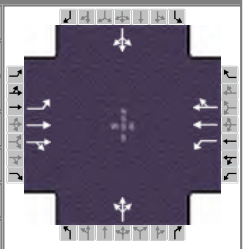
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	31	1013	1013	43	739	734	86	75			54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	344	1698	1653	201	1698	1685	1385	1529			957	
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

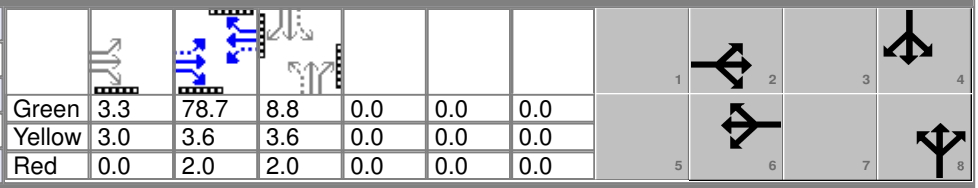
HCS 2010 Signalized Intersection Results Summary

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

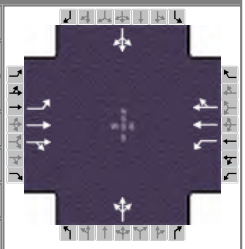
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	59	636	628	59	1012	1012		71			94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1676	420	1698	1670		1432			1468	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

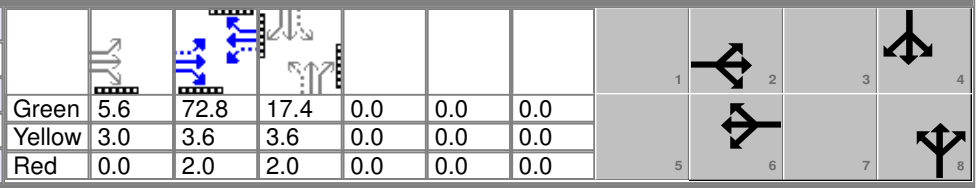
HCS 2010 Signalized Intersection Results Summary

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, ($Y+R_c$), 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	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

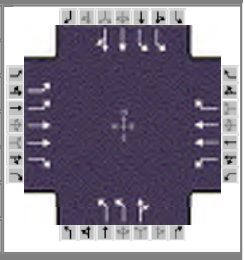
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	154	1009	1009	43	756	738		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1656	203	1698	1642		1433			1275	
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

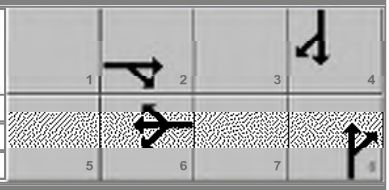
HCS 2010 Signalized Intersection Results Summary

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	Green	12.0	44.4	11.0	20.4	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	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*+*Rc*), 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

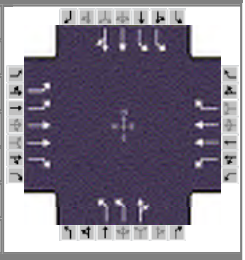
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	353	976	80	47	1600	345	294	414		294	294	271
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	552	1617	1439	1632	1736		1632	1765	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

Copyright © 2016 University of Florida, All Rights Reserved.

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				

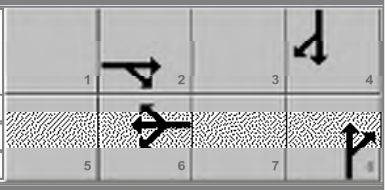


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	360	1530	240	40	970	360	170	190	140	450	310	250

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*+*Rc*), 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

Copyright © 2016 University of Florida, All Rights Reserved.

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		Movement 5	
	V(t)	V(l,prot)	V(t)	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) 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	8	9	10	11	12
	L	T	R	L	T	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		

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				

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 L	2 T	3 R	4 L	5 T	6 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 L	8 T	9 R	10 L	11 T	12 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		Movement 5	
	V(t)	V(l,prot)	V(t)	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) 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	8	9	10	11	12
	L	T	R	L	T	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

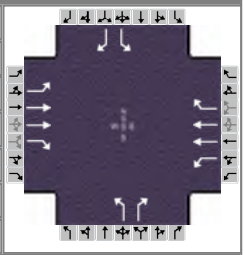
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					86			
C(m) (vph)					451			
v/c					0.19			
95% queue length					0.70			
Control Delay					14.9			
LOS					B			
Approach Delay				14.9				
Approach LOS				B				

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		

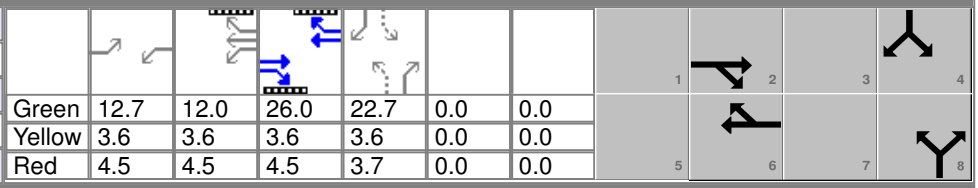
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.7	12.0	26.0	22.7	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	20.8	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

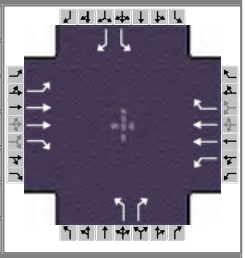
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	165	612	0	489	1019	0	353		0	235		0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

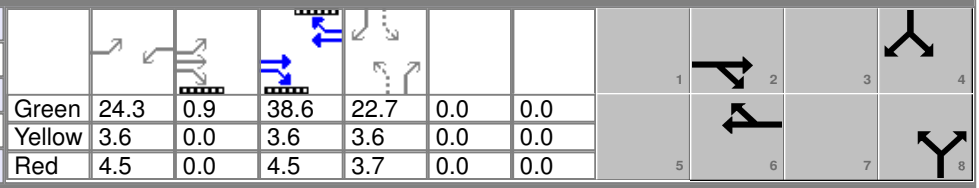
HCS 2010 Signalized Intersection Results Summary

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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	24.3	0.9	38.6	22.7	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	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

Copyright © 2016 University of Florida, All Rights Reserved.

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) 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	8	9	10	11	12
	L	T	R	L	T	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	8	9	10	11	12
	L	T	R	L	T	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	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
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	8	9	10	11	12
	L	T	R	L	T	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 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
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 L	8 T	9 R	10 L	11 T	12 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		Movement 5	
	V(t)	V(l,prot)	V(t)	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) 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	8	9	10	11	12
	L	T	R	L	T	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	8	9	10	11	12
	L	T	R	L	T	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

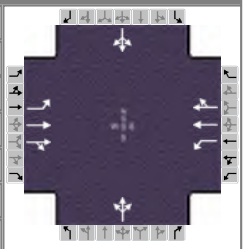
Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					86			75
C(m) (vph)					328			628
v/c					0.26			0.12
95% queue length					1.03			0.40
Control Delay					19.8			11.5
LOS					C			B
Approach Delay				19.8			11.5	
Approach LOS				C			B	

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		

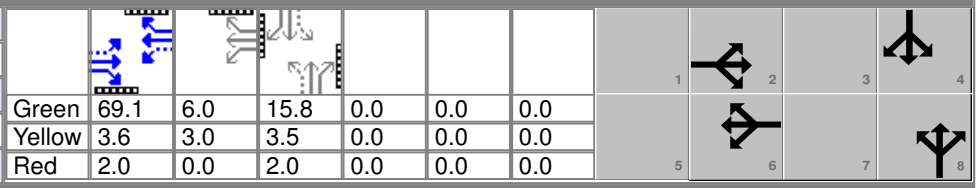
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	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

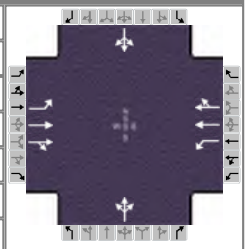
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	461	457	65	870	862		118			165	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	268	1698	1683	1617	1698	1657		1572			1325	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

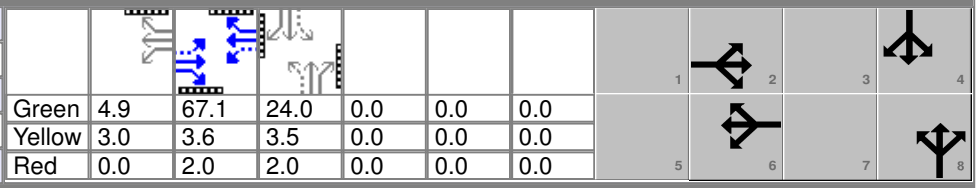
HCS 2010 Signalized Intersection Results Summary

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

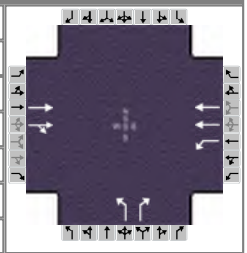
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	82	860	858	118	657	642		129			237	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	407	1698	1687	1617	1698	1653		1569			1243	
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

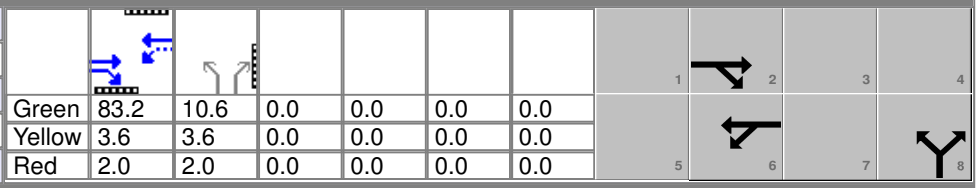
HCS 2010 Signalized Intersection Results Summary

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, ($Y+R_c$), s		5.6		5.6		5.6		
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		
Queue Clearance Time (g_s), s						9.9		
Green Extension Time (g_e), s		0.0		0.0		0.7		
Phase Call Probability						1.00		
Max Out Probability						0.00		

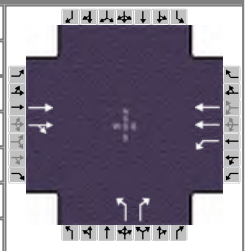
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		462	456	33	1651		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1675	583	1617		1681		1496			
Queue Service Time (g_s), s		20.4	4.6	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			
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		

Copyright © 2016 University of Florida, All Rights Reserved.

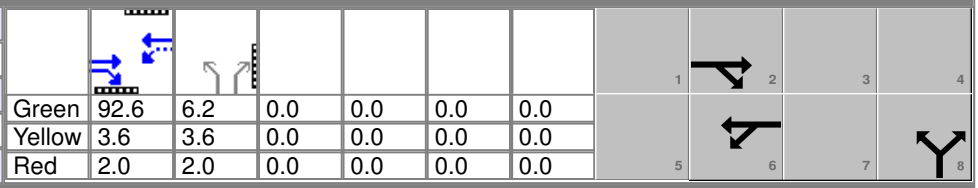
HCS 2010 Signalized Intersection Results Summary

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		

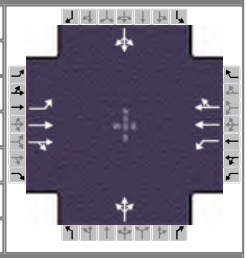
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		941	938	86	1192		65		43			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1659	232	1617		1681		1496			
Queue Service Time (g_s), s		52.4	7.3	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		

Copyright © 2016 University of Florida, All Rights Reserved.

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



								1	2	3	4	
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	5	6	7	8		

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

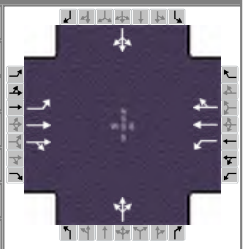
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	430	428	22	880	878		59			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	261	1698	1690	616	1698	1687		1603			1538	
Queue Service Time (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	
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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	88.0	10.8	0.0	0.0	0.0	0.0	5	6	7	8
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

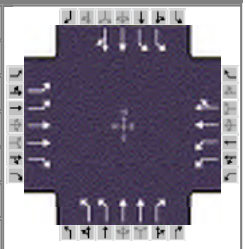
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	51	944	942	64	600	592		65			118	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	450	1698	1669	231	1698	1676		1521			1528	
Queue Service Time (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	
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

Copyright © 2016 University of Florida, All Rights Reserved.

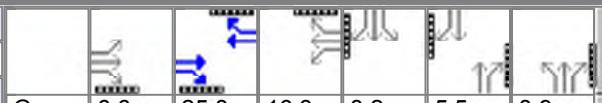
HCS 2010 Signalized Intersection Results Summary

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				

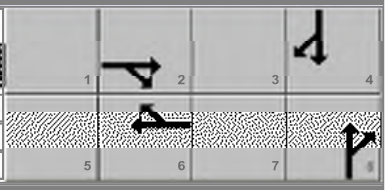


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	400	140	310	1090	210	150	400	180	160	370	140

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

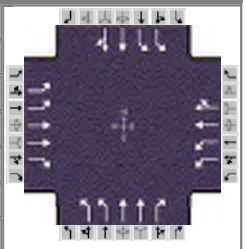
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	471	0	338	706	677	176	471	0	188	273	259
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1615	1616	1664	1481	1616	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

Copyright © 2016 University of Florida, All Rights Reserved.

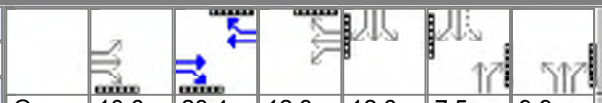
HCS 2010 Signalized Intersection Results Summary

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				

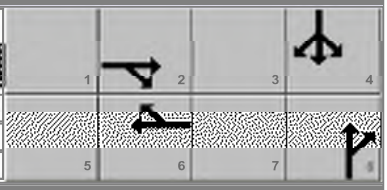


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	220	1180	200	240	680	210	210	520	360	360	530	160

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

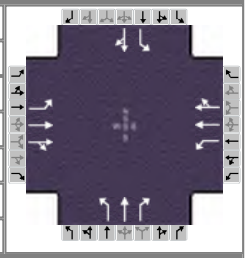
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1269	65	258	496	456	226	559	194	387	368	344
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1562	1616	1664	1481	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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	73.0	20.8	0.0	0.0	0.0	0.0	5	6	7	8
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

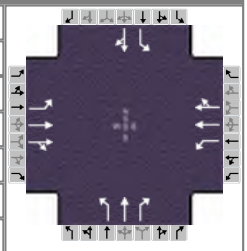
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	387	377	67	735	730	188	47	24	35	71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	347	1698	1652	673	1698	1684	1324	1765	1496	1353	1619	
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

Copyright © 2016 University of Florida, All Rights Reserved.

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				

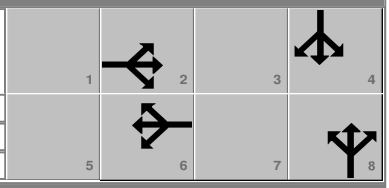


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1490	150	70	920	60	70	30	60	50	100	30

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

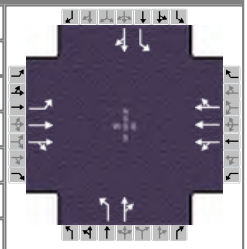
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	887	877	75	532	521	75	32	65	54	140	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	514	1698	1644	260	1698	1661	1244	1765	1496	1371	1694	
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

Copyright © 2016 University of Florida, All Rights Reserved.

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				

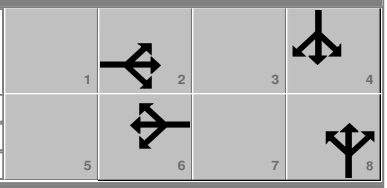


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	650	40	10	1420	50	20	10	10	20	10	70

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

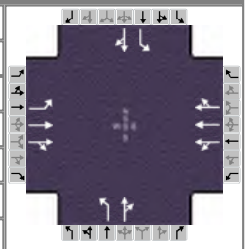
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	410	402	587	539	529	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	292	1698	1663	1680	1545	1516	1297	1619		1382	1525	
Queue 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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	87.4	11.4	0.0	0.0	0.0	0.0	5	6	7	8
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

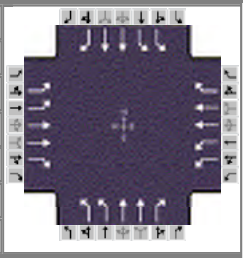
Copyright © 2016 University of Florida, All Rights Reserved.

APPENDIX -

2035 NO-BUILD "BEST CASE" HCS 2010 REPORTS

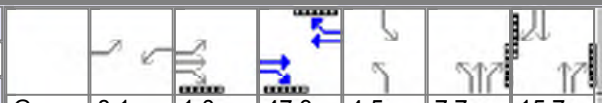
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 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				

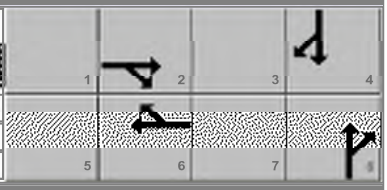


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	260	690	130	140	1080	130	350	520	100	70	310	310

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

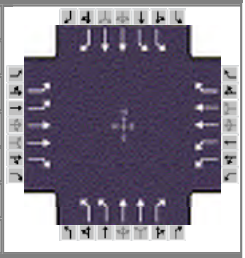
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	292	775	124	165	1271	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1525	1570	1617	1525	1632	1680	1525	1632	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

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

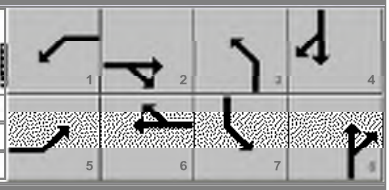
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Sycamore Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_NB_10th_St_PM_BestCase.xus				
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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.6	2.7	38.8	11.8	1.7	20.4	
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	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

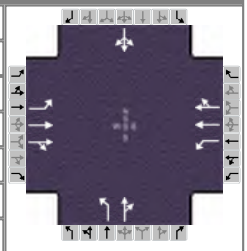
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	329	1190	292	161	817	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1525	1570	1617	1525	1632	1680	1525	1632	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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	86.4	12.4	0.0	0.0	0.0	0.0	5	6	7	8
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

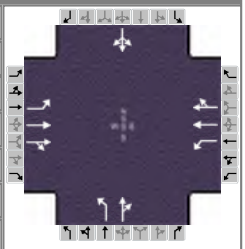
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	610	601	35	1006	1006	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	204	1698	1670	442	1698	1687	1382	1543			1491	
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	80.2	13.6	0.0	0.0	0.0	0.0	5	6	7	8
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

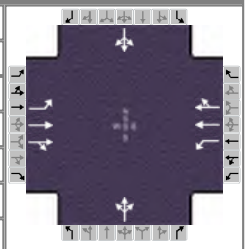
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	29	951	948	43	739	734	86	75			54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	344	1698	1653	228	1698	1685	1385	1529			969	
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

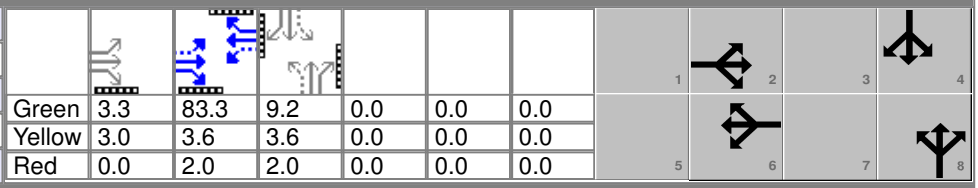
HCS 2010 Signalized Intersection Results Summary

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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.3	83.3	9.2	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	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

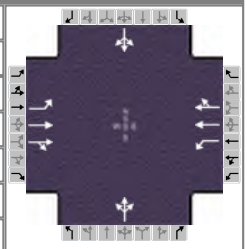
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	56	607	600	59	1012	1012		71			94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1676	444	1698	1670		1426			1461	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

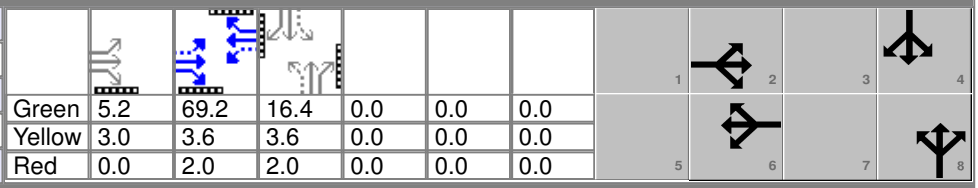
HCS 2010 Signalized Intersection Results Summary

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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.2	69.2	16.4	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	8.2	83.0		74.8		22.0		22.0
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	4.7					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

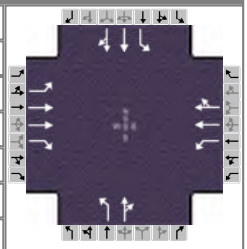
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	143	941	938	43	756	738		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1656	232	1698	1642		1435			1280	
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

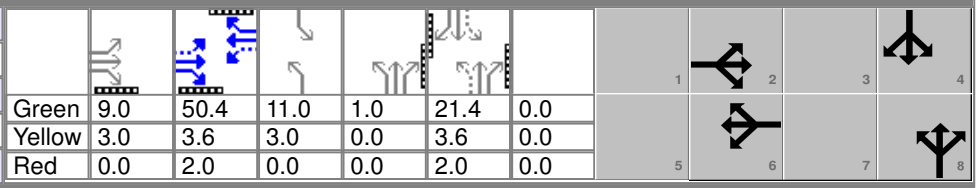
HCS 2010 Signalized Intersection Results Summary

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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.0	50.4	11.0	1.0	21.4	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	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

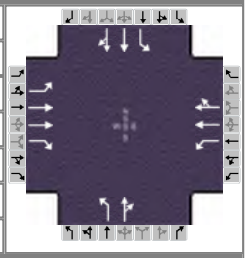
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	353	976	80	47	972	972	294	414		294	294	271
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	552	1698	1596	1681	1736		1681	1765	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

Copyright © 2016 University of Florida, All Rights Reserved.

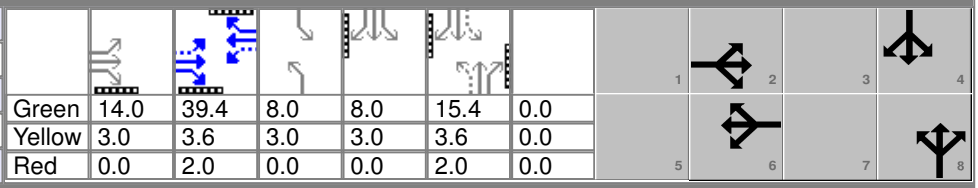
HCS 2010 Signalized Intersection Results Summary

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

Copyright © 2016 University of Florida, All Rights Reserved.

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		Movement 5	
	V(t)	V(l,prot)	V(t)	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) 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	8	9	10	11	12
	L	T	R	L	T	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		

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				

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 L	2 T	3 R	4 L	5 T	6 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 L	8 T	9 R	10 L	11 T	12 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		Movement 5	
	V(t)	V(l,prot)	V(t)	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) 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	8	9	10	11	12
	L	T	R	L	T	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

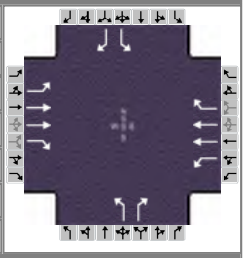
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					86			
C(m) (vph)					451			
v/c					0.19			
95% queue length					0.70			
Control Delay					14.9			
LOS					B			
Approach Delay				14.9				
Approach LOS				B				

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		

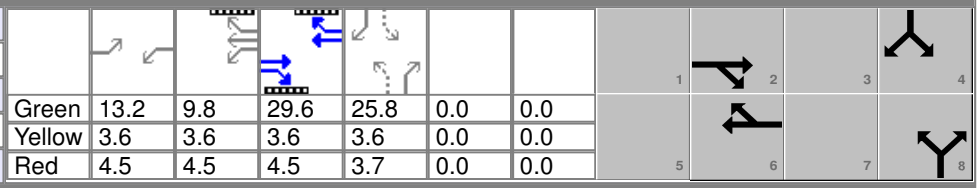
HCS 2010 Signalized Intersection Results Summary

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

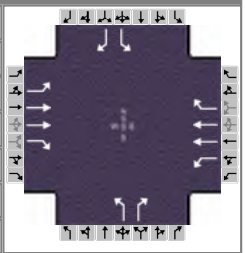
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	165	612	0	441	919	0	353		0	235		0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	1617	1617	1439	1617		1439	1617		1439
Queue Service 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

Copyright © 2016 University of Florida, All Rights Reserved.

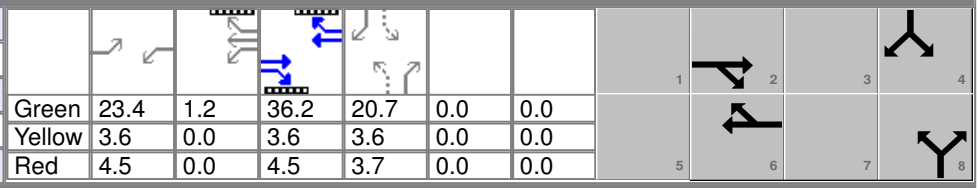
HCS 2010 Signalized Intersection Results Summary

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

Copyright © 2016 University of Florida, All Rights Reserved.

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) 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	8	9	10	11	12
	L	T	R	L	T	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	8	9	10	11	12
	L	T	R	L	T	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	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
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	8	9	10	11	12
	L	T	R	L	T	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 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
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 L	8 T	9 R	10 L	11 T	12 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		Movement 5	
	V(t)	V(l,prot)	V(t)	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) 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	8	9	10	11	12
	L	T	R	L	T	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	8	9	10	11	12
	L	T	R	L	T	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

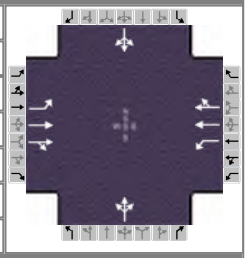
Movement	1	4	7	8	9	10	11	12
Lane Config					R			R
v (vph)					86			75
C(m) (vph)					328			628
v/c					0.26			0.12
95% queue length					1.03			0.40
Control Delay					19.8			11.5
LOS					C			B
Approach Delay				19.8			11.5	
Approach LOS				C			B	

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		

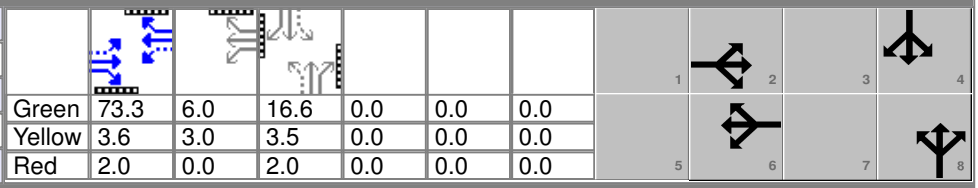
HCS 2010 Signalized Intersection Results Summary

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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	73.3	6.0	16.6	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		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

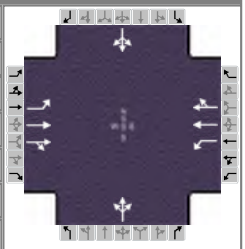
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	461	457	61	823	812		118			165	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	294	1698	1683	1617	1698	1657		1567			1312	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

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				

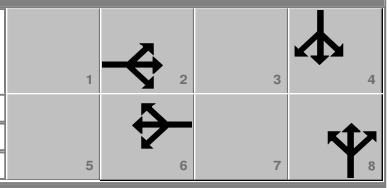


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1650	30	110	1120	90	20	20	80	130	40	50

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, ($Y+R_c$), 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			4.6			9.3		21.6
Green Extension Time (g_e), 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

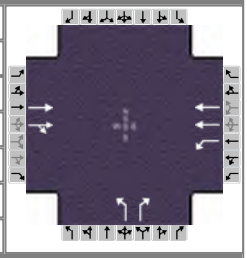
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	82	867	865	111	621	605		129			237	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	436	1698	1687	1617	1698	1653		1569			1252	
Queue Service Time (g_s), s	10.0	40.3	40.6	2.6	19.8	19.2		0.0			12.0	
Cycle Queue Clearance Time (g_c), 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 (c_a), 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 (d_1), s/veh	13.1	12.9	13.0	21.1	8.8	8.4		34.9			40.4	
Incremental Delay (d_2), s/veh	1.8	6.2	6.4	1.5	1.1	1.2		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	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

Copyright © 2016 University of Florida, All Rights Reserved.

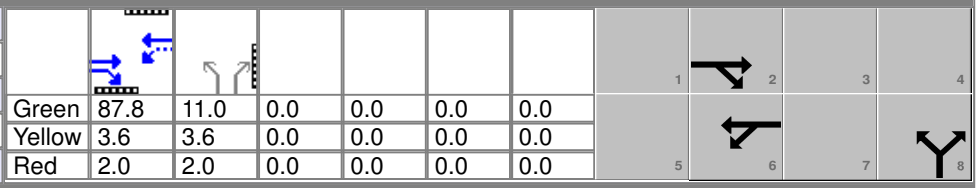
HCS 2010 Signalized Intersection Results Summary

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
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	87.8	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		
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		

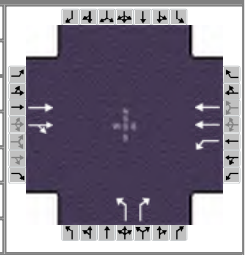
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		462	456	31	1563		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1675	583	1617		1681		1496			
Queue Service Time (g_s), s		18.9	4.5	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			
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		

Copyright © 2016 University of Florida, All Rights Reserved.

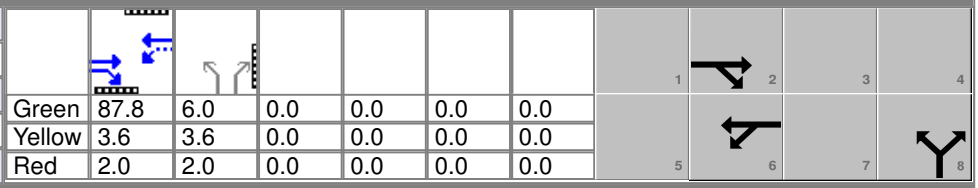
HCS 2010 Signalized Intersection Results Summary

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		

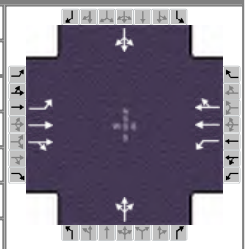
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		949	947	81	1129		65		43			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1659	229	1617		1681		1496			
Queue Service Time (g_s), s		51.0	7.6	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		

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	91.6	7.2	0.0	0.0	0.0	0.0	5	6	7	8
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

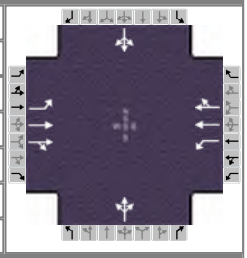
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	430	428	21	837	834		59			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	284	1698	1690	616	1698	1687		1606			1524	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	83.4	10.4	0.0	0.0	0.0	0.0	5	6	7	8
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

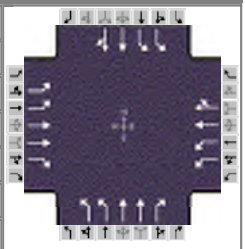
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	51	952	950	61	570	562		65			118	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	477	1698	1669	227	1698	1676		1533			1539	
Queue Service Time (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

Copyright © 2016 University of Florida, All Rights Reserved.

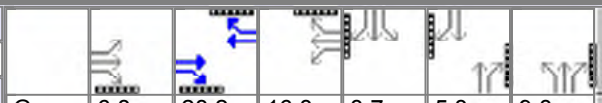
HCS 2010 Signalized Intersection Results Summary

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				

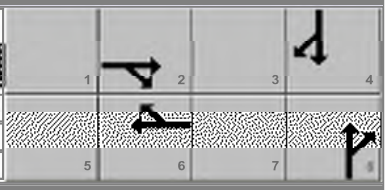


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	400	140	310	1090	210	150	400	180	160	370	140

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

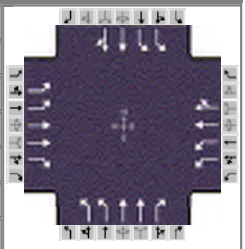
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	471	0	322	672	643	176	471	0	188	273	259
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1615	1616	1664	1481	1616	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

Copyright © 2016 University of Florida, All Rights Reserved.

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

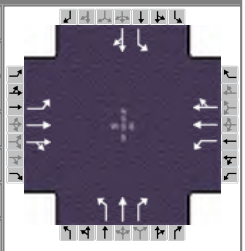
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1269	65	245	472	434	226	559	194	387	368	344
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1698	1562	1616	1664	1481	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

Copyright © 2016 University of Florida, All Rights Reserved.

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				

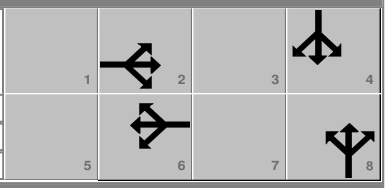


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	600	50	60	1290	30	160	40	20	30	30	30

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

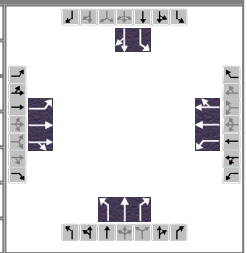
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	387	377	64	707	702	188	47	24	35	71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	366	1698	1652	673	1698	1684	1324	1765	1496	1353	1619	
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	
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

Copyright © 2016 University of Florida, All Rights Reserved.

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



							1	2	3	4
Green	78.4	15.4	0.0	0.0	0.0	0.0	5	6	7	8
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

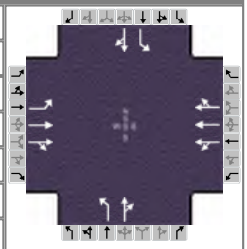
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	887	877	73	516	505	75	32	65	54	140	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	530	1698	1644	260	1698	1661	1244	1765	1496	1371	1694	
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

Copyright © 2016 University of Florida, All Rights Reserved.

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				

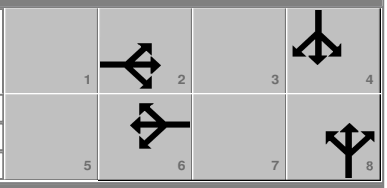


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	650	40	10	1420	50	20	10	10	20	10	70

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

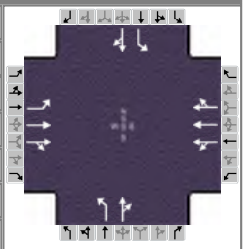
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	410	402	567	521	512	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	308	1698	1663	1680	1545	1516	1297	1619		1382	1525	
Queue 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

Copyright © 2016 University of Florida, All Rights Reserved.

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 & Franklin 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	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



							1	2	3	4
Green	82.8	11.0	0.0	0.0	0.0	0.0	5	6	7	8
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, ($Y+R_c$), 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		7.6
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	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 (g_s), 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 (g_c), 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 (c_a), 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 (d_1), s/veh	0.3	0.0	0.0	2.8	2.9	3.0	49.0	43.3		46.1	44.6	
Incremental Delay (d_2), 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 (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	1.2	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

Copyright © 2016 University of Florida, All Rights Reserved.

APPENDIX -

2035 NO-BUILD FREEWAY HCS 2010 REPORTS

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		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: 900	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	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	

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)

Copyright © 2013 University of Florida, All Rights Reserved

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		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: 900	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	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	

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	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)

Copyright © 2013 University of Florida, All Rights Reserved

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	*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	*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	

Copyright © 2013 University of Florida, All Rights Reserved

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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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		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: 2950	
	Ramp Volume, V_R: 770	
	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 x f_{HV} x 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)

Copyright © 2013 University of Florida, All Rights Reserved

HCS2010™ Version 6.50 Generated: 1/10/2017 10:52 AM

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 x f_{HV} x 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)

Copyright © 2013 University of Florida, All Rights Reserved

HCS2010™ Version 6.50 Generated: 1/10/2017 10:52 AM

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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	5110ft	Freeway maximum capacity, C_{IFL}	2350
Freeway free-flow speed, FFS	67 mph	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	Minimum weaving lane changes, LC_{MIN}	1146 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1570 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2661 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	4231 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	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 intensity factor, W	0.195
Weaving segment capacity, c_w	6529 veh/h	Weaving segment speed, S	54.9 mph
Weaving segment v/c ratio	0.499	Average weaving speed, S_W	58.5 mph
Weaving segment density, D	20.8 pc/mi/ln	Average non-weaving speed, S_{NW}	53.3 mph
Level of Service, LOS	C	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".

Copyright © 2013 University of Florida, All Rights Reserved

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	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	5110ft	Freeway maximum capacity, C_{IFL}	2350
Freeway free-flow speed, FFS	67 mph	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	Minimum weaving lane changes, LC_{MIN}	1198 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1622 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2526 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	4148 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	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 intensity factor, W	0.192
Weaving segment capacity, c_w	5384 veh/h	Weaving segment speed, S	55.8 mph
Weaving segment v/c ratio	0.499	Average weaving speed, S_W	58.6 mph
Weaving segment density, D	16.9 pc/mi/ln	Average non-weaving speed, S_{NW}	53.9 mph
Level of Service, LOS	B	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".

Copyright © 2013 University of Florida, All Rights Reserved

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	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	4840ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	69 mph	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	Minimum weaving lane changes, LC_{MIN}	1309 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1721 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2435 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	4156 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	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 intensity factor, W	0.200
Weaving segment capacity, c_w	5586 veh/h	Weaving segment speed, S	56.6 mph
Weaving segment v/c ratio	0.545	Average weaving speed, S_W	60.0 mph
Weaving segment density, D	18.8 pc/mi/ln	Average non-weaving speed, S_{NW}	54.5 mph
Level of Service, LOS	B	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".

Copyright © 2013 University of Florida, All Rights Reserved

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	Segment type	Freeway
Weaving number of lanes, N	3	Freeway minimum speed, S_{MIN}	15
Weaving segment length, L_S	4840ft	Freeway maximum capacity, C_{IFL}	2400
Freeway free-flow speed, FFS	69 mph	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	Minimum weaving lane changes, LC_{MIN}	1418 lc/h
Interchange density, ID	1.0 int/mi	Weaving lane changes, LC_W	1830 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2513 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	4343 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	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 intensity factor, W	0.207
Weaving segment capacity, c_w	5943 veh/h	Weaving segment speed, S	55.3 mph
Weaving segment v/c ratio	0.591	Average weaving speed, S_W	59.7 mph
Weaving segment density, D	22.2 pc/mi/ln	Average non-weaving speed, S_{NW}	52.9 mph
Level of Service, LOS	C	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".

Copyright © 2013 University of Florida, All Rights Reserved

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 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	*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

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)	*1291*	pc/h/ln
S	*65.0*	mph
D = v_p / S	*19.9*	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	

Copyright © 2013 University of Florida, All Rights Reserved

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 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	*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	

Copyright © 2013 University of Florida, All Rights Reserved

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		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: 575	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	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	

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	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)

Copyright © 2013 University of Florida, All Rights Reserved

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		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: 575	L_{down} = ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	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	

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)

Copyright © 2013 University of Florida, All Rights Reserved

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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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	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	

Copyright © 2013 University of Florida, All Rights Reserved

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		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: 400	V_D = veh/h
	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	

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	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)

Copyright © 2013 University of Florida, All Rights Reserved

HCS2010™ Version 6.50 Generated: 1/10/2017 10:55 AM

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		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: 400	V_D = veh/h
	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	

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	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)

Copyright © 2013 University of Florida, All Rights Reserved

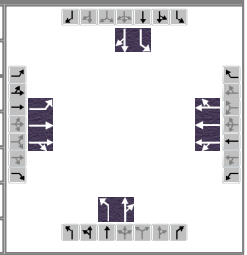
HCS2010™ Version 6.50 Generated: 1/10/2017 10:55 AM

APPENDIX -

YEAR 2035 BUILD HCS 2010 REPORTS

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_Build_10th_St_10th-2A_AM.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



							1	2	3	4
Green	87.9	10.9	0.0	0.0	0.0	0.0	5	6	7	8
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						10.7		8.5
Green Extension Time (g_e), s		0.0		0.0		0.3		0.3
Phase Call Probability						0.99		0.99
Max Out Probability						0.19		0.04

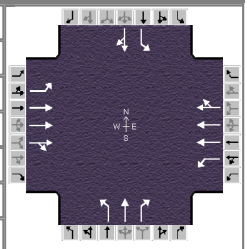
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	410	402	617	567	557	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	269	1698	1663	1679	1545	1516	1297	1619		1382	1525	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	8.9	8.9	2.0	1.5		1.7	6.5	
Cycle Queue Clearance Time (g_c), s	12.9	0.0	0.0	8.8	8.9	8.9	8.7	1.5		3.4	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	259	1359	1331	1377	1236	1213	113	159		180	150	
Volume-to-Capacity Ratio (*X*)	0.272	0.302	0.302	0.448	0.459	0.459	0.209	0.148		0.131	0.629	
Available Capacity (c_a), veh/h	259	1359	1331	1377	1236	1213	191	256		263	241	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	0.4	0.4	4.2	4.0	3.9	1.2	1.1		1.1	4.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.01	0.01	0.15	0.14	0.14	0.40	0.06		0.38	0.24	
Uniform Delay (d_1), s/veh	0.6	0.0	0.0	2.0	2.1	2.0	52.0	45.4		47.1	47.7	
Incremental Delay (d_2), s/veh	2.6	0.6	0.6	0.9	1.1	1.1	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	3.2	0.6	0.6	3.0	3.2	3.1	52.9	45.8		47.4	52.0	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	0.8	A		3.1	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

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

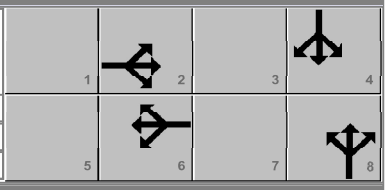
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Fairfax Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th-2A_AM.xus				
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	103	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							
Green	77.0	21.8	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		82.6		82.6		27.4		27.4
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						21.4		6.9
Green Extension Time (*ge*), s		0.0		0.0		0.4		1.2
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.00

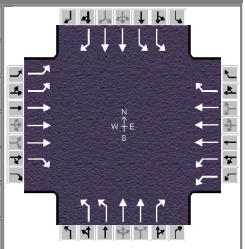
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	515	249	71	1040	513	188	47	24	35	71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	319	1698	1629	673	1698	1677	1324	1765	1496	1353	1619	
Queue Service Time (*gs*), s	5.2	6.1	6.2	1.1	6.3	6.1	15.3	2.4	1.4	2.4	4.0	
Cycle Queue Clearance Time (*gc*), s	11.4	6.1	6.2	8.0	6.3	6.1	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	0.20	0.20	0.20	0.20	0.20	
Capacity (*c*), veh/h	270	2377	1140	499	2377	1174	279	350	297	303	321	
Volume-to-Capacity Ratio (*X*)	0.130	0.217	0.219	0.141	0.437	0.437	0.675	0.134	0.079	0.116	0.220	
Available Capacity (*ca*), veh/h	270	2377	1140	499	2377	1174	310	391	332	335	359	
Back of Queue (*Q*), veh/ln (95th percentile)	0.8	4.0	4.0	0.4	3.0	3.1	9.2	1.9	0.9	1.5	2.9	
Queue Storage Ratio (*RQ*) (95th percentile)	0.14	0.14	0.14	0.06	0.11	0.11	0.93	0.10	0.19	0.38	0.15	
Uniform Delay (*d1*), s/veh	8.5	6.1	6.1	1.9	2.2	2.2	45.1	36.3	35.9	38.4	37.0	
Incremental Delay (*d2*), s/veh	1.0	0.2	0.4	0.5	0.5	1.0	5.0	0.2	0.1	0.2	0.3	
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	
Control Delay (*d*), s/veh	9.4	6.3	6.6	2.3	2.7	3.1	50.1	36.5	36.0	38.5	37.3	
Level of Service (LOS)	A	A	A	A	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	6.5	A		2.8	A		46.4	D		37.7	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	3.3	C	3.3	C
Bicycle LOS Score / LOS	0.9	A	1.4	A	0.9	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_AM.xus				
Project Description	2035 NB AM				

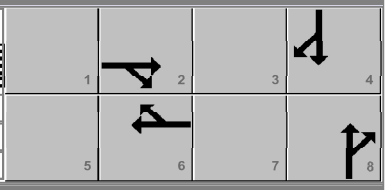


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	400	140	310	1090	210	150	400	180	160	370	140

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	105	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.8	29.5	17.2	8.8	3.1	10.8
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	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	12.4	47.6	22.8	58.0	16.4	25.2	14.4	23.2
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	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	6.5		14.0		7.6	16.6	8.2	15.7
Green Extension Time (g_e), s	0.4	0.0	3.9	0.0	2.9	2.9	0.6	1.8
Phase Call Probability	0.98		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.00		0.70		0.21	0.22	0.00	0.05

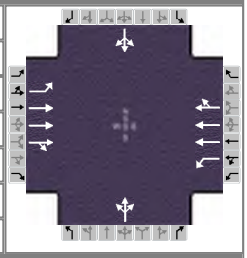
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	471	165	365	1282	208	176	471	212	188	435	98
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1542	1439	1570	1542	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	4.5	6.6	6.2	12.0	23.2	8.9	5.6	14.6	12.0	6.2	13.7	5.8
Cycle Queue Clearance Time (g_c), s	4.5	6.6	6.2	12.0	23.2	8.9	5.6	14.6	12.0	6.2	13.7	5.8
Green Ratio (*g/C*)	0.06	0.38	0.48	0.16	0.48	0.56	0.10	0.18	0.33	0.08	0.16	0.22
Capacity (*c*), veh/h	194	1763	688	488	2200	800	314	589	492	259	530	327
Volume-to-Capacity Ratio (*X*)	0.669	0.267	0.239	0.748	0.583	0.260	0.562	0.798	0.430	0.726	0.821	0.298
Available Capacity (c_a), veh/h	571	1763	688	665	2200	800	537	819	595	723	832	462
Back of Queue (*Q*), veh/ln (95th percentile)	3.6	4.3	3.8	8.1	13.5	7.9	4.1	10.0	3.6	4.6	9.5	2.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.47	0.15	0.66	0.84	0.27	0.91	0.60	0.29	0.37	0.53	0.42	0.70
Uniform Delay (d_1), s/veh	53.6	19.0	13.2	41.4	23.1	14.0	45.7	40.2	5.5	48.0	41.8	4.1
Incremental Delay (d_2), s/veh	3.9	0.4	0.8	2.8	1.0	0.7	1.6	3.9	0.6	3.9	3.8	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	0.0
Control Delay (*d*), s/veh	57.5	19.4	14.0	44.2	24.1	14.7	47.3	44.0	6.1	51.8	45.6	4.6
Level of Service (LOS)	E	B	B	D	C	B	D	D	A	D	D	A
Approach Delay, s/veh / LOS	24.7	C		27.0	C		35.3	D		41.7	D	
Intersection Delay, s/veh / LOS	30.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	3.5	D	3.5	C
Bicycle LOS Score / LOS	0.9	A	1.5	A	1.2	A	1.1	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_AM.xus				
Project Description	2035 NB AM				

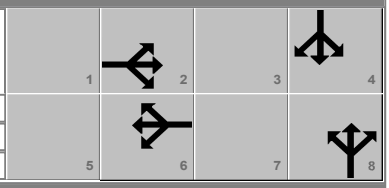


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	720	10	20	1580	30	10	10	30	30	10	20

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	18	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	91.7	7.1	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		97.3		97.3		12.7		12.7
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						5.8		7.1
Green Extension Time (g_e), s		0.0		0.0		0.2		0.2
Phase Call Probability						0.98		0.98
Max Out Probability						0.03		0.08

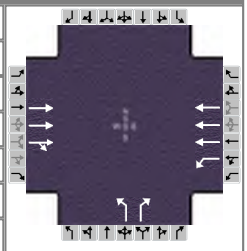
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	574	285	24	1267	628		59			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	229	1698	1686	616	1698	1681		1611			1488	
Queue Service Time (g_s), s	1.0	4.2	4.1	0.4	8.2	8.1		0.0			1.3	
Cycle Queue Clearance Time (g_c), s	9.4	4.2	4.1	4.8	8.2	8.1		3.8			5.1	
Green Ratio (*g*/*C*)	0.83	0.83	0.83	0.83	0.83	0.83		0.06			0.06	
Capacity (*c*), veh/h	239	2831	1405	555	2831	1402		143			145	
Volume-to-Capacity Ratio (*X*)	0.049	0.203	0.203	0.042	0.447	0.448		0.411			0.487	
Available Capacity (c_a), veh/h	239	2831	1405	555	2831	1402		244			242	
Back of Queue (*Q*), veh/ln (95th percentile)	0.1	2.0	2.0	0.1	2.8	3.1		3.0			3.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.04	0.04	0.02	0.07	0.08		0.15			0.18	
Uniform Delay (d_1), s/veh	2.4	2.1	2.1	1.2	1.6	1.6		50.0			50.5	
Incremental Delay (d_2), s/veh	0.4	0.1	0.3	0.1	0.4	0.9		1.9			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	2.8	2.3	2.4	1.3	2.1	2.5		51.8			53.0	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	2.3	A		2.2	A		51.8	D		53.0	D	
Intersection Delay, s/veh / LOS	4.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.5	A	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

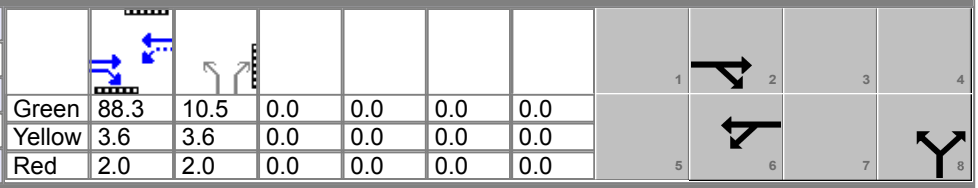
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2A_AM.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	100	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	88.3	10.5	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		
Case Number		8.0		6.0		9.0		
Phase Duration, s		93.9		93.9		16.1		
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		0.2		
Phase Call Probability						1.00		
Max Out Probability						1.00		

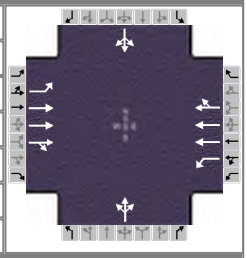
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		615	302	35	1788		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1663	583	1542		1681		1496			
Queue Service Time (g_s), s		5.7	4.7	0.4	3.3		8.3		4.9			
Cycle Queue Clearance Time (g_c), s		5.7	4.7	6.4	3.3		8.3		4.9			
Green Ratio (*g/C*)		0.80	0.80	0.80	0.80		0.10		0.10			
Capacity (*c*), veh/h		2725	1335	503	3712		161		143			
Volume-to-Capacity Ratio (*X*)		0.226	0.226	0.070	0.482		0.805		0.493			
Available Capacity (c_a), veh/h		2725	1335	503	3712		220		196			
Back of Queue (*Q*), veh/ln (95th percentile)		2.2	2.3	0.1	1.0		7.4		3.5			
Queue Storage Ratio (*RQ*) (95th percentile)		0.06	0.06	0.02	0.02		0.94		0.44			
Uniform Delay (d_1), s/veh		2.5	2.5	0.9	0.5		48.7		47.2			
Incremental Delay (d_2), s/veh		0.2	0.4	0.2	0.4		14.1		2.6			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		2.7	2.9	1.1	0.9		62.8		49.8			
Level of Service (LOS)		A	A	A	A		E		D			
Approach Delay, s/veh / LOS	2.8	A		0.9	A		58.2	E		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	3.3	C	3.2	C
Bicycle LOS Score / LOS	1.0	A	1.5	A		F		

Copyright © 2016 University of Florida, All Rights Reserved.

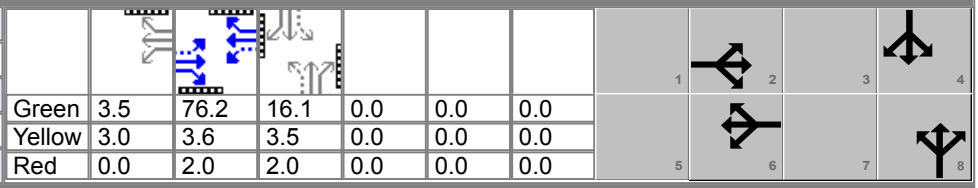
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2A_AM.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	79	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.5	76.2	16.1	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		81.8	6.5	88.4		21.6		21.6
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 (g_s), s			3.3			9.3		15.8
Green Extension Time (g_e), s		0.0	0.1	0.0		0.7		0.4
Phase Call Probability			0.88			1.00		1.00
Max Out Probability			0.14			0.04		1.00

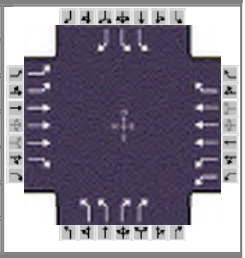
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	614	303	71	1269	613		118			165	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	231	1698	1675	1617	1698	1636		1563			1308	
Queue Service Time (g_s), s	12.1	8.4	8.4	1.3	28.8	29.6		0.0			6.4	
Cycle Queue Clearance Time (g_c), s	33.8	8.4	8.4	1.3	28.8	29.6		7.3			13.8	
Green Ratio (*g*/*C*)	0.69	0.69	0.69	0.74	0.75	0.75		0.15			0.15	
Capacity (*c*), veh/h	178	2353	1160	477	2555	1231		269			241	
Volume-to-Capacity Ratio (*X*)	0.199	0.261	0.262	0.148	0.497	0.498		0.438			0.683	
Available Capacity (c_a), veh/h	178	2353	1160	562	2555	1231		316			285	
Back of Queue (*Q*), veh/ln (95th percentile)	1.3	5.3	5.4	0.7	16.8	17.0		5.4			8.3	
Queue Storage Ratio (*RQ*) (95th percentile)	0.22	0.08	0.09	0.12	0.71	0.71		0.14			0.21	
Uniform Delay (d_1), s/veh	19.9	7.4	7.4	4.3	15.2	16.0		43.1			46.1	
Incremental Delay (d_2), s/veh	2.5	0.3	0.5	0.1	0.4	0.9		1.1			5.2	
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	22.4	7.6	8.0	4.4	15.6	16.9		44.2			51.3	
Level of Service (LOS)	C	A	A	A	B	B		D			D	
Approach Delay, s/veh / LOS	8.3	A		15.6	B		44.2	D		51.3	D	
Intersection Delay, s/veh / LOS	16.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.6	A	0.7	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_AM.xus				
Project Description	2035 NB AM				

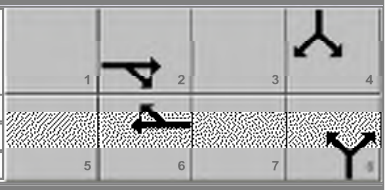


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	140	520	280	480	1000	470	300		470	200		320

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	35	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	42.9	4.0	25.9	13.7	1.0	0.0
Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Red	4.5	0.0	4.5	2.7	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	2.0	3.0	2.0	3.0	1.1	3.0	1.1	3.0
Phase Duration, s	38.0	34.0	55.0	51.0	20.0	1.0	20.0	1.0
Change Period, ($Y+R_c$), s	8.1	8.1	8.1	8.1	6.3	0.0	6.3	0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0	4.1	4.3	4.1	4.3
Queue Clearance Time (g_s), s	5.4		9.5		14.5	3.0	10.1	3.0
Green Extension Time (g_e), s	3.7	0.0	2.7	0.0	0.0	0.0	0.3	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.00		0.00		1.00	1.00	1.00	1.00

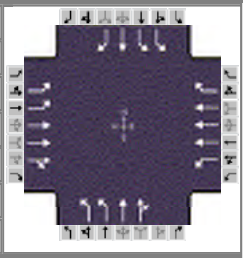
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	165	612	0	565	1176	0	353		553	235		376
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1491	1483	1350	1552	1524	1350	1519		1243	1501		1425
Queue Service Time (g_s), s	3.4	11.3	0.0	7.5	18.4	0.0	12.5		1.0	8.1		1.0
Cycle Queue Clearance Time (g_c), s	3.4	11.3	0.0	7.5	18.4	0.0	12.5		1.0	8.1		1.0
Green Ratio (*g/C*)	0.27	0.24	0.24	0.43	0.39	0.39	0.13		0.44	0.13		0.28
Capacity (*c*), veh/h	811	1048	318	1323	1783	527	509		1082	505		400
Volume-to-Capacity Ratio (*X*)	0.203	0.584	0.000	0.427	0.660	0.000	0.693		0.511	0.466		0.941
Available Capacity (c_a), veh/h	811	1048	318	1323	1783	527	509		1082	505		400
Back of Queue (*Q*), veh/ln (95th percentile)	2.2	6.5	0.0	3.6	7.2	0.0	8.9		8.7	5.7		11.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.29	0.27	0.00	0.47	0.27	0.00	0.58		0.65	0.40		1.00
Uniform Delay (d_1), s/veh	21.1	26.5	0.0	9.1	16.5	0.0	46.7		22.5	44.8		8.9
Incremental Delay (d_2), s/veh	0.5	2.3	0.0	0.4	0.8	0.0	7.6		0.4	3.1		30.3
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	21.6	28.8	0.0	9.5	17.3	0.0	54.3		22.9	47.9		39.2
Level of Service (LOS)	C	C		A	B		D		C	D		D
Approach Delay, s/veh / LOS	27.3	C		14.7	B		35.2	D		42.5	D	
Intersection Delay, s/veh / LOS	26.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.8	C	4.2	D	3.9	D
Bicycle LOS Score / LOS	0.9	A	1.4	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

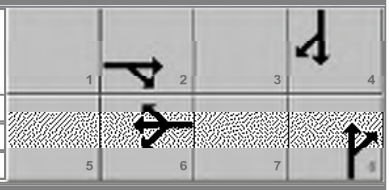
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2A_AM.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							
Uncoordinated	No	Simult. Gap E/W	On							
Force Mode	Fixed	Simult. Gap N/S	On							
				Green	13.8	41.4	12.1	0.4	21.1	0.0
				Yellow	3.0	3.6	3.0	0.0	3.6	0.0
				Red	2.0	2.0	2.0	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	4.0		5.3	2.0	4.0	2.0	3.0
Phase Duration, s	18.8	65.8		47.0	17.1	26.7	17.5	27.1
Change Period, (Y+R_c), s	5.0	5.6		5.6	5.0	5.6	5.0	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	13.4				11.7	14.1	11.7	19.7
Green Extension Time (g_e), s	0.4	0.0		0.0	0.4	2.9	0.8	1.8
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	0.33	0.05	0.92

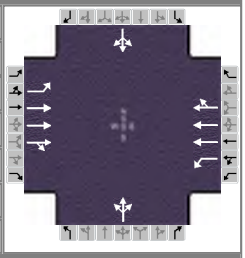
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	353	713	343	47	1600	345	294	209	205	294	294	271
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1630	512	1542	1439	1632	1765	1708	1632	1765	1496
Queue Service Time (g_s), s	11.4	2.4	2.0	5.5	34.9	15.3	9.7	12.0	12.1	9.7	17.7	16.5
Cycle Queue Clearance Time (g_c), s	11.4	2.4	2.0	5.5	34.9	15.3	9.7	12.0	12.1	9.7	17.7	16.5
Green Ratio (*g*/*C*)	0.13	0.55	0.55	0.38	0.38	0.49	0.11	0.19	0.19	0.11	0.20	0.32
Capacity (*c*), veh/h	395	1860	892	258	1741	705	359	338	327	371	345	480
Volume-to-Capacity Ratio (*X*)	0.894	0.383	0.385	0.182	0.919	0.489	0.820	0.619	0.626	0.794	0.854	0.564
Available Capacity (c_a), veh/h	452	1860	892	258	1741	705	445	383	371	623	390	519
Back of Queue (*Q*), veh/ln (95th percentile)	6.1	1.3	1.2	1.3	16.8	7.0	7.9	9.2	9.1	7.4	14.1	10.1
Queue Storage Ratio (*RQ*) (95th percentile)	0.79	0.05	0.04	0.17	0.42	0.92	1.00	0.26	0.26	0.23	0.36	1.71
Uniform Delay (d_1), s/veh	30.6	1.8	1.4	17.5	24.5	13.8	47.9	40.8	40.8	47.5	42.7	31.0
Incremental Delay (d_2), s/veh	12.2	0.4	0.8	1.3	8.0	2.0	9.6	2.5	2.7	3.9	15.2	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	42.9	2.1	2.2	18.8	32.5	15.8	57.5	43.2	43.5	51.4	58.0	32.2
Level of Service (LOS)	D	A	A	B	C	B	E	D	D	D	E	C
Approach Delay, s/veh / LOS	12.3	B		29.3	C		49.2	D		47.6	D	
Intersection Delay, s/veh / LOS	30.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.1	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	1.3	A	1.6	A	1.1	A	1.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

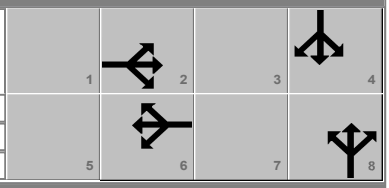
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th-2A_AM.xus				
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	104	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.3	83.4	9.0	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	95.4		89.0		14.6		14.6
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					7.3		9.0
Green Extension Time (g_e), s	0.0	0.0		0.0		0.1		0.1
Phase Call Probability	0.83					0.99		0.99
Max Out Probability	0.18					1.00		1.00

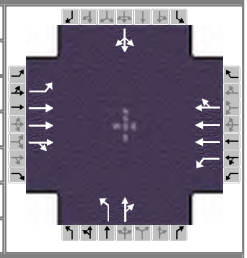
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	59	853	418	59	1359	665		71			94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1664	418	1698	1656		1410			1449	
Queue Service Time (g_s), s	0.8	5.9	5.6	5.1	19.4	19.6		0.0			1.8	
Cycle Queue Clearance Time (g_c), s	0.8	5.9	5.6	5.1	19.4	19.6		5.3			7.0	
Green Ratio (*g*/*C*)	0.81	0.82	0.82	0.76	0.76	0.76		0.08			0.08	
Capacity (*c*), veh/h	233	2772	1358	382	2576	1256		165			168	
Volume-to-Capacity Ratio (*X*)	0.252	0.308	0.308	0.154	0.527	0.529		0.429			0.560	
Available Capacity (c_a), veh/h	307	2772	1358	382	2576	1256		183			186	
Back of Queue (*Q*), veh/ln (95th percentile)	0.5	2.3	2.3	0.8	9.8	10.1		3.5			4.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.08	0.06	0.06	0.14	0.19	0.20		0.18			0.24	
Uniform Delay (d_1), s/veh	5.0	2.1	1.9	4.5	6.2	6.3		48.6			49.5	
Incremental Delay (d_2), s/veh	0.5	0.3	0.5	0.7	0.7	1.4		1.8			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	5.5	2.3	2.4	5.2	6.9	7.7		50.4			52.5	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	2.5	A		7.1	A		50.4	D		52.5	D	
Intersection Delay, s/veh / LOS	7.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.2	A	1.6	A	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_AM.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	42	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	85.8	13.0	0.0	0.0	0.0	0.0	5	6	7	8
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		91.4		91.4		18.6		18.6
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						13.5		6.3
Green Extension Time (g_e), s		0.0		0.0		0.1		0.4
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.07

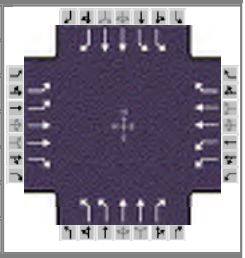
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	24	854	417	35	1345	667	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	204	1698	1656	418	1698	1682	1382	1543			1486	
Queue Service Time (g_s), s	9.2	12.1	12.2	6.0	21.5	21.7	7.4	3.9			0.0	
Cycle Queue Clearance Time (g_c), s	27.4	12.1	12.2	15.8	21.5	21.7	11.5	3.9			4.3	
Green Ratio (*g/C*)	0.78	0.78	0.78	0.78	0.78	0.78	0.12	0.12			0.12	
Capacity (*c*), veh/h	188	2666	1300	351	2666	1320	170	175			212	
Volume-to-Capacity Ratio (*X*)	0.125	0.320	0.321	0.100	0.505	0.505	0.553	0.337			0.167	
Available Capacity (c_a), veh/h	188	2666	1300	351	2666	1320	195	202			239	
Back of Queue (*Q*), veh/ln (95th percentile)	0.7	7.4	7.4	0.9	9.7	9.8	4.8	2.8			1.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.13	0.15	0.15	0.15	0.08	0.08	0.82	0.14			0.08	
Uniform Delay (d_1), s/veh	14.6	6.2	6.2	11.0	7.4	7.5	50.4	45.0			44.2	
Incremental Delay (d_2), s/veh	1.3	0.3	0.6	0.1	0.2	0.3	2.8	1.1			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	
Control Delay (*d*), s/veh	15.9	6.5	6.9	11.1	7.5	7.8	53.2	46.1			44.5	
Level of Service (LOS)	B	A	A	B	A	A	D	D			D	
Approach Delay, s/veh / LOS	6.8	A		7.7	A		50.5	D		44.5	D	
Intersection Delay, s/veh / LOS	9.6						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.2	A	1.6	A	0.7	A	0.5	A

Copyright © 2016 University of Florida, All Rights Reserved.

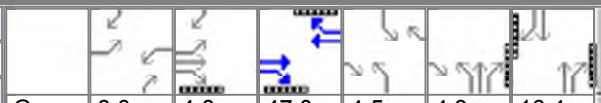
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2A_AM.xus				
Project Description	2035 NB AM				

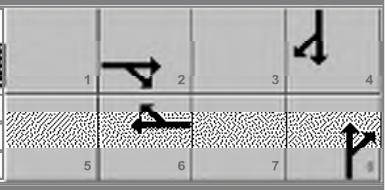


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	260	690	130	140	1080	130	350	520	100	70	310	310

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	86	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.0	4.8	47.0	4.5	4.3	13.4
Yellow	3.6	0.0	3.6	3.6	3.6	3.6
Red	2.0	0.0	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	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	18.4	57.4	13.6	52.6	20.0	28.9	10.1	19.0
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	12.6		7.6		15.8	21.0	4.7	13.7
Green Extension Time (g_e), s	0.2	0.0	0.5	0.0	0.0	1.2	0.2	0.0
Phase Call Probability	1.00		0.99		1.00	1.00	0.92	1.00
Max Out Probability	1.00		0.00		1.00	1.00	0.00	1.00

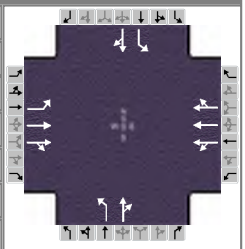
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	306	812	129	165	1271	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	10.6	17.0	3.7	5.6	39.1	5.0	13.8	19.0	5.3	2.7	11.7	0.0
Cycle Queue Clearance Time (g_c), s	10.6	17.0	3.7	5.6	39.1	5.0	13.8	19.0	5.3	2.7	11.7	0.0
Green Ratio (*g/C*)	0.12	0.47	0.60	0.07	0.43	0.47	0.13	0.21	0.29	0.04	0.12	0.24
Capacity (*c*), veh/h	366	1521	865	230	1381	674	427	711	426	134	409	356
Volume-to-Capacity Ratio (*X*)	0.837	0.534	0.150	0.716	0.920	0.210	0.964	0.860	0.235	0.615	0.891	0.000
Available Capacity (c_a), veh/h	411	1521	865	640	1381	674	427	711	426	487	409	356
Back of Queue (*Q*), veh/ln (95th percentile)	8.4	9.5	2.1	4.1	20.4	2.9	11.8	13.1	3.4	2.1	9.8	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.46	0.08	0.31	0.61	0.53	0.77	1.33	0.33	0.57	0.43	0.25	0.00
Uniform Delay (d_1), s/veh	49.5	16.1	7.9	48.5	22.0	12.7	45.1	37.9	27.3	51.1	45.4	0.0
Incremental Delay (d_2), s/veh	12.4	1.3	0.3	4.1	11.4	0.7	34.1	10.4	0.3	4.5	20.9	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	61.9	17.4	8.3	52.6	33.3	13.4	79.3	48.3	27.6	55.7	66.3	0.0
Level of Service (LOS)	E	B	A	D	C	B	E	D	C	E	E	
Approach Delay, s/veh / LOS	27.4	C		33.6	C		57.8	E		64.3	E	
Intersection Delay, s/veh / LOS	41.1						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

Copyright © 2016 University of Florida, All Rights Reserved.

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 & Franklin Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-2A_PM.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	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



							1	2	3	4
Green	83.3	10.5	0.0	0.0	0.0	0.0	5	6	7	8
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		88.9		88.9		16.1		16.1
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						10.4		7.2
Green Extension Time (g_e), s		0.0		0.0		0.2		0.4
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.15

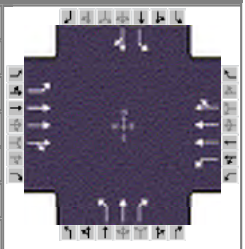
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	872	870	350	377	370	43	32		43	75	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	503	1698	1691	1419	1545	1514	1319	1576		1371	1529	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	6.4	6.5	3.4	2.0		3.1	4.9	
Cycle Queue Clearance Time (g_c), s	8.1	0.0	0.0	5.2	6.4	6.5	8.4	2.0		5.2	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	437	1347	1341	1162	1226	1201	137	158		178	153	
Volume-to-Capacity Ratio (*X*)	0.197	0.647	0.649	0.301	0.307	0.308	0.314	0.205		0.241	0.492	
Available Capacity (c_a), veh/h	437	1347	1341	1162	1226	1201	186	216		229	210	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	1.6	1.6	2.9	3.2	3.2	2.1	1.4		2.0	3.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.04	0.04	0.10	0.11	0.11	0.70	0.07		0.67	0.18	
Uniform Delay (d_1), s/veh	0.3	0.0	0.0	2.5	2.7	2.7	48.8	43.4		45.9	44.7	
Incremental Delay (d_2), s/veh	1.0	2.4	2.4	0.6	0.6	0.6	1.3	0.6		0.7	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		0.0	0.0	
Control Delay (*d*), s/veh	1.3	2.4	2.4	3.2	3.3	3.3	50.1	44.0		46.6	47.2	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	2.4	A		3.3	A		47.5	D		47.0	D	
Intersection Delay, s/veh / LOS	5.5						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

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_PM.xus				
Project Description	2035 NB PM				

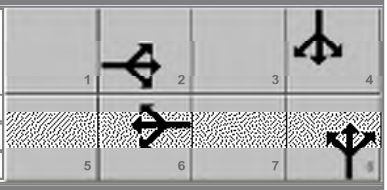


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1490	150	70	920	60	70	30	60	50	100	30

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	89	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	79.4	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		85.0		85.0		20.0		20.0
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						16.4		10.1
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		1.00

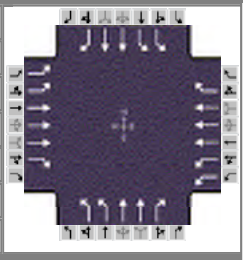
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	1194	569	75	710	344	75	32	65	54	140	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	513	1698	1616	260	1698	1643	1244	1765	1496	1371	1694	
Queue Service Time (g_s), s	1.3	13.6	13.6	8.9	4.3	4.0	6.3	1.7	4.1	3.8	8.1	
Cycle Queue Clearance Time (g_c), s	5.6	13.6	13.6	26.3	4.3	4.0	14.4	1.7	4.1	5.5	8.1	
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	436	2568	1222	231	2568	1242	143	242	205	235	232	
Volume-to-Capacity Ratio (*X*)	0.049	0.465	0.466	0.325	0.276	0.277	0.528	0.133	0.315	0.229	0.602	
Available Capacity (c_a), veh/h	436	2568	1222	231	2568	1242	143	242	205	235	232	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	7.2	7.1	1.5	2.3	2.2	3.8	1.3	2.8	2.3	6.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.05	0.25	0.25	0.25	0.08	0.08	0.39	0.07	0.57	0.60	0.34	
Uniform Delay (d_1), s/veh	4.3	4.7	4.7	6.1	2.3	2.1	49.4	39.8	40.8	42.2	42.6	
Incremental Delay (d_2), s/veh	0.2	0.4	0.9	3.3	0.2	0.5	3.6	0.2	0.9	0.5	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	0.0	
Control Delay (*d*), s/veh	4.5	5.1	5.6	9.4	2.5	2.6	53.0	40.1	41.7	42.7	46.9	
Level of Service (LOS)	A	A	A	A	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	5.3	A		3.0	A		46.4	D		45.7	D	
Intersection Delay, s/veh / LOS	9.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.5	A	1.1	A	0.8	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_PM.xus				
Project Description	2035 NB PM				

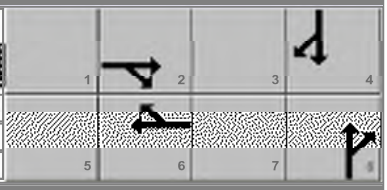


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	220	1180	200	240	680	210	210	520	360	360	530	160

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	4	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.8	18.0	12.1	15.3	0.6	15.4
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	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	15.4	39.1	17.7	41.4	21.0	27.3	20.9	27.2
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	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	9.5		10.2		8.5	23.5	14.1	18.9
Green Extension Time (g_e), s	0.3	0.0	1.8	0.0	3.1	0.0	1.2	2.6
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		0.65	1.00	0.04	0.08

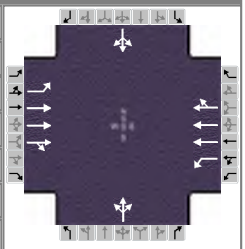
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1269	215	258	731	222	226	559	387	387	570	142
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1542	1439	1570	1542	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	7.5	25.5	8.0	8.2	13.9	10.6	6.5	16.5	21.5	12.1	16.9	7.4
Cycle Queue Clearance Time (g_c), s	7.5	25.5	8.0	8.2	13.9	10.6	6.5	16.5	21.5	12.1	16.9	7.4
Green Ratio (*g/C*)	0.09	0.32	0.46	0.11	0.34	0.49	0.15	0.21	0.32	0.15	0.20	0.30
Capacity (*c*), veh/h	293	1475	668	358	1576	700	469	683	473	471	682	442
Volume-to-Capacity Ratio (*X*)	0.808	0.860	0.322	0.720	0.464	0.316	0.482	0.819	0.819	0.822	0.836	0.321
Available Capacity (c_a), veh/h	381	1475	668	398	1576	700	474	688	475	761	1002	584
Back of Queue (*Q*), veh/ln (95th percentile)	5.2	13.8	4.5	6.1	9.4	7.2	4.6	11.3	9.7	8.4	11.1	3.1
Queue Storage Ratio (*RQ*) (95th percentile)	0.68	0.50	0.79	0.64	0.19	0.84	0.68	0.33	0.99	0.95	0.49	0.80
Uniform Delay (d_1), s/veh	39.0	25.4	12.3	43.0	30.6	18.6	38.8	36.3	4.0	41.0	36.5	5.6
Incremental Delay (d_2), s/veh	8.6	6.1	1.1	5.3	0.9	1.1	0.8	7.7	10.8	3.9	4.1	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	0.0
Control Delay (*d*), s/veh	47.5	31.5	13.4	48.3	31.5	19.8	39.6	44.0	14.8	44.8	40.6	6.0
Level of Service (LOS)	D	C	B	D	C	B	D	D	B	D	D	A
Approach Delay, s/veh / LOS	31.4	C		33.0	C		33.5	C		37.6	D	
Intersection Delay, s/veh / LOS	33.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	3.5	C	3.5	C
Bicycle LOS Score / LOS	1.4	A	1.2	A	1.5	A	1.4	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_PM.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	25	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	83.7	10.1	0.0	0.0	0.0	0.0	5	6	7	8
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		89.3		89.3		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						6.0		10.0
Green Extension Time (g_e), s		0.0		0.0		0.4		0.2
Phase Call Probability						1.00		1.00
Max Out Probability						0.06		0.89

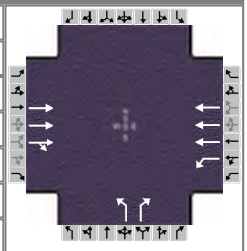
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	1336	653	65	801	393		65			118	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	450	1698	1654	209	1698	1665		1510			1516	
Queue Service Time (g_s), s	1.2	9.6	8.7	8.4	4.8	4.8		0.0			3.9	
Cycle Queue Clearance Time (g_c), s	6.6	9.6	8.7	20.4	4.8	4.8		4.0			8.0	
Green Ratio (*g*/*C*)	0.80	0.80	0.80	0.80	0.80	0.80		0.10			0.10	
Capacity (*c*), veh/h	406	2707	1318	216	2707	1327		191			196	
Volume-to-Capacity Ratio (*X*)	0.132	0.494	0.495	0.299	0.296	0.296		0.338			0.604	
Available Capacity (c_a), veh/h	406	2707	1318	216	2707	1327		251			256	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	3.7	3.4	0.9	2.1	2.2		2.9			5.7	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.07	0.07	0.16	0.05	0.06		0.15			0.29	
Uniform Delay (d_1), s/veh	1.2	2.0	1.8	4.0	1.9	1.9		44.7			46.4	
Incremental Delay (d_2), s/veh	0.3	0.3	0.6	3.4	0.3	0.5		1.0			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	1.5	2.3	2.3	7.4	2.2	2.4		45.7			49.4	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	2.3	A		2.5	A		45.7	D		49.4	D	
Intersection Delay, s/veh / LOS	4.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.2	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

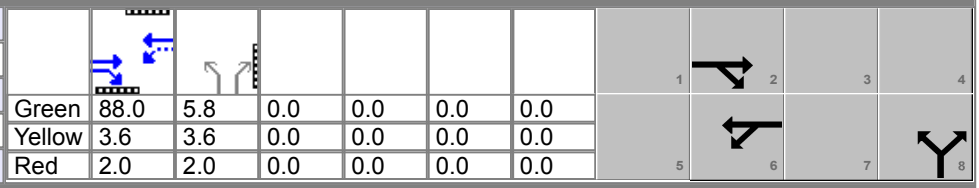
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2A_PM.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	12	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	88.0	5.8	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		
Case Number		8.0		6.0		9.0		
Phase Duration, s		93.6		93.6		11.4		
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 (*gs*), s						6.0		
Green Extension Time (*ge*), s		0.0		0.0		0.1		
Phase Call Probability						0.96		
Max Out Probability						0.88		

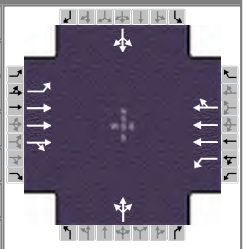
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		1333	646	86	1194		65		43			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1639	211	1542		1681		1496			
Queue Service Time (*gs*), s		13.9	11.9	23.7	6.6		4.0		2.9			
Cycle Queue Clearance Time (*gc*), s		13.9	11.9	36.2	6.6		4.0		2.9			
Green Ratio (*g*/*C*)		0.84	0.84	0.84	0.84		0.06		0.06			
Capacity (*c*), veh/h		2846	1374	217	3876		93		83			
Volume-to-Capacity Ratio (*X*)		0.468	0.470	0.396	0.308		0.694		0.520			
Available Capacity (*ca*), veh/h		2846	1374	217	3876		166		148			
Back of Queue (*Q*), veh/ln (95th percentile)		4.5	4.8	2.2	2.2		3.4		2.2			
Queue Storage Ratio (*RQ*) (95th percentile)		0.12	0.13	0.38	0.04		0.43		0.28			
Uniform Delay (*d1*), s/veh		2.5	2.5	8.5	2.1		48.7		48.2			
Incremental Delay (*d2*), s/veh		0.5	1.0	4.9	0.2		8.9		5.0			
Initial Queue Delay (*d3*), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		3.0	3.5	13.4	2.3		57.6		53.2			
Level of Service (LOS)		A	A	B	A		E		D			
Approach Delay, s/veh / LOS	3.2	A		3.1	A		55.9	E		0.0		
Intersection Delay, s/veh / LOS	4.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	3.3	C	3.2	C
Bicycle LOS Score / LOS	1.6	A	1.2	A		F		

Copyright © 2016 University of Florida, All Rights Reserved.

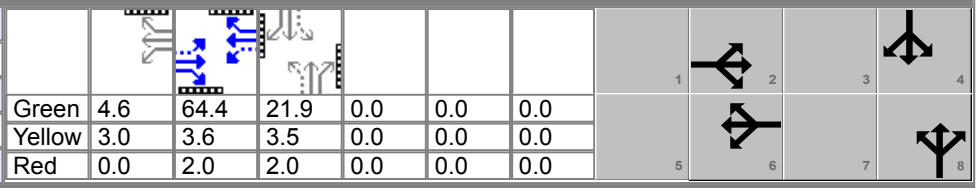
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2A_PM.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	48	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.6	64.4	21.9	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		70.0	7.6	77.6		27.4		27.4
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			4.6			9.4		21.8
Green Extension Time (g_e), s		0.0	0.1	0.0		1.2		0.1
Phase Call Probability			0.97			1.00		1.00
Max Out Probability			1.00			0.02		1.00

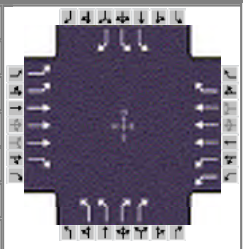
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	1208	598	118	879	422		129			237	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	406	1698	1682	1617	1698	1631		1572			1246	
Queue Service Time (g_s), s	9.7	18.6	18.6	2.6	14.1	13.2		0.0			12.4	
Cycle Queue Clearance Time (g_c), s	17.1	18.6	18.6	2.6	14.1	13.2		7.4			19.8	
Green Ratio (*g*/*C*)	0.61	0.61	0.61	0.68	0.69	0.69		0.21			0.21	
Capacity (*c*), veh/h	292	2084	1032	247	2328	1118		368			315	
Volume-to-Capacity Ratio (*X*)	0.294	0.580	0.580	0.478	0.377	0.378		0.350			0.752	
Available Capacity (c_a), veh/h	292	2084	1032	294	2328	1118		377			322	
Back of Queue (*Q*), veh/ln (95th percentile)	1.8	9.4	9.7	1.7	8.8	7.9		5.2			11.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.31	0.15	0.15	0.30	0.37	0.33		0.13			0.28	
Uniform Delay (d_1), s/veh	9.7	8.7	8.7	10.3	9.5	8.5		35.8			41.4	
Incremental Delay (d_2), s/veh	2.3	1.0	2.1	1.2	0.4	0.8		0.6			9.3	
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	12.0	9.8	10.8	11.5	9.9	9.3		36.4			50.8	
Level of Service (LOS)	B	A	B	B	A	A		D			D	
Approach Delay, s/veh / LOS	10.2	B		9.9	A		36.4	D		50.8	D	
Intersection Delay, s/veh / LOS	13.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.5	A	1.3	A	0.7	A	0.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

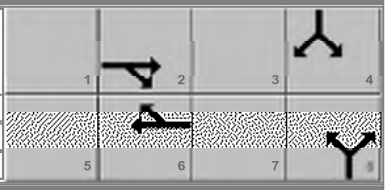
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-2A_PM.xus				
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	70	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	28.9	2.0	35.9	14.7	1.0	0.0
Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Red	4.5	0.0	4.5	2.7	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	2.0	3.0	2.0	3.0	1.1	3.0	1.1	3.0
Phase Duration, s	37.0	44.0	39.0	46.0	21.0	1.0	21.0	1.0
Change Period, ($Y+R_c$), s	8.1	8.1	8.1	8.1	6.3	0.0	6.3	0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0	4.1	4.3	4.1	4.3
Queue Clearance Time (g_s), s	13.7		8.4		14.6	3.0	16.7	3.0
Green Extension Time (g_e), s	1.3	0.0	1.9	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	0.00		0.00		1.00	1.00	1.00	1.00

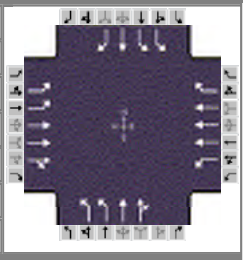
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	344	1290	0	441	753	0	376		538	441		237
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1515	1528	1350	1529	1491	1350	1520		1239	1529		1394
Queue Service Time (g_s), s	11.7	23.5	0.0	6.4	13.5	0.0	12.6		1.0	14.7		1.0
Cycle Queue Clearance Time (g_c), s	11.7	23.5	0.0	6.4	13.5	0.0	12.6		1.0	14.7		1.0
Green Ratio (*g/C*)	0.28	0.34	0.34	0.29	0.36	0.36	0.15		0.30	0.15		0.28
Capacity (*c*), veh/h	834	1567	462	900	1614	487	563		753	565		397
Volume-to-Capacity Ratio (*X*)	0.413	0.823	0.000	0.490	0.466	0.000	0.669		0.714	0.780		0.596
Available Capacity (c_a), veh/h	834	1567	462	900	1614	487	563		753	565		397
Back of Queue (*Q*), veh/ln (95th percentile)	8.3	10.0	0.0	3.2	8.0	0.0	8.8		10.2	10.5		9.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.09	0.42	0.00	0.42	0.30	0.00	0.58		0.77	0.73		0.79
Uniform Delay (d_1), s/veh	42.7	18.9	0.0	10.9	25.4	0.0	43.3		32.5	44.4		32.3
Incremental Delay (d_2), s/veh	1.2	4.0	0.0	1.5	0.7	0.0	6.2		3.2	10.2		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	0.0		0.0
Control Delay (*d*), s/veh	43.8	22.9	0.0	12.4	26.2	0.0	49.5		35.7	54.6		34.8
Level of Service (LOS)	D	C		B	C		D		D	D		C
Approach Delay, s/veh / LOS	27.3	C		21.1	C		41.4	D		47.7	D	
Intersection Delay, s/veh / LOS	31.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	3.9	D	4.0	D
Bicycle LOS Score / LOS	1.4	A	1.1	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_PM.xus				
Project Description	2035 NB PM				

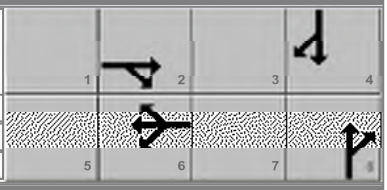


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	360	1530	240	40	970	360	170	190	140	450	310	250

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	104	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	13.5	38.7	8.1	5.6	13.0	0.0
Yellow	3.0	3.6	3.0	3.0	3.6	0.0
Red	2.0	2.0	2.0	2.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	4.0		5.3	2.0	4.0	2.0	3.0
Phase Duration, s	18.5	62.8		44.3	13.1	18.6	23.7	29.2
Change Period, (Y+R_c), s	5.0	5.6		5.6	5.0	5.6	5.0	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	13.4				7.8	12.5	17.0	21.0
Green Extension Time (g_e), s	0.1	0.0		0.0	0.3	0.5	1.6	1.3
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				0.20	1.00	0.06	1.00

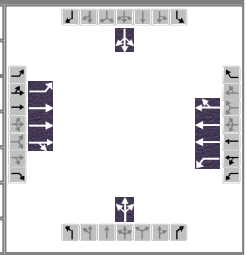
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	362	1194	560	43	1043	357	183	170	158	484	333	225
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1589	262	1542	1439	1632	1765	1546	1632	1765	1496
Queue Service Time (g_s), s	11.4	19.8	20.7	9.4	14.7	12.2	5.8	9.8	10.5	15.0	19.0	12.0
Cycle Queue Clearance Time (g_c), s	11.4	19.8	20.7	11.9	14.7	12.2	5.8	9.8	10.5	15.0	19.0	12.0
Green Ratio (*g/C*)	0.13	0.54	0.54	0.37	0.37	0.55	0.08	0.12	0.12	0.18	0.22	0.35
Capacity (*c*), veh/h	403	1849	865	160	1704	786	250	218	191	581	396	528
Volume-to-Capacity Ratio (*X*)	0.898	0.645	0.647	0.268	0.612	0.454	0.730	0.782	0.827	0.833	0.841	0.426
Available Capacity (c_a), veh/h	413	1849	865	160	1704	786	435	231	202	870	409	539
Back of Queue (*Q*), veh/ln (95th percentile)	4.9	7.0	7.4	1.1	7.1	4.8	4.4	8.9	8.9	10.5	14.8	7.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.64	0.26	0.28	0.15	0.18	0.63	0.56	0.25	0.25	0.32	0.38	1.30
Uniform Delay (d_1), s/veh	31.8	9.8	10.6	15.5	15.8	8.2	47.4	44.7	44.9	41.7	38.9	25.9
Incremental Delay (d_2), s/veh	6.0	0.4	0.8	3.5	1.4	1.6	4.1	15.2	22.9	4.5	14.3	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	0.0
Control Delay (*d*), s/veh	37.8	10.2	11.4	19.1	17.2	9.8	51.5	59.8	67.8	46.1	53.2	26.4
Level of Service (LOS)	D	B	B	B	B	A	D	E	E	D	D	C
Approach Delay, s/veh / LOS	15.2	B		15.4	B		59.3	E		44.1	D	
Intersection Delay, s/veh / LOS	25.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	1.7	A	1.3	A	0.9	A	2.2	B

Copyright © 2016 University of Florida, All Rights Reserved.

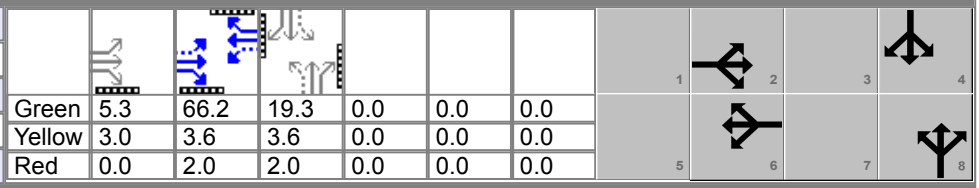
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2A_PM.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	89	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.3	66.2	19.3	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	8.3	80.1		71.8		24.9		24.9
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	5.2					8.6		18.8
Green Extension Time (g_e), s	0.2	0.0		0.0		1.0		0.4
Phase Call Probability	0.99					1.00		1.00
Max Out Probability	0.52					0.01		1.00

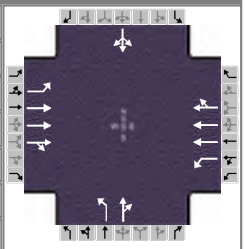
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	154	1362	659	43	1013	481		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1634	202	1698	1614		1434			1323	
Queue Service Time (g_s), s	3.2	17.9	18.4	16.6	20.8	20.7		0.0			10.1	
Cycle Queue Clearance Time (g_c), s	3.2	17.9	18.4	25.3	20.8	20.7		6.6			16.8	
Green Ratio (*g*/*C*)	0.70	0.71	0.71	0.63	0.63	0.63		0.18			0.18	
Capacity (*c*), veh/h	296	2411	1160	177	2142	1018		311			297	
Volume-to-Capacity Ratio (*X*)	0.519	0.565	0.568	0.243	0.473	0.473		0.346			0.723	
Available Capacity (c_a), veh/h	371	2411	1160	177	2142	1018		354			339	
Back of Queue (*Q*), veh/ln (95th percentile)	1.9	7.8	8.0	1.6	12.9	12.6		4.5			9.9	
Queue Storage Ratio (*RQ*) (95th percentile)	0.33	0.19	0.20	0.27	0.26	0.25		0.23			0.50	
Uniform Delay (d_1), s/veh	10.2	5.9	6.1	19.1	15.2	15.0		37.6			42.2	
Incremental Delay (d_2), s/veh	0.9	0.6	1.3	3.0	0.7	1.4		0.7			6.4	
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	11.1	6.5	7.4	22.1	15.8	16.5		38.3			48.6	
Level of Service (LOS)	B	A	A	C	B	B		D			D	
Approach Delay, s/veh / LOS	7.1	A		16.2	B		38.3	D		48.6	D	
Intersection Delay, s/veh / LOS	13.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.1	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.7	A	1.3	A	0.7	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2A_PM.xus				
Project Description	2035 NB PM				

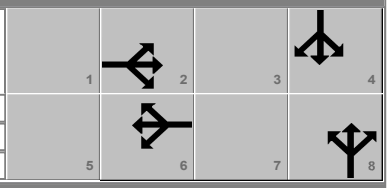


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	1820	150	40	1340	30	80	10	60	30	10	10

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	61	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	76.2	4.3	7.7	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	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		4
Case Number		6.0		6.0		10.0		12.0
Phase Duration, s		81.8		81.8		13.3		9.9
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		4.2
Queue Clearance Time (g_s), s						7.3		5.4
Green Extension Time (g_e), s		0.0		0.0		0.5		0.1
Phase Call Probability						0.99		0.79
Max Out Probability						0.00		0.00

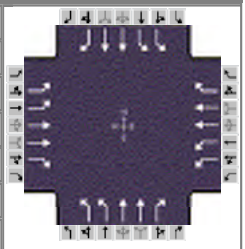
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	31	1368	661	43	986	487	86	75			54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	344	1698	1630	201	1698	1678	1681	1529			1655	
Queue Service Time (g_s), s	5.9	25.4	25.8	16.5	10.4	10.5	5.3	5.0			3.4	
Cycle Queue Clearance Time (g_c), s	15.9	25.4	25.8	41.4	10.4	10.5	5.3	5.0			3.4	
Green Ratio (*g*/*C*)	0.73	0.73	0.73	0.73	0.73	0.73	0.07	0.07			0.04	
Capacity (*c*), veh/h	283	2465	1183	164	2465	1218	123	112			68	
Volume-to-Capacity Ratio (*X*)	0.109	0.555	0.559	0.262	0.400	0.400	0.701	0.674			0.788	
Available Capacity (c_a), veh/h	283	2465	1183	164	2465	1218	391	356			227	
Back of Queue (*Q*), veh/ln (95th percentile)	0.8	14.2	14.2	1.4	5.0	5.1	4.4	3.8			3.1	
Queue Storage Ratio (*RQ*) (95th percentile)	0.14	0.28	0.28	0.25	0.04	0.04	0.74	0.19			0.16	
Uniform Delay (d_1), s/veh	12.3	10.9	11.1	19.6	4.6	4.7	47.5	47.5			49.9	
Incremental Delay (d_2), s/veh	0.6	0.7	1.5	2.3	0.3	0.6	7.1	6.9			17.9	
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	
Control Delay (*d*), s/veh	12.9	11.6	12.6	21.8	4.9	5.3	54.6	54.3			67.8	
Level of Service (LOS)	B	B	B	C	A	A	D	D			E	
Approach Delay, s/veh / LOS	11.9	B		5.5	A		54.5	D		67.8	E	
Intersection Delay, s/veh / LOS	12.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.7	A	1.3	A	0.8	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

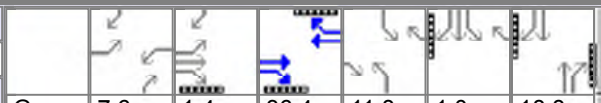
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2A_PM.xus				
Project Description	2035 NB PM				

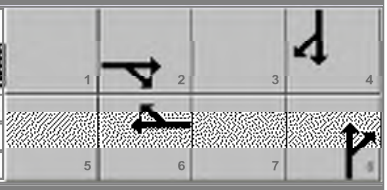


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	340	1230	340	150	760	70	270	390	270	310	440	380

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	90	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.6	1.4	36.4	11.8	1.0	18.8
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
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	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	20.2	49.1	13.2	42.0	17.4	24.4	18.4	25.4
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	13.6		7.2		11.0	17.4	12.4	15.6
Green Extension Time (g_e), s	1.0	0.0	0.4	0.0	0.8	1.4	0.4	2.5
Phase Call Probability	1.00		0.99		1.00	1.00	1.00	1.00
Max Out Probability	0.07		0.00		0.08	1.00	1.00	0.80

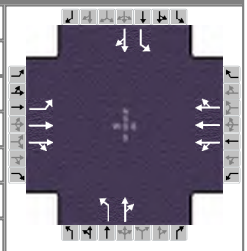
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	351	1268	311	161	817	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	11.6	38.9	12.2	5.2	21.5	2.5	9.0	12.0	15.4	10.4	13.6	0.0
Cycle Queue Clearance Time (g_c), s	11.6	38.9	12.2	5.2	21.5	2.5	9.0	12.0	15.4	10.4	13.6	0.0
Green Ratio (*g/C*)	0.14	0.41	0.53	0.07	0.35	0.47	0.11	0.18	0.25	0.12	0.19	0.33
Capacity (*c*), veh/h	437	1339	757	226	1122	675	366	600	375	398	633	490
Volume-to-Capacity Ratio (*X*)	0.802	0.948	0.411	0.712	0.729	0.107	0.793	0.699	0.657	0.837	0.747	0.000
Available Capacity (c_a), veh/h	678	1339	757	528	1122	675	603	639	392	479	673	508
Back of Queue (*Q*), veh/ln (95th percentile)	8.4	20.4	7.0	3.8	12.3	1.5	6.7	8.5	9.4	8.1	9.5	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.47	0.17	1.05	0.57	0.32	0.39	0.75	0.22	1.60	1.65	0.24	0.00
Uniform Delay (d_1), s/veh	49.0	23.6	12.2	46.4	24.2	12.7	43.5	37.4	32.7	42.9	37.0	0.0
Incremental Delay (d_2), s/veh	3.1	12.7	1.3	4.1	4.2	0.3	3.9	3.1	3.7	10.6	4.3	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	52.2	36.3	13.5	50.5	28.4	13.0	47.4	40.6	36.4	53.5	41.3	0.0
Level of Service (LOS)	D	D	B	D	C	B	D	D	D	D	D	
Approach Delay, s/veh / LOS	35.5	D		30.7	C		41.6	D		46.4	D	
Intersection Delay, s/veh / LOS	37.5						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

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2B&C_AM.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



							1	2	3	4
Green	83.4	10.4	0.0	0.0	0.0	0.0	5	6	7	8
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

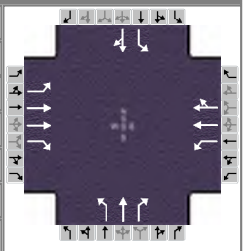
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	410	402	617	567	557	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	269	1698	1663	1680	1545	1516	1297	1619		1382	1525	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	9.6	9.6	1.9	1.4		1.7	6.2	
Cycle Queue Clearance Time (g_c), s	14.0	0.0	0.0	9.5	9.6	9.6	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	258	1350	1322	1370	1228	1205	117	159		184	150	
Volume-to-Capacity Ratio (*X*)	0.273	0.304	0.304	0.450	0.462	0.462	0.202	0.148		0.128	0.627	
Available Capacity (c_a), veh/h	258	1350	1322	1370	1228	1205	179	237		250	224	
Back of Queue (*Q*), veh/ln (95th percentile)	0.4	0.4	0.4	4.5	4.2	4.2	1.1	1.0		1.1	4.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.01	0.01	0.16	0.15	0.15	0.38	0.05		0.36	0.23	
Uniform Delay (d_1), s/veh	0.8	0.0	0.0	2.4	2.4	2.4	49.6	43.3		44.9	45.5	
Incremental Delay (d_2), s/veh	2.6	0.6	0.6	0.8	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	3.4	0.6	0.6	3.1	3.3	3.3	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		3.2	A		47.1	D		48.8	D	
Intersection Delay, s/veh / LOS	5.1						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

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2B&C_AM.xus				
Project Description	2035 NB AM				

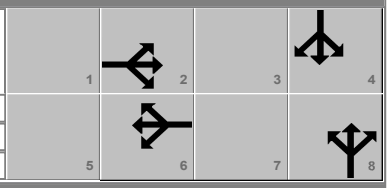


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	600	50	60	1290	30	160	40	20	30	30	30

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	105	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	73.2	20.6	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		5.0		6.0		5.0		6.0
Phase Duration, s		78.8		78.8		26.2		26.2
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						20.5		6.7
Green Extension Time (g_e), s		0.0		0.0		0.1		1.2
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.01

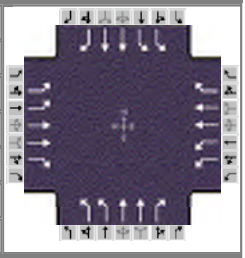
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	706	59	71	779	774	188	47	24	35	71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	319	1617	1439	711	1698	1684	1324	1765	1496	1353	1619	
Queue Service Time (g_s), s	6.1	9.2	1.4	1.6	14.7	14.6	14.6	2.3	1.3	2.3	3.8	
Cycle Queue Clearance Time (g_c), s	20.7	9.2	1.4	11.7	14.7	14.6	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	246	2253	1003	502	1183	1174	280	347	294	304	318	
Volume-to-Capacity Ratio (*X*)	0.143	0.313	0.059	0.141	0.658	0.660	0.672	0.136	0.080	0.116	0.222	
Available Capacity (c_a), veh/h	246	2253	1003	502	1183	1174	290	360	305	314	330	
Back of Queue (*Q*), veh/ln (95th percentile)	0.9	5.7	0.8	0.5	5.4	5.3	8.9	1.8	0.9	1.4	2.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.16	0.20	0.03	0.09	0.19	0.19	0.91	0.09	0.18	0.36	0.14	
Uniform Delay (d_1), s/veh	12.2	6.5	5.3	3.3	3.0	3.0	43.2	34.8	34.4	36.8	35.4	
Incremental Delay (d_2), s/veh	1.2	0.4	0.1	0.3	1.6	1.6	5.7	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	13.4	6.8	5.4	3.7	4.6	4.6	48.9	35.0	34.6	36.9	35.8	
Level of Service (LOS)	B	A	A	A	A	A	D	C	C	D	D	
Approach Delay, s/veh / LOS	7.0	A		4.6	A		45.1	D		36.2	D	
Intersection Delay, s/veh / LOS	10.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	2.8	C	3.0	C
Bicycle LOS Score / LOS	1.1	A	1.8	A	0.9	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2B&C_AM.xus				
Project Description	2035 NB AM				

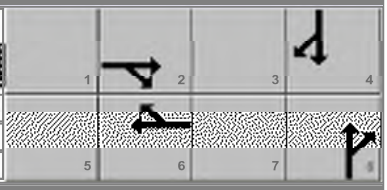


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	400	140	310	1090	210	150	400	180	160	370	140

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	103	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	28.4	16.4	8.2	2.2	9.7
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	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	12.0	46.0	22.0	56.0	15.3	23.2	13.8	21.7
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	6.3		13.7		7.4	16.2	7.9	15.3
Green Extension Time (g_e), s	0.2	0.0	3.4	0.0	1.6	1.3	0.3	0.7
Phase Call Probability	0.98		1.00		0.99	1.00	1.00	1.00
Max Out Probability	0.51		0.92		1.00	1.00	0.81	1.00

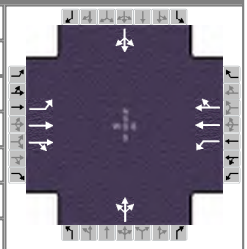
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	471	165	365	1282	208	176	471	212	188	435	98
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	4.3	9.9	6.3	11.7	32.9	6.2	5.4	14.2	11.7	5.9	13.3	5.6
Cycle Queue Clearance Time (g_c), s	4.3	9.9	6.3	11.7	32.9	6.2	5.4	14.2	11.7	5.9	13.3	5.6
Green Ratio (*g/C*)	0.06	0.38	0.48	0.16	0.48	0.56	0.09	0.17	0.32	0.08	0.15	0.21
Capacity (*c*), veh/h	190	1241	684	487	1550	802	296	555	477	252	507	315
Volume-to-Capacity Ratio (*X*)	0.680	0.379	0.241	0.748	0.827	0.260	0.597	0.848	0.444	0.748	0.859	0.310
Available Capacity (c_a), veh/h	342	1241	684	577	1550	802	358	619	505	382	580	348
Back of Queue (*Q*), veh/ln (95th percentile)	3.4	6.8	3.9	7.8	16.1	3.9	4.0	10.3	3.8	4.5	9.9	2.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.45	0.24	0.67	0.81	0.32	0.45	0.58	0.30	0.19	0.42	0.44	0.70
Uniform Delay (d_1), s/veh	51.1	19.9	13.6	42.4	17.2	8.7	44.3	39.5	5.5	46.0	40.8	2.1
Incremental Delay (d_2), s/veh	4.1	0.9	0.8	3.1	3.6	0.5	1.9	9.9	0.6	4.4	11.2	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	0.0
Control Delay (*d*), s/veh	55.2	20.7	14.4	45.5	20.8	9.3	46.2	49.4	6.1	50.5	52.0	2.7
Level of Service (LOS)	E	C	B	D	C	A	D	D	A	D	D	A
Approach Delay, s/veh / LOS	25.2	C		24.4	C		38.1	D		44.9	D	
Intersection Delay, s/veh / LOS	30.8						C					

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	1.1	A	2.0	B	1.2	A	1.1	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2B&C_AM.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	1	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	86.9	6.9	0.0	0.0	0.0	0.0	5	6	7	8
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		6.7
Green Extension Time (g_e), s		0.0		0.0		0.4		0.4
Phase Call Probability						0.98		0.98
Max Out Probability						0.00		0.00

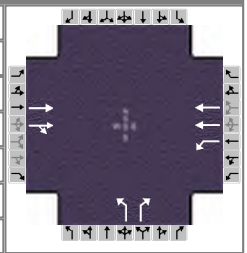
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	430	428	24	947	947		59			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	229	1698	1690	616	1698	1687		1613			1521	
Queue Service Time (g_s), s	0.3	0.6	0.6	0.8	22.0	22.3		0.0			1.2	
Cycle Queue Clearance Time (g_c), s	24.5	0.6	0.6	1.6	22.0	22.3		3.6			4.7	
Green Ratio (*g/C*)	0.83	0.83	0.83	0.83	0.83	0.83		0.07			0.07	
Capacity (*c*), veh/h	208	1406	1399	574	1406	1397		146			151	
Volume-to-Capacity Ratio (*X*)	0.056	0.306	0.306	0.041	0.674	0.678		0.402			0.469	
Available Capacity (c_a), veh/h	208	1406	1399	574	1406	1397		471			463	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	0.5	0.5	0.1	7.7	7.7		2.8			3.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.03	0.01	0.01	0.02	0.20	0.20		0.14			0.17	
Uniform Delay (d_1), s/veh	3.9	0.1	0.1	1.8	3.3	3.3		47.6			48.0	
Incremental Delay (d_2), s/veh	0.5	0.5	0.5	0.1	1.7	1.7		1.8			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	
Control Delay (*d*), s/veh	4.4	0.6	0.6	1.9	5.0	5.0		49.4			50.3	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	0.7	A		5.0	A		49.4	D		50.3	D	
Intersection Delay, s/veh / LOS	5.7						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	1.2	A	2.1	B	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

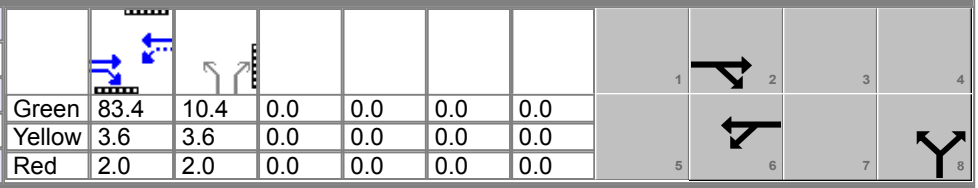
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2B&C_AM.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	93	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		
Case Number		8.0		6.0		9.0		
Phase Duration, s		89.0		89.0		16.0		
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						9.9		
Green Extension Time (g_e), s		0.0		0.0		0.6		
Phase Call Probability						1.00		
Max Out Probability						0.00		

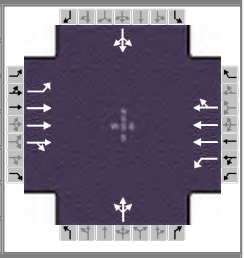
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		462	456	35	1788		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1675	583	1617		1681		1496			
Queue Service Time (g_s), s		12.9	9.2	0.6	9.0		7.9		4.7			
Cycle Queue Clearance Time (g_c), s		12.9	9.2	14.4	9.0		7.9		4.7			
Green Ratio (*g/C*)		0.79	0.79	0.79	0.79		0.10		0.10			
Capacity (*c*), veh/h		1348	1330	459	2567		167		149			
Volume-to-Capacity Ratio (*X*)		0.343	0.343	0.077	0.697		0.775		0.475			
Available Capacity (c_a), veh/h		1348	1330	459	2567		375		333			
Back of Queue (*Q*), veh/ln (95th percentile)		4.8	4.8	0.2	2.4		6.5		3.3			
Queue Storage Ratio (*RQ*) (95th percentile)		0.13	0.13	0.04	0.04		0.83		0.42			
Uniform Delay (d_1), s/veh		3.7	3.7	2.3	0.8		46.1		44.7			
Incremental Delay (d_2), s/veh		0.7	0.7	0.3	1.4		7.5		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		4.3	4.4	2.6	2.2		53.6		47.0			
Level of Service (LOS)		A	A	A	A		D		D			
Approach Delay, s/veh / LOS	4.3	A		2.2	A		51.3	D		0.0		
Intersection Delay, s/veh / LOS	6.2						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		

Copyright © 2016 University of Florida, All Rights Reserved.

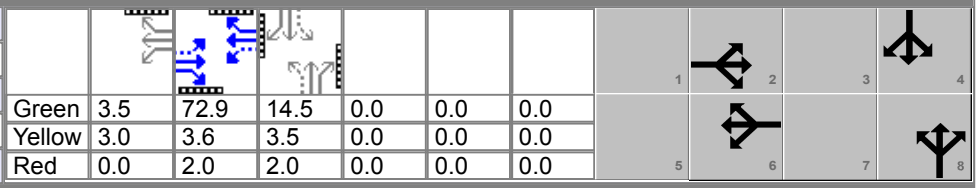
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2B&C_AM.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	53	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.5	72.9	14.5	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		78.5	6.5	85.0		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		4.3		4.3
Queue Clearance Time (g_s), s			3.2			9.1		15.3
Green Extension Time (g_e), s		0.0	0.0	0.0		0.5		0.0
Phase Call Probability			0.87			1.00		1.00
Max Out Probability			1.00			0.55		1.00

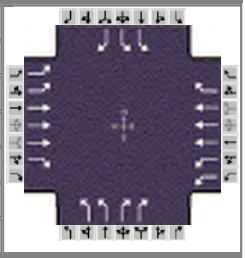
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	614	303	71	1269	613		118			165	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	231	1698	1675	1617	1698	1636		1559			1294	
Queue Service Time (g_s), s	6.8	7.9	8.0	1.2	5.9	5.3		0.0			6.2	
Cycle Queue Clearance Time (g_c), s	6.9	7.9	8.0	1.2	5.9	5.3		7.1			13.3	
Green Ratio (*g/C*)	0.69	0.69	0.69	0.75	0.76	0.76		0.14			0.14	
Capacity (*c*), veh/h	229	2358	1163	483	2568	1237		256			230	
Volume-to-Capacity Ratio (*X*)	0.154	0.260	0.261	0.146	0.494	0.496		0.459			0.716	
Available Capacity (c_a), veh/h	229	2358	1163	491	2568	1237		256			230	
Back of Queue (*Q*), veh/ln (95th percentile)	0.7	4.9	5.0	0.6	2.1	2.1		5.2			8.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.13	0.08	0.08	0.11	0.09	0.09		0.13			0.22	
Uniform Delay (d_1), s/veh	7.1	6.9	7.0	4.2	1.3	1.1		42.0			45.0	
Incremental Delay (d_2), s/veh	1.4	0.3	0.5	0.1	0.4	0.8		1.3			10.1	
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	8.5	7.1	7.5	4.2	1.7	1.9		43.3			55.1	
Level of Service (LOS)	A	A	A	A	A	A		D			E	
Approach Delay, s/veh / LOS	7.3	A		1.8	A		43.3	D		55.1	E	
Intersection Delay, s/veh / LOS	7.8						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.6	A	0.7	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2B&C_AM.xus				
Project Description	2035 NB AM				

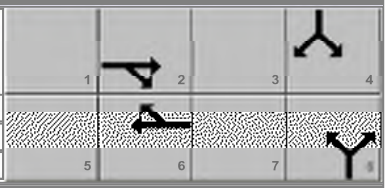


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	140	520	280	480	1000	470	300		470	200		320

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	53	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	30.9	4.0	33.9	12.7	1.0	0.0
Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Red	4.5	0.0	4.5	2.7	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	2.0	3.0	2.0	3.0	1.1	3.0	1.1	3.0
Phase Duration, s	42.0	46.0	39.0	43.0	19.0	1.0	19.0	1.0
Change Period, ($Y+R_c$), s	8.1	8.1	8.1	8.1	6.3	0.0	6.3	0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0	4.1	4.3	4.1	4.3
Queue Clearance Time (g_s), s	6.3		16.8		14.0	3.0	9.8	3.0
Green Extension Time (g_e), s	3.8	0.0	2.2	0.0	0.0	0.0	0.2	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.00		0.03		1.00	1.00	1.00	1.00

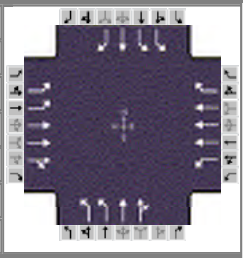
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	165	612	0	565	1176	0	353		553	235		376
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1490	1481	1350	1548	1520	1350	1517		1240	1500		1421
Queue Service Time (g_s), s	4.3	11.2	0.0	14.8	22.6	0.0	12.0		1.0	7.8		1.0
Cycle Queue Clearance Time (g_c), s	4.3	11.2	0.0	14.8	22.6	0.0	12.0		1.0	7.8		1.0
Green Ratio (*g/C*)	0.32	0.36	0.36	0.29	0.33	0.33	0.13		0.30	0.13		0.33
Capacity (*c*), veh/h	962	1604	487	911	1516	449	504		754	500		472
Volume-to-Capacity Ratio (*X*)	0.171	0.381	0.000	0.620	0.776	0.000	0.700		0.734	0.471		0.797
Available Capacity (c_a), veh/h	962	1604	487	911	1516	449	504		754	500		472
Back of Queue (*Q*), veh/ln (95th percentile)	2.8	7.4	0.0	7.2	10.1	0.0	8.6		10.6	5.4		9.3
Queue Storage Ratio (*RQ*) (95th percentile)	0.37	0.31	0.00	0.95	0.38	0.00	0.56		0.79	0.38		0.81
Uniform Delay (d_1), s/veh	26.4	26.6	0.0	25.2	24.5	0.0	44.9		32.7	43.1		11.4
Incremental Delay (d_2), s/veh	0.4	0.7	0.0	1.3	1.7	0.0	7.9		3.7	3.2		9.3
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	26.8	27.3	0.0	26.5	26.2	0.0	52.8		36.5	46.2		20.7
Level of Service (LOS)	C	C		C	C		D		D	D		C
Approach Delay, s/veh / LOS	27.2	C		26.3	C		42.8	D		30.5	C	
Intersection Delay, s/veh / LOS	30.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.8	C	4.2	D	3.9	D
Bicycle LOS Score / LOS	0.9	A	1.4	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

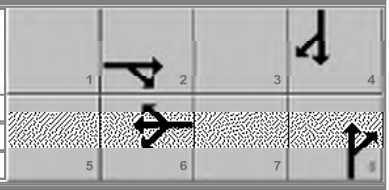
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2B&C_AM.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					EB			WB			NB			SB		
Cycle, s	105.0	Reference Phase	2		L	T	R	L	T	R	L	T	R	L	T	R
Offset, s	105	Reference Point	Begin	Green	11.9	40.5		11.6	0.5		19.3	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	2.0	2.0		2.0	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	4.0		5.3	2.0	4.0	2.0	3.0
Phase Duration, s	16.9	63.0		46.1	16.6	24.9	17.1	25.4
Change Period, (Y+R_c), s	5.0	5.6		5.6	5.0	5.6	5.0	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	11.7				11.3	13.7	11.2	19.0
Green Extension Time (g_e), s	0.2	0.0		0.0	0.3	2.3	0.9	0.8
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	0.62	0.02	1.00

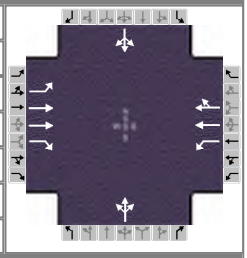
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	313	632	305	47	1600	345	294	209	205	294	294	271
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1630	573	1542	1439	1632	1765	1708	1632	1765	1496
Queue Service Time (g_s), s	9.7	5.2	4.6	3.6	30.9	12.3	9.3	11.5	11.7	9.2	17.0	16.2
Cycle Queue Clearance Time (g_c), s	9.7	5.2	4.6	3.6	30.9	12.3	9.3	11.5	11.7	9.2	17.0	16.2
Green Ratio (*g*/*C*)	0.11	0.55	0.55	0.39	0.39	0.50	0.11	0.18	0.18	0.12	0.19	0.30
Capacity (*c*), veh/h	356	1856	891	289	1784	721	360	325	314	376	333	452
Volume-to-Capacity Ratio (*X*)	0.880	0.341	0.342	0.163	0.897	0.478	0.817	0.645	0.652	0.782	0.882	0.599
Available Capacity (c_a), veh/h	389	1856	891	289	1784	721	435	341	330	684	350	466
Back of Queue (*Q*), veh/ln (95th percentile)	5.2	2.8	2.5	0.9	10.9	4.7	7.6	9.1	9.0	7.0	14.3	10.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.68	0.11	0.09	0.11	0.27	0.62	0.96	0.26	0.25	0.22	0.36	1.70
Uniform Delay (d_1), s/veh	31.4	5.1	4.4	12.5	17.5	9.6	45.7	39.7	39.7	45.2	41.4	31.2
Incremental Delay (d_2), s/veh	10.5	0.2	0.5	0.6	4.2	1.2	9.8	3.9	4.2	3.6	21.6	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	41.9	5.3	4.9	13.1	21.7	10.8	55.5	43.6	44.0	48.7	63.0	33.2
Level of Service (LOS)	D	A	A	B	C	B	E	D	D	D	E	C
Approach Delay, s/veh / LOS	14.4	B		19.6	B		48.6	D		48.7	D	
Intersection Delay, s/veh / LOS	27.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.1	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	1.3	A	1.6	A	1.1	A	1.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

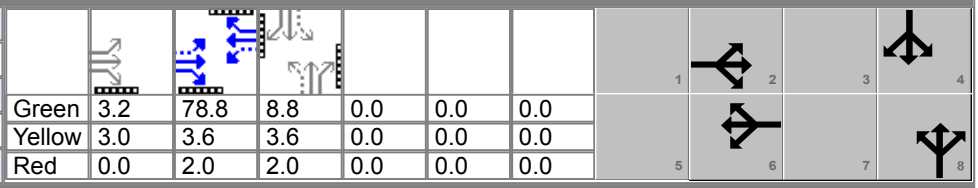
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2B&C_AM.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	99	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.2	78.8	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	3.0		6.3		8.0		8.0
Phase Duration, s	6.2	90.6		84.4		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	2.7					6.9		8.5
Green Extension Time (g_e), s	0.1	0.0		0.0		0.4		0.4
Phase Call Probability	0.79					0.99		0.99
Max Out Probability	0.00					0.00		0.00

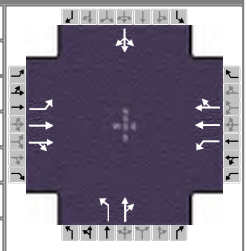
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	1122	43	59	1012	1012		71			94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	481	1698	1670		1440			1474	
Queue Service Time (g_s), s	0.7	10.8	0.6	6.9	47.5	49.1		0.0			1.8	
Cycle Queue Clearance Time (g_c), s	0.7	10.8	0.6	11.1	47.5	49.1		4.9			6.5	
Green Ratio (*g/C*)	0.80	0.81	0.81	0.75	0.75	0.75		0.08			0.08	
Capacity (*c*), veh/h	176	2618	1165	408	1275	1254		172			175	
Volume-to-Capacity Ratio (*X*)	0.307	0.428	0.037	0.144	0.793	0.807		0.411			0.539	
Available Capacity (c_a), veh/h	384	2618	1165	408	1275	1254		347			350	
Back of Queue (*Q*), veh/ln (95th percentile)	1.5	4.2	0.2	1.3	24.1	24.5		3.3			4.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.27	0.10	0.01	0.22	0.48	0.49		0.17			0.23	
Uniform Delay (d_1), s/veh	19.0	3.0	1.9	8.8	14.5	14.9		46.2			47.0	
Incremental Delay (d_2), s/veh	0.9	0.5	0.1	0.4	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	19.9	3.4	2.0	9.3	17.6	18.3		47.8			49.6	
Level of Service (LOS)	B	A	A	A	B	B		D			D	
Approach Delay, s/veh / LOS	4.1	A		17.7	B		47.8	D		49.6	D	
Intersection Delay, s/veh / LOS	14.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.6	A	2.2	B	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2B&C_AM.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	41	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	81.7	12.1	0.0	0.0	0.0	0.0	5	6	7	8
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		87.3		87.3		17.7		17.7
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						12.6		6.0
Green Extension Time (g_e), s		0.0		0.0		0.1		0.4
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.05

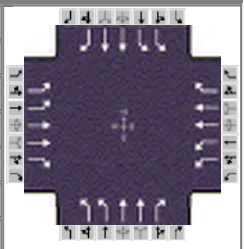
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	590	581	35	1006	1006	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	204	1698	1670	459	1698	1687	1382	1543			1514	
Queue Service Time (g_s), s	8.3	14.1	14.2	4.1	34.3	35.0	7.1	3.7			0.0	
Cycle Queue Clearance Time (g_c), s	41.8	14.1	14.2	17.6	34.3	35.0	10.6	3.7			4.0	
Green Ratio (*g*/*C*)	0.78	0.78	0.78	0.78	0.78	0.78	0.12	0.12			0.12	
Capacity (*c*), veh/h	161	1330	1308	367	1330	1322	174	170			212	
Volume-to-Capacity Ratio (*X*)	0.135	0.444	0.444	0.096	0.756	0.761	0.541	0.347			0.166	
Available Capacity (c_a), veh/h	161	1330	1308	367	1330	1322	212	212			253	
Back of Queue (*Q*), veh/ln (95th percentile)	0.7	7.5	7.4	0.7	11.6	11.8	4.6	2.6			1.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.13	0.15	0.15	0.11	0.10	0.10	0.78	0.13			0.08	
Uniform Delay (d_1), s/veh	19.6	4.8	4.8	9.0	6.6	6.7	48.1	43.2			42.5	
Incremental Delay (d_2), s/veh	1.6	1.0	1.0	0.1	0.9	1.0	2.6	1.2			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	
Control Delay (*d*), s/veh	21.2	5.8	5.8	9.1	7.5	7.7	50.7	44.5			42.9	
Level of Service (LOS)	C	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	6.1	A		7.6	A		48.3	D		42.9	D	
Intersection Delay, s/veh / LOS	9.3						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	1.6	A	2.2	B	0.7	A	0.5	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

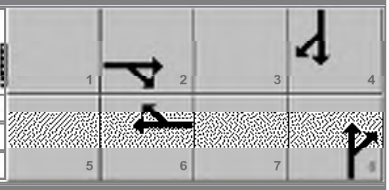
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Sycamore Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th-2B&C_AM.xus				
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	81	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.7	3.8	42.3	4.3	6.0	12.9
Yellow	3.6	0.0	3.6	3.6	3.6	3.6
Red	2.0	0.0	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	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	17.2	51.7	13.3	47.9	21.5	30.1	9.9	18.5
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	11.3		7.3		14.7	19.4	4.6	13.2
Green Extension Time (g_e), s	0.3	0.0	0.4	0.0	1.2	2.3	0.1	0.0
Phase Call Probability	1.00		0.99		1.00	1.00	0.91	1.00
Max Out Probability	1.00		0.00		0.12	0.82	0.50	1.00

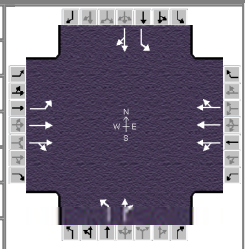
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	283	750	120	165	1271	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	9.3	16.5	3.6	5.3	40.1	5.1	12.7	17.4	4.8	2.6	11.2	0.0
Cycle Queue Clearance Time (g_c), s	9.3	16.5	3.6	5.3	40.1	5.1	12.7	17.4	4.8	2.6	11.2	0.0
Green Ratio (*g/C*)	0.11	0.44	0.59	0.07	0.40	0.44	0.15	0.23	0.31	0.04	0.12	0.23
Capacity (*c*), veh/h	346	1421	851	231	1303	638	495	783	458	132	410	347
Volume-to-Capacity Ratio (*X*)	0.817	0.528	0.141	0.713	0.975	0.221	0.833	0.782	0.218	0.622	0.889	0.000
Available Capacity (c_a), veh/h	405	1421	851	555	1303	638	727	785	459	292	412	348
Back of Queue (*Q*), veh/ln (95th percentile)	7.3	9.6	2.1	3.9	22.6	3.0	8.9	11.5	3.0	2.0	9.4	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.27	0.08	0.31	0.58	0.59	0.80	1.01	0.29	0.51	0.41	0.24	0.00
Uniform Delay (d_1), s/veh	47.0	18.8	8.9	46.3	23.8	13.7	40.6	33.8	24.2	48.9	43.3	0.0
Incremental Delay (d_2), s/veh	9.8	1.3	0.3	4.1	19.7	0.8	5.4	5.1	0.2	4.7	20.5	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	56.9	20.0	9.2	50.3	43.4	14.5	46.0	38.9	24.4	53.6	63.7	0.0
Level of Service (LOS)	E	C	A	D	D	B	D	D	C	D	E	
Approach Delay, s/veh / LOS	27.9	C		41.6	D		40.2	D		61.9	E	
Intersection Delay, s/veh / LOS	39.7						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

Copyright © 2016 University of Florida, All Rights Reserved.

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 & Franklin Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-2B&C_PM.xus				
Project Description	2035 NB PM				

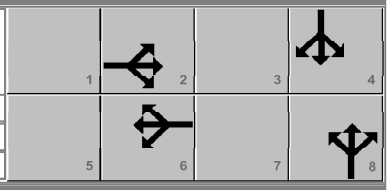


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1600	20	20	960	40	40	10	20	40	10	60

Signal Information			
Cycle, s	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	83.3	10.5	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		8.0		6.0		6.0
Phase Duration, s		88.9		88.9		16.1		16.1
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 (g_s), s						10.4		7.2
Green Extension Time (g_e), s		0.0		0.0		0.2		0.4
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.15

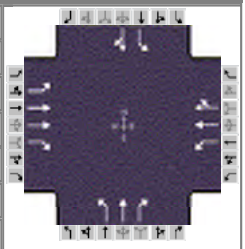
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	872	870	349	375	368	43	32		43	75	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	505	1698	1691	1419	1545	1514	1319	1576		1371	1529	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	3.7	3.4	3.4	2.0		3.1	4.9	
Cycle Queue Clearance Time (g_c), s	4.5	0.0	0.0	2.8	3.7	3.4	8.4	2.0		5.2	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	452	1347	1341	1162	1226	1201	137	158		178	153	
Volume-to-Capacity Ratio (*X*)	0.190	0.647	0.649	0.300	0.306	0.306	0.314	0.205		0.241	0.492	
Available Capacity (c_a), veh/h	452	1347	1341	1162	1226	1201	186	216		229	210	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	1.6	1.6	1.6	1.7	1.6	2.1	1.4		2.0	3.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.04	0.04	0.05	0.06	0.06	0.70	0.07		0.67	0.18	
Uniform Delay (d_1), s/veh	0.1	0.0	0.0	1.2	1.3	1.2	48.8	43.4		45.9	44.7	
Incremental Delay (d_2), s/veh	0.9	2.4	2.4	0.6	0.6	0.6	1.3	0.6		0.7	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		0.0	0.0	
Control Delay (*d*), s/veh	1.0	2.4	2.4	1.8	1.9	1.8	50.1	44.0		46.6	47.2	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	2.4	A		1.9	A		47.5	D		47.0	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	2.0	A	1.1	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

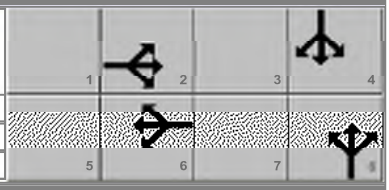
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2B&C_PM.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					EB		WB		NB		SB	
Cycle, s	105.0	Reference Phase	2									
Offset, s	75	Reference Point	Begin	Green	77.0	16.8	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		4
Case Number		5.0		6.0		5.0		6.0
Phase Duration, s		82.6		82.6		22.4		22.4
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						16.3		9.9
Green Extension Time (g_e), s		0.0		0.0		0.5		1.0
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.05

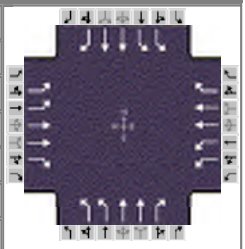
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	1602	161	75	530	519	75	32	65	54	140	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	516	1617	1439	304	1698	1661	1244	1765	1496	1371	1694	
Queue Service Time (g_s), s	1.9	31.1	4.4	6.8	7.3	6.7	6.2	1.6	4.0	3.7	7.9	
Cycle Queue Clearance Time (g_c), s	8.9	31.1	4.4	47.7	7.3	6.7	14.3	1.6	4.0	5.4	7.9	
Green Ratio (*g/C*)	0.73	0.73	0.73	0.73	0.73	0.73	0.16	0.16	0.16	0.16	0.16	
Capacity (*c*), veh/h	412	2371	1055	202	1245	1218	172	282	239	265	271	
Volume-to-Capacity Ratio (*X*)	0.052	0.676	0.153	0.370	0.426	0.426	0.438	0.114	0.270	0.203	0.516	
Available Capacity (c_a), veh/h	412	2371	1055	202	1245	1218	215	343	291	312	329	
Back of Queue (*Q*), veh/ln (95th percentile)	0.4	15.7	2.4	2.4	3.8	3.4	3.6	1.3	2.7	2.3	6.1	
Queue Storage Ratio (*RQ*) (95th percentile)	0.07	0.55	0.08	0.42	0.14	0.12	0.36	0.07	0.55	0.58	0.31	
Uniform Delay (d_1), s/veh	7.6	9.6	5.4	13.3	2.5	2.2	47.0	37.7	38.7	40.1	40.4	
Incremental Delay (d_2), s/veh	0.2	1.2	0.2	4.2	0.9	0.9	1.8	0.2	0.6	0.4	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	0.0	
Control Delay (*d*), s/veh	7.8	10.7	5.6	17.5	3.4	3.1	48.7	37.9	39.3	40.5	41.9	
Level of Service (LOS)	A	B	A	B	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	10.2	B		4.2	A		43.2	D		41.5	D	
Intersection Delay, s/veh / LOS	11.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	2.0	A	1.4	A	0.8	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

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_Build_10th_St_10th-2B&C_PM.xus				
Project Description	2035 NB PM				

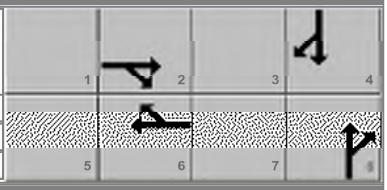


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	220	1180	200	240	680	210	210	520	360	360	530	160

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	88	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.4	41.3	13.4	1.9	10.8	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	2.0	2.1	2.0	2.1	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	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	15.0	47.0	15.0	47.0	16.4	24.0	19.0	26.6
Change Period, ($Y+R_c$), s	5.6	5.7	5.6	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	9.9		10.5		9.0	20.3	14.4	19.1
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.7
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	0.55

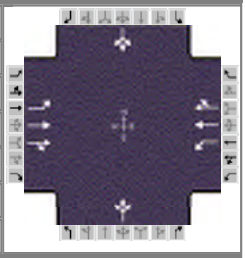
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1269	215	256	726	220	226	559	387	387	570	142
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	7.9	41.1	6.2	8.5	19.4	9.7	7.0	17.5	18.3	12.4	17.1	7.5
Cycle Queue Clearance Time (g_c), s	7.9	41.1	6.2	8.5	19.4	9.7	7.0	17.5	18.3	12.4	17.1	7.5
Green Ratio (*g/C*)	0.09	0.39	0.50	0.09	0.39	0.52	0.10	0.17	0.26	0.13	0.20	0.29
Capacity (*c*), veh/h	281	1272	713	281	1272	750	331	580	391	412	661	427
Volume-to-Capacity Ratio (*X*)	0.841	0.998	0.302	0.911	0.571	0.293	0.683	0.964	0.991	0.938	0.862	0.333
Available Capacity (c_a), veh/h	281	1272	713	281	1272	750	331	580	391	412	802	489
Back of Queue (*Q*), veh/ln (95th percentile)	6.7	21.7	2.4	7.8	12.5	8.2	5.4	13.9	20.4	10.5	11.7	3.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.88	0.78	0.42	0.82	0.25	0.95	0.78	0.41	1.00	0.98	0.52	0.86
Uniform Delay (d_1), s/veh	51.3	20.7	7.4	47.5	27.7	15.8	43.7	40.0	36.1	43.2	37.2	2.8
Incremental Delay (d_2), s/veh	15.1	20.9	0.8	29.1	1.7	0.9	5.7	28.5	43.0	29.2	8.2	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	0.0
Control Delay (*d*), s/veh	66.5	41.5	8.2	76.6	29.4	16.7	49.4	68.5	79.1	72.4	45.4	3.3
Level of Service (LOS)	E	D	A	E	C	B	D	E	E	E	D	A
Approach Delay, s/veh / LOS	40.8	D		37.1	D		68.3	E		49.5	D	
Intersection Delay, s/veh / LOS	48.0						D					

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	1.9	A	1.5	A	1.5	A	1.4	A

Copyright © 2016 University of Florida, All Rights Reserved.

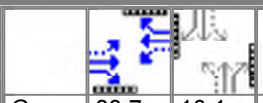
HCS 2010 Signalized Intersection Results Summary

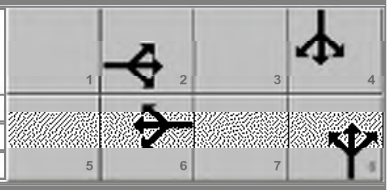
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Blauvelt Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-2B&C_PM.xus				
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					EB		WB		NB		SB	
Cycle, s	105.0	Reference Phase	2									
Offset, s	10	Reference Point	Begin	Green	83.7	10.1	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	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		89.3		89.3		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						6.0		10.0
Green Extension Time (g_e), s		0.0		0.0		0.3		0.1
Phase Call Probability						1.00		1.00
Max Out Probability						0.23		1.00

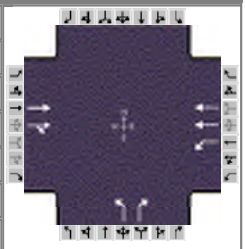
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	995	995	64	596	588		65			118	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	454	1698	1669	209	1698	1676		1507			1514	
Queue Service Time (g_s), s	0.8	13.1	13.0	15.0	10.8	10.9		0.0			4.0	
Cycle Queue Clearance Time (g_c), s	13.2	13.1	13.0	28.2	10.8	10.9		4.0			8.0	
Green Ratio (*g/C*)	0.80	0.80	0.80	0.80	0.80	0.80		0.10			0.10	
Capacity (*c*), veh/h	383	1354	1331	209	1354	1337		190			195	
Volume-to-Capacity Ratio (*X*)	0.140	0.734	0.747	0.306	0.440	0.440		0.339			0.607	
Available Capacity (c_a), veh/h	383	1354	1331	209	1354	1337		223			228	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	2.3	2.2	1.4	5.1	5.1		2.9			5.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.05	0.04	0.25	0.13	0.13		0.15			0.29	
Uniform Delay (d_1), s/veh	1.7	1.1	1.1	8.0	3.0	3.1		44.7			46.4	
Incremental Delay (d_2), s/veh	0.1	0.5	0.5	3.4	0.9	0.9		1.0			3.5	
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	1.8	1.6	1.6	11.3	4.0	4.0		45.8			49.9	
Level of Service (LOS)	A	A	A	B	A	A		D			D	
Approach Delay, s/veh / LOS	1.6	A		4.4	A		45.8	D		49.9	D	
Intersection Delay, s/veh / LOS	5.1						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

Copyright © 2016 University of Florida, All Rights Reserved.

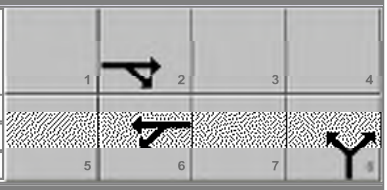
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2B&C_PM.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					EB		WB		NB		SB	
Cycle, s	105.0	Reference Phase	2									
Offset, s	10	Reference Point	Begin	Green	88.0	5.8	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		93.6		93.6		11.4		
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 (*gs*), s						6.0		
Green Extension Time (*ge*), s		0.0		0.0		0.1		
Phase Call Probability						0.96		
Max Out Probability						0.88		

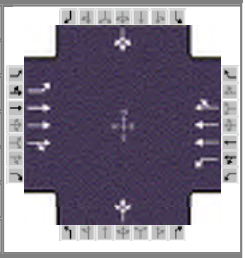
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		989	989	85	1183		65		43			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1659	211	1617		1681		1496			
Queue Service Time (*gs*), s		30.9	27.9	36.0	10.8		4.0		2.9			
Cycle Queue Clearance Time (*gc*), s		30.9	27.9	64.0	10.8		4.0		2.9			
Green Ratio (*g*/*C*)		0.84	0.84	0.84	0.84		0.06		0.06			
Capacity (*c*), veh/h		1423	1390	183	2709		93		83			
Volume-to-Capacity Ratio (*X*)		0.695	0.711	0.466	0.437		0.694		0.520			
Available Capacity (*ca*), veh/h		1423	1390	183	2709		166		148			
Back of Queue (*Q*), veh/ln (95th percentile)		10.1	10.5	3.5	4.1		3.4		2.2			
Queue Storage Ratio (*RQ*) (95th percentile)		0.27	0.27	0.61	0.06		0.43		0.28			
Uniform Delay (*d1*), s/veh		4.1	4.2	19.4	2.5		48.7		48.2			
Incremental Delay (*d2*), s/veh		1.7	1.9	7.7	0.5		8.9		5.0			
Initial Queue Delay (*d3*), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		5.8	6.1	27.1	3.0		57.6		53.2			
Level of Service (LOS)		A	A	C	A		E		D			
Approach Delay, s/veh / LOS	6.0	A		4.6	A		55.9	E		0.0		
Intersection Delay, s/veh / LOS	7.1						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	2.1	B	1.5	A		F		

Copyright © 2016 University of Florida, All Rights Reserved.

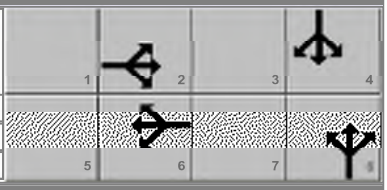
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2B&C_PM.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					EB			WB			NB			SB		
Cycle, s	105.0	Reference Phase	6													
Offset, s	45	Reference Point	Begin	Green	4.3	68.1		18.5	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		73.7	7.3	81.0		24.0		24.0
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 (g_s), s			4.3			9.7		20.5
Green Extension Time (g_e), s		0.0	0.1	0.0		1.0		0.0
Phase Call Probability			0.97			1.00		1.00
Max Out Probability			0.65			0.13		1.00

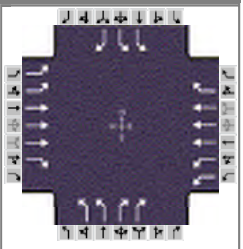
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	1208	598	118	876	421		129			237	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	407	1698	1682	1617	1698	1631		1581			1171	
Queue Service Time (g_s), s	8.2	16.0	15.9	2.3	13.2	12.1		0.0			10.8	
Cycle Queue Clearance Time (g_c), s	14.8	16.0	15.9	2.3	13.2	12.1		7.7			18.5	
Green Ratio (*g*/*C*)	0.65	0.65	0.65	0.71	0.72	0.72		0.18			0.18	
Capacity (*c*), veh/h	310	2202	1090	259	2439	1171		319			261	
Volume-to-Capacity Ratio (*X*)	0.277	0.549	0.549	0.456	0.359	0.359		0.405			0.907	
Available Capacity (c_a), veh/h	310	2202	1090	331	2439	1171		319			261	
Back of Queue (*Q*), veh/ln (95th percentile)	1.4	7.3	7.5	1.5	8.2	7.2		5.5			13.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.24	0.12	0.12	0.26	0.34	0.30		0.14			0.34	
Uniform Delay (d_1), s/veh	7.4	6.7	6.6	8.1	8.1	7.1		38.8			45.3	
Incremental Delay (d_2), s/veh	1.5	0.7	1.3	1.0	0.3	0.7		0.8			32.4	
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	8.8	7.3	7.9	9.2	8.4	7.8		39.6			77.7	
Level of Service (LOS)	A	A	A	A	A	A		D			E	
Approach Delay, s/veh / LOS	7.6	A		8.3	A		39.6	D		77.7	E	
Intersection Delay, s/veh / LOS	13.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.5	A	1.3	A	0.7	A	0.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

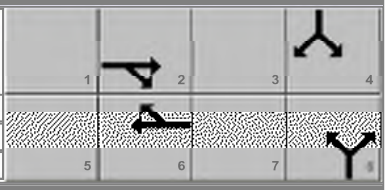
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 SPUI	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-2B&C_PM.xus				
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	67	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	30.9	2.0	33.9	14.7	1.0	0.0
Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Red	4.5	0.0	4.5	2.7	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	2.0	3.0	2.0	3.0	1.1	3.0	1.1	3.0
Phase Duration, s	39.0	42.0	41.0	44.0	21.0	1.0	21.0	1.0
Change Period, ($Y+R_c$), s	8.1	8.1	8.1	8.1	6.3	0.0	6.3	0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0	4.1	4.3	4.1	4.3
Queue Clearance Time (g_s), s	13.5		8.3		14.6	3.0	16.7	3.0
Green Extension Time (g_e), s	1.3	0.0	1.9	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	0.00		0.00		1.00	1.00	1.00	1.00

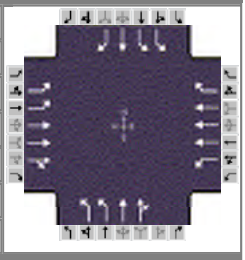
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	344	1290	0	438	748	0	376		538	441		237
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1515	1528	1350	1529	1490	1350	1520		1239	1529		1394
Queue Service Time (g_s), s	11.5	25.6	0.0	6.3	13.5	0.0	12.6		1.0	14.7		1.0
Cycle Queue Clearance Time (g_c), s	11.5	25.6	0.0	6.3	13.5	0.0	12.6		1.0	14.7		1.0
Green Ratio (*g/C*)	0.29	0.32	0.32	0.31	0.34	0.34	0.15		0.32	0.15		0.30
Capacity (*c*), veh/h	892	1480	436	958	1529	462	563		800	565		424
Volume-to-Capacity Ratio (*X*)	0.386	0.872	0.000	0.457	0.489	0.000	0.669		0.672	0.780		0.559
Available Capacity (c_a), veh/h	892	1480	436	958	1529	462	563		800	565		424
Back of Queue (*Q*), veh/ln (95th percentile)	8.1	11.8	0.0	3.2	8.0	0.0	8.8		9.9	10.5		8.7
Queue Storage Ratio (*RQ*) (95th percentile)	1.06	0.50	0.00	0.42	0.30	0.00	0.58		0.74	0.73		0.76
Uniform Delay (d_1), s/veh	40.4	22.1	0.0	10.9	26.1	0.0	43.3		30.7	44.4		30.6
Incremental Delay (d_2), s/veh	1.0	6.0	0.0	1.2	0.9	0.0	6.2		2.2	10.2		1.6
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
Control Delay (*d*), s/veh	41.4	28.1	0.0	12.2	27.0	0.0	49.5		32.9	54.6		32.3
Level of Service (LOS)	D	C		B	C		D		C	D		C
Approach Delay, s/veh / LOS	30.9	C		21.5	C		39.8	D		46.8	D	
Intersection Delay, s/veh / LOS	32.7						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.8	C	3.9	D	4.0	D
Bicycle LOS Score / LOS	1.4	A	1.1	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

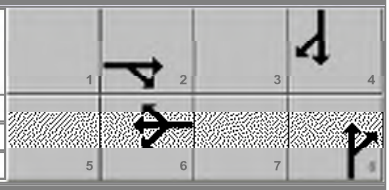
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-2B&C_PM.xus				
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	103	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	13.5	40.4	8.1	3.9	12.9	0.0
Yellow	3.0	3.6	3.0	3.0	3.6	0.0
Red	2.0	2.0	2.0	2.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	4.0		5.3	2.0	4.0	2.0	3.0
Phase Duration, s	18.5	64.5		46.0	13.1	18.5	22.0	27.4
Change Period, (Y+R_c), s	5.0	5.6		5.6	5.0	5.6	5.0	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				7.7	12.5	17.3	21.4
Green Extension Time (g_e), s	0.0	0.0		0.0	0.4	0.4	0.0	0.4
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				0.09	1.00	1.00	1.00

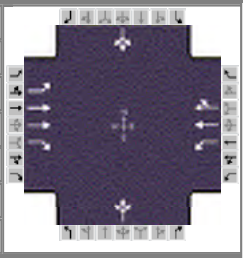
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	366	1206	566	43	1035	354	183	170	158	484	333	225
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1589	258	1542	1439	1632	1765	1546	1632	1765	1496
Queue Service Time (g_s), s	11.6	21.3	22.5	11.4	16.2	13.7	5.7	9.8	10.5	15.3	19.4	12.3
Cycle Queue Clearance Time (g_c), s	11.6	21.3	22.5	15.8	16.2	13.7	5.7	9.8	10.5	15.3	19.4	12.3
Green Ratio (*g*/*C*)	0.13	0.56	0.56	0.38	0.38	0.55	0.08	0.12	0.12	0.16	0.21	0.34
Capacity (*c*), veh/h	405	1906	892	158	1779	787	252	216	190	528	366	503
Volume-to-Capacity Ratio (*X*)	0.904	0.633	0.635	0.270	0.582	0.451	0.726	0.787	0.832	0.916	0.911	0.447
Available Capacity (c_a), veh/h	405	1906	892	158	1779	787	466	225	197	528	375	510
Back of Queue (*Q*), veh/ln (95th percentile)	4.9	8.3	8.8	1.3	8.1	6.2	4.4	9.0	9.0	12.2	16.3	7.9
Queue Storage Ratio (*RQ*) (95th percentile)	0.64	0.31	0.33	0.18	0.20	0.81	0.56	0.25	0.26	0.37	0.41	1.34
Uniform Delay (d_1), s/veh	31.8	11.1	12.1	20.6	19.5	10.8	47.4	44.7	45.0	43.3	40.7	27.2
Incremental Delay (d_2), s/veh	6.0	0.3	0.7	2.9	1.0	1.3	4.0	16.2	24.4	20.7	25.4	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	0.0
Control Delay (*d*), s/veh	37.9	11.4	12.8	23.5	20.4	12.1	51.3	61.0	69.4	64.0	66.1	27.8
Level of Service (LOS)	D	B	B	C	C	B	D	E	E	E	E	C
Approach Delay, s/veh / LOS	16.3	B		18.4	B		60.1	E		56.9	E	
Intersection Delay, s/veh / LOS	29.5						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	1.7	A	1.3	A	0.9	A	2.2	B

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

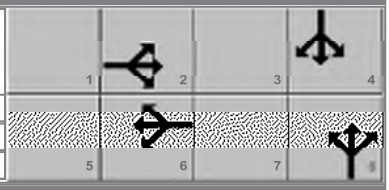
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-2B&C_PM.xus				
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	78	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.0	71.4	15.4	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	3.0		6.3		8.0		8.0
Phase Duration, s	7.0	84.0		77.0		21.0		21.0
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	4.8					9.0		17.4
Green Extension Time (g_e), s	0.0	0.0		0.0		0.7		0.0
Phase Call Probability	0.99					1.00		1.00
Max Out Probability	1.00					0.35		1.00

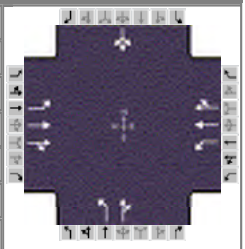
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	155	1891	145	43	756	738		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	229	1698	1642		1438			1260	
Queue Service Time (g_s), s	2.8	33.4	3.0	13.9	26.2	26.8		0.0			8.4	
Cycle Queue Clearance Time (g_c), s	2.8	33.4	3.0	40.3	26.2	26.8		7.0			15.4	
Green Ratio (*g/C*)	0.74	0.75	0.75	0.68	0.68	0.68		0.15			0.15	
Capacity (*c*), veh/h	274	2414	1075	167	1155	1117		259			240	
Volume-to-Capacity Ratio (*X*)	0.567	0.783	0.135	0.258	0.655	0.661		0.415			0.897	
Available Capacity (c_a), veh/h	274	2414	1075	167	1155	1117		259			240	
Back of Queue (*Q*), veh/ln (95th percentile)	2.9	10.8	1.3	1.5	13.1	13.1		4.7			12.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.51	0.27	0.03	0.27	0.26	0.26		0.24			0.63	
Uniform Delay (d_1), s/veh	11.8	6.2	3.7	21.2	9.2	9.3		41.1			46.3	
Incremental Delay (d_2), s/veh	1.8	1.7	0.2	3.0	2.3	2.5		1.1			32.4	
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	13.5	7.9	3.9	24.1	11.5	11.8		42.1			78.6	
Level of Service (LOS)	B	A	A	C	B	B		D			E	
Approach Delay, s/veh / LOS	8.0	A		12.0	B		42.1	D		78.6	E	
Intersection Delay, s/veh / LOS	14.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.1	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	2.4	B	1.8	A	0.7	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

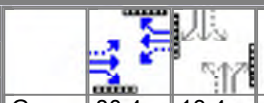
HCS 2010 Signalized Intersection Results Summary

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_Build_10th_St_10th-2B&C_PM.xus				
Project Description	2035 NB PM				

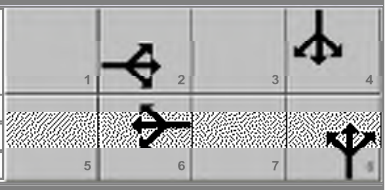


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	1820	150	40	1340	30	80	10	60	30	10	10

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	92	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	80.4	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		86.0		86.0		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						15.4		8.9
Green Extension Time (g_e), s		0.0		0.0		0.0		0.3
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.86

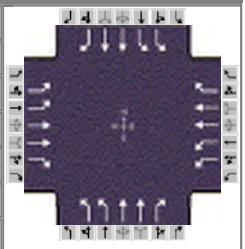
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	31	1022	1022	43	739	734	86	75			54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	344	1698	1653	198	1698	1685	1385	1529			1088	
Queue Service Time (g_s), s	2.2	25.3	27.4	4.9	19.0	18.8	6.5	4.7			2.1	
Cycle Queue Clearance Time (g_c), s	22.8	25.3	27.4	39.5	19.0	18.8	13.4	4.7			6.9	
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	269	1300	1266	168	1300	1290	154	195			194	
Volume-to-Capacity Ratio (*X*)	0.116	0.786	0.807	0.255	0.568	0.569	0.558	0.386			0.278	
Available Capacity (c_a), veh/h	269	1300	1266	168	1300	1290	154	195			194	
Back of Queue (*Q*), veh/ln (95th percentile)	0.4	6.3	6.5	1.0	8.5	8.3	4.4	3.3			2.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.08	0.13	0.13	0.18	0.07	0.07	0.74	0.17			0.12	
Uniform Delay (d_1), s/veh	6.3	3.1	3.2	9.6	5.1	5.0	49.3	42.0			43.1	
Incremental Delay (d_2), s/veh	0.5	2.7	3.1	2.5	1.2	1.3	4.4	1.2			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	
Control Delay (*d*), s/veh	6.8	5.8	6.3	12.1	6.4	6.3	53.7	43.3			43.9	
Level of Service (LOS)	A	A	A	B	A	A	D	D			D	
Approach Delay, s/veh / LOS	6.1	A		6.5	A		48.8	D		43.9	D	
Intersection Delay, s/veh / LOS	8.6						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	2.3	B	1.7	A	0.8	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

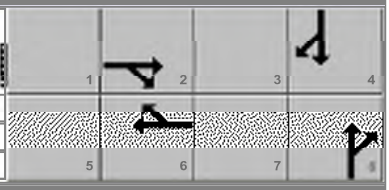
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Oct 10, 2014	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Sycamore Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-2B&C_PM.xus				
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	74	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.5	4.2	42.2	11.7	1.5	15.5
Yellow	3.6	0.0	3.6	3.6	0.0	3.6
Red	2.0	0.0	2.0	2.0	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	17.3	52.0	13.1	47.8	17.3	21.1	18.8	22.6
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	13.8		7.2		11.0	17.5	12.3	16.3
Green Extension Time (g_e), s	0.0	0.0	0.3	0.0	0.7	0.0	0.9	0.5
Phase Call Probability	1.00		0.99		1.00	1.00	1.00	1.00
Max Out Probability	1.00		0.07		0.14	1.00	0.12	1.00

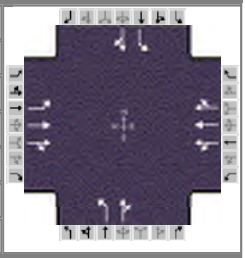
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	353	1277	314	161	817	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	11.8	37.6	11.9	5.2	18.7	2.1	9.0	12.6	15.5	10.3	14.3	0.0
Cycle Queue Clearance Time (g_c), s	11.8	37.6	11.9	5.2	18.7	2.1	9.0	12.6	15.5	10.3	14.3	0.0
Green Ratio (*g/C*)	0.11	0.44	0.55	0.07	0.40	0.53	0.11	0.15	0.22	0.13	0.16	0.28
Capacity (*c*), veh/h	355	1429	797	224	1294	757	364	495	327	411	543	411
Volume-to-Capacity Ratio (*X*)	0.994	0.894	0.394	0.719	0.631	0.095	0.797	0.846	0.752	0.811	0.871	0.000
Available Capacity (c_a), veh/h	355	1429	797	436	1294	757	572	498	329	634	546	412
Back of Queue (*Q*), veh/ln (95th percentile)	8.8	18.4	6.8	3.8	10.3	1.2	6.7	9.7	10.6	7.6	10.8	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.54	0.15	1.03	0.57	0.27	0.32	0.75	0.25	1.79	1.55	0.27	0.00
Uniform Delay (d_1), s/veh	43.7	24.3	11.4	46.5	19.0	9.5	43.5	41.0	36.2	42.5	40.1	0.0
Incremental Delay (d_2), s/veh	33.6	5.2	0.8	4.3	2.4	0.2	4.2	12.7	9.4	4.6	14.2	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	77.2	29.5	12.2	50.8	21.4	9.8	47.8	53.7	45.5	47.1	54.3	0.0
Level of Service (LOS)	E	C	B	D	C	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	35.4	D		25.1	C		49.8	D		51.3	D	
Intersection Delay, s/veh / LOS	38.7						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

Copyright © 2016 University of Florida, All Rights Reserved.

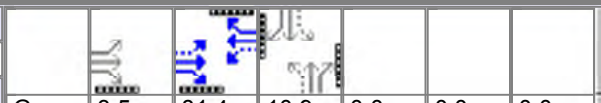
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build AM				

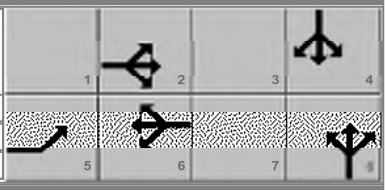


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	650	40	10	1420	50	20	10	10	20	10	70

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	3.5	81.4	10.9	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		8.3		6.0		6.0
Phase Duration, s	6.5	93.5		87.0		16.5		16.5
Change Period, (Y+R_c), s	3.0	5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.3	0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s	3.1					10.7		8.5
Green Extension Time (g_e), s	0.1	0.0		0.0		0.3		0.3
Phase Call Probability	0.88					0.99		0.99
Max Out Probability	0.04					0.19		0.04

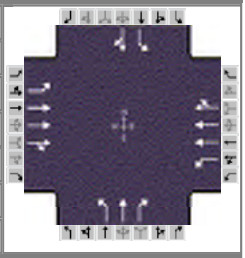
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	410	402	626	576	566	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1663	1679	1545	1516	1297	1619		1382	1525	
Queue Service Time (g_s), s	1.1	0.0	0.0	0.0	12.4	12.0	2.0	1.5		1.7	6.5	
Cycle Queue Clearance Time (g_c), s	1.1	0.0	0.0	12.1	12.4	12.0	8.7	1.5		3.4	6.5	
Green Ratio (*g*/*C*)	0.79	0.80	0.80	0.74	0.74	0.74	0.10	0.10		0.10	0.10	
Capacity (*c*), veh/h	283	1359	1331	1277	1145	1123	113	159		180	150	
Volume-to-Capacity Ratio (*X*)	0.249	0.302	0.302	0.490	0.503	0.504	0.209	0.148		0.131	0.629	
Available Capacity (c_a), veh/h	390	1359	1331	1277	1145	1123	191	256		263	241	
Back of Queue (*Q*), veh/ln (95th percentile)	0.6	0.4	0.4	6.3	6.0	5.7	1.2	1.1		1.1	4.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.01	0.01	0.22	0.21	0.20	0.40	0.06		0.38	0.24	
Uniform Delay (d_1), s/veh	3.7	0.0	0.0	3.6	3.6	3.5	52.0	45.4		47.1	47.7	
Incremental Delay (d_2), s/veh	0.5	0.6	0.6	1.2	1.4	1.4	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	4.1	0.6	0.6	4.7	5.0	4.9	52.9	45.8		47.4	52.0	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	0.9	A		4.8	A		49.4	D		51.1	D	
Intersection Delay, s/veh / LOS	6.3						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	1.2	A	1.4	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

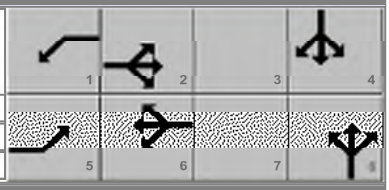
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Fairfax Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build 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	105	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.6	0.9	70.7	21.5	0.0	0.0	
Yellow	3.0	0.0	3.6	3.6	0.0	0.0	
Red	0.0	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	1.1	4.0	1.1	4.0		5.0		6.0
Phase Duration, s	5.6	76.3	6.6	77.2		27.1		27.1
Change Period, (*Y*+*Rc*), s	3.0	5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.3	0.0	4.3	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.8		3.6			21.4		6.9
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.2		1.2
Phase Call Probability	0.66		0.89			1.00		1.00
Max Out Probability	1.00		1.00			1.00		0.01

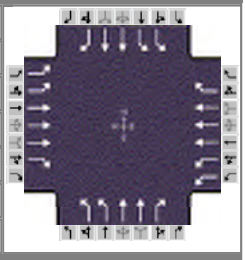
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	515	249	72	1058	522	188	47	24	35	71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1629	1617	1698	1677	1324	1765	1496	1353	1619	
Queue Service Time (g_s), s	0.8	7.3	7.4	1.6	9.0	8.9	15.3	2.4	1.4	2.4	4.0	
Cycle Queue Clearance Time (g_c), s	0.8	7.3	7.4	1.6	9.0	8.9	19.4	2.4	1.4	4.9	4.0	
Green Ratio (*g*/*C*)	0.67	0.64	0.64	0.68	0.65	0.65	0.20	0.20	0.20	0.20	0.20	
Capacity (*c*), veh/h	275	2183	1047	505	2211	1092	276	346	293	300	317	
Volume-to-Capacity Ratio (*X*)	0.128	0.236	0.238	0.142	0.478	0.478	0.682	0.136	0.080	0.118	0.223	
Available Capacity (c_a), veh/h	308	2183	1047	525	2211	1092	286	359	305	311	330	
Back of Queue (*Q*), veh/ln (95th percentile)	0.5	5.0	5.0	1.1	4.4	4.6	9.3	1.9	0.9	1.5	2.9	
Queue Storage Ratio (*RQ*) (95th percentile)	0.09	0.18	0.17	0.19	0.16	0.17	0.95	0.10	0.19	0.38	0.15	
Uniform Delay (d_1), s/veh	6.9	8.7	8.7	6.6	3.7	3.6	45.3	36.5	36.1	38.6	37.2	
Incremental Delay (d_2), s/veh	0.2	0.2	0.5	0.1	0.6	1.2	6.2	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	7.1	9.0	9.2	6.7	4.3	4.9	51.6	36.7	36.2	38.7	37.5	
Level of Service (LOS)	A	A	A	A	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	9.0	A		4.6	A		47.5	D		37.9	D	
Intersection Delay, s/veh / LOS	11.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	0.9	A	1.4	A	0.9	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build AM				

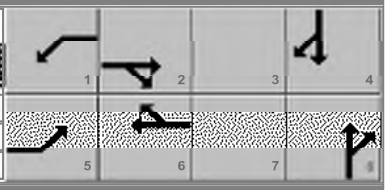


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	110	400	140	310	1090	210	150	400	180	160	370	140

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	101	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.5	33.0	16.6	8.3	2.8	9.1
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	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	12.1	50.8	22.2	60.8	14.7	23.2	13.9	22.4
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	4.1	4.1	4.2	4.2
Queue Clearance Time (g_s), s	6.5		14.1		7.8	17.1	8.2	15.9
Green Extension Time (g_e), s	0.1	0.0	3.2	0.0	0.6	0.4	0.1	0.8
Phase Call Probability	0.98		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		0.94		1.00	1.00	1.00	1.00

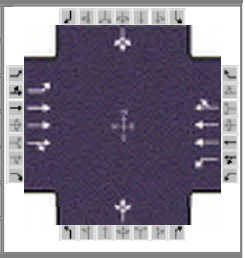
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	471	0	373	1311	213	176	471	0	188	435	98
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1542	1439	1570	1542	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	4.5	6.1	0.0	12.1	21.7	8.1	5.8	15.1	0.0	6.2	13.9	5.9
Cycle Queue Clearance Time (g_c), s	4.5	6.1	0.0	12.1	21.7	8.1	5.8	15.1	0.0	6.2	13.9	5.9
Green Ratio (*g/C*)	0.06	0.41	0.49	0.15	0.50	0.58	0.08	0.16	0.31	0.08	0.15	0.21
Capacity (*c*), veh/h	186	1895	707	470	2317	829	265	529	457	243	504	312
Volume-to-Capacity Ratio (*X*)	0.696	0.248	0.000	0.793	0.566	0.257	0.667	0.889	0.000	0.773	0.863	0.313
Available Capacity (c_a), veh/h	262	1895	707	551	2317	829	287	552	467	271	579	345
Back of Queue (*Q*), veh/ln (95th percentile)	3.6	4.0	0.0	7.8	12.3	7.0	4.4	11.4	0.0	5.1	10.3	3.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.47	0.14	0.00	0.82	0.24	0.82	0.65	0.33	0.00	0.88	0.46	0.76
Uniform Delay (d_1), s/veh	53.9	17.0	0.0	37.8	19.0	11.6	47.6	42.4	0.0	48.6	42.8	1.6
Incremental Delay (d_2), s/veh	4.6	0.3	0.0	5.9	0.9	0.7	5.2	15.9	0.0	11.8	11.6	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	0.0
Control Delay (*d*), s/veh	58.4	17.3	0.0	43.7	19.9	12.2	52.8	58.3	0.0	60.3	54.4	2.1
Level of Service (LOS)	E	B		D	B	B	D	E		E	D	A
Approach Delay, s/veh / LOS	26.1	C		23.7	C		56.8	E		48.9	D	
Intersection Delay, s/veh / LOS	34.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.1	C	3.5	D	3.7	D
Bicycle LOS Score / LOS	0.8	A	1.5	A	1.0	A	1.1	A

Copyright © 2016 University of Florida, All Rights Reserved.

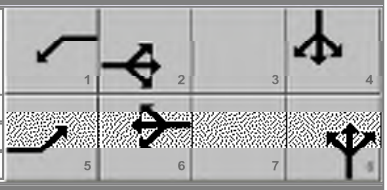
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build 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	12	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On	Green	1.2	0.9	86.7	7.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.0	0.0	3.6	3.6	0.0	0.0		
				Red	0.0	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	1.1	4.0	1.1	4.0		8.0		8.0
Phase Duration, s	4.2	92.3	5.1	93.1		12.6		12.6
Change Period, (*Y*+R_c), s	3.0	5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.3	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.2		2.3			5.9		7.1
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.1		0.1
Phase Call Probability	0.30		0.52			0.98		0.98
Max Out Probability	1.00		1.00			1.00		1.00

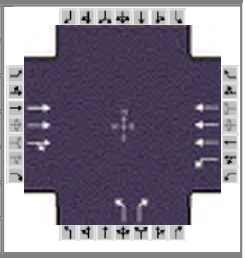
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	574	285	24	1294	641		59			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1686	1617	1698	1681		1610			1482	
Queue Service Time (g_s), s	0.2	4.1	4.0	0.3	15.2	15.2		0.0			1.3	
Cycle Queue Clearance Time (g_c), s	0.2	4.1	4.0	0.3	15.2	15.2		3.9			5.1	
Green Ratio (*g*/*C*)	0.80	0.79	0.79	0.81	0.80	0.80		0.06			0.06	
Capacity (*c*), veh/h	224	2676	1328	558	2703	1338		142			144	
Volume-to-Capacity Ratio (*X*)	0.053	0.214	0.215	0.043	0.479	0.479		0.413			0.490	
Available Capacity (c_a), veh/h	300	2676	1328	621	2703	1338		175			175	
Back of Queue (*Q*), veh/ln (95th percentile)	0.1	2.2	2.3	0.1	7.6	7.8		3.0			3.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.04	0.04	0.02	0.20	0.21		0.15			0.18	
Uniform Delay (d_1), s/veh	3.6	2.5	2.5	2.2	4.3	4.3		50.0			50.5	
Incremental Delay (d_2), s/veh	0.1	0.2	0.3	0.0	0.5	1.0		1.9			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	3.7	2.7	2.8	2.2	4.8	5.4		51.9			53.1	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	2.7	A		5.0	A		51.9	D		53.1	D	
Intersection Delay, s/veh / LOS	6.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.5	A	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

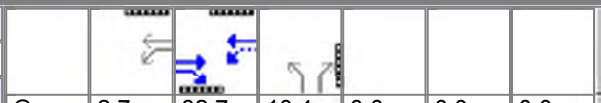
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build AM				

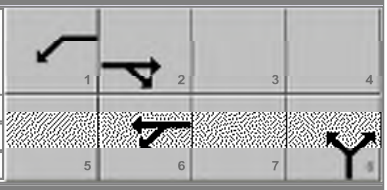


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		750	30	30	1520		110		60			

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	29	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	2.7	82.7	10.4	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		2	1	6		8		
Case Number		8.3	1.0	4.0		9.0		
Phase Duration, s		88.3	5.7	94.0		16.0		
Change Period, (*Y*+*Rc*), s		5.6	3.0	5.6		5.6		
Max Allow Headway (*MAH*), s		0.0	4.2	0.0		4.3		
Queue Clearance Time (g_s), s			2.5			10.3		
Green Extension Time (g_e), s		0.0	0.0	0.0		0.1		
Phase Call Probability			0.67			1.00		
Max Out Probability			1.00			1.00		

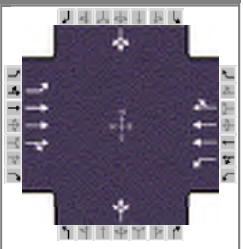
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		615	302	36	1830		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1663	1617	1542		1681		1496			
Queue Service Time (g_s), s		6.8	2.4	0.5	4.6		8.3		4.9			
Cycle Queue Clearance Time (g_c), s		6.8	2.4	0.5	4.6		8.3		4.9			
Green Ratio (*g*/*C*)		0.75	0.75	0.79	0.80		0.09		0.09			
Capacity (*c*), veh/h		2553	1250	507	3716		159		142			
Volume-to-Capacity Ratio (*X*)		0.241	0.242	0.071	0.493		0.813		0.498			
Available Capacity (c_a), veh/h		2553	1250	556	3716		189		169			
Back of Queue (*Q*), veh/ln (95th percentile)		1.2	1.3	0.2	1.3		7.8		3.5			
Queue Storage Ratio (*RQ*) (95th percentile)		0.03	0.04	0.04	0.02		0.99		0.44			
Uniform Delay (d_1), s/veh		1.5	1.4	2.7	0.7		48.8		47.3			
Incremental Delay (d_2), s/veh		0.2	0.4	0.0	0.4		19.9		2.7			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		1.7	1.9	2.7	1.1		68.8		50.0			
Level of Service (LOS)		A	A	A	A		E		D			
Approach Delay, s/veh / LOS	1.7	A		1.1	A		62.1	E		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	3.3	C	3.2	C
Bicycle LOS Score / LOS	1.0	A	1.5	A		F		

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

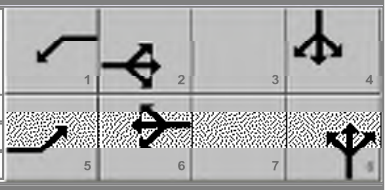
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Lowell Ave	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build 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	30	60	1490	120	20	40	120	70	30	90

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	97	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	2.6	0.9	70.9	21.5	0.0	0.0
Yellow	3.0	0.0	3.6	3.5	0.0	0.0
Red	0.0	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	1.1	4.0	1.1	4.0		8.0		8.0
Phase Duration, s	5.6	76.5	6.5	77.4		27.0		27.0
Change Period, ($Y+R_c$), s	3.0	5.6	3.0	5.6		5.5		5.5
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.4		4.4
Queue Clearance Time (g_s), s	2.8		3.6			16.0		23.5
Green Extension Time (g_e), s	0.0	0.0	0.1	0.0		0.9		0.0
Phase Call Probability	0.66		0.88			1.00		1.00
Max Out Probability	1.00		0.27			0.66		1.00

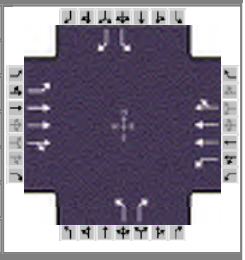
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	616	302	70	1270	612		212			224	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1664	1617	1698	1631		1532			1100	
Queue Service Time (g_s), s	0.8	9.9	10.0	1.6	6.7	6.5		0.0			7.5	
Cycle Queue Clearance Time (g_c), s	0.8	9.9	10.0	1.6	6.7	6.5		14.0			21.5	
Green Ratio (*g/C*)	0.67	0.64	0.64	0.68	0.65	0.65		0.20			0.20	
Capacity (*c*), veh/h	237	2188	1072	440	2216	1064		336			260	
Volume-to-Capacity Ratio (*X*)	0.147	0.281	0.282	0.159	0.573	0.575		0.631			0.861	
Available Capacity (c_a), veh/h	257	2188	1072	520	2216	1064		336			260	
Back of Queue (*Q*), veh/ln (95th percentile)	0.5	6.7	6.9	0.9	2.4	2.5		9.6			12.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.09	0.11	0.11	0.16	0.15	0.16		0.24			0.32	
Uniform Delay (d_1), s/veh	6.4	10.2	10.3	6.6	1.7	1.7		41.2			45.1	
Incremental Delay (d_2), s/veh	0.3	0.3	0.6	0.1	0.5	1.1		3.8			24.1	
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	6.7	10.5	11.0	6.6	2.2	2.7		44.9			69.3	
Level of Service (LOS)	A	B	B	A	A	A		D			E	
Approach Delay, s/veh / LOS	10.5	B		2.5	A		44.9	D		69.3	E	
Intersection Delay, s/veh / LOS	12.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.6	A	0.8	A	0.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

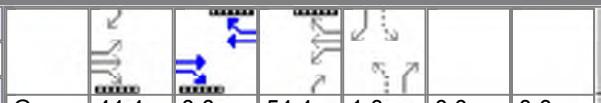
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & I-229 SB Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build AM				

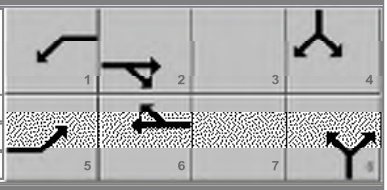


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	660	280	1	1300	480	0		200	0		320

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	78	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	44.4	0.0	54.4	1.0	0.0	0.0
Yellow	3.6	0.0	3.6	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	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	2.0	4.0		5.0		5.0
Phase Duration, s	50.0	50.0	59.0	59.0		1.0		1.0
Change Period, (Y+R_c), s	5.6	0.0	4.6	4.6		0.0		0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.1		2.0			3.0		3.0
Green Extension Time (g_e), s	0.0	0.0	16.4	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.08			1.00		1.00

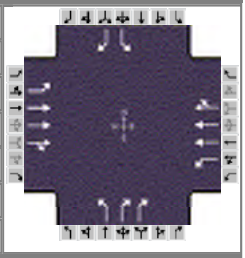
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	1	832	355	1	1450	642	0		235	0		376
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1440	1617	1698	1466	1617		1439	1617		1439
Queue Service Time (g_s), s	0.1	21.3	21.4	0.0	22.7	25.5	0.0		0.5	0.0		0.5
Cycle Queue Clearance Time (g_c), s	0.1	21.3	21.4	0.0	22.7	25.5	0.0		0.5	0.0		0.5
Green Ratio (*g*/*C*)	0.40	0.45	0.45	0.49	0.49	0.49	0.01		0.50	0.01		0.41
Capacity (*c*), veh/h	653	1544	654	800	1680	725	65		712	65		581
Volume-to-Capacity Ratio (*X*)	0.002	0.539	0.542	0.001	0.863	0.886	0.000		0.331	0.000		0.648
Available Capacity (c_a), veh/h	653	1544	654	800	1680	725	65		712	65		581
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	13.9	12.6	0.0	4.9	5.7	0.0		6.2	0.0		12.6
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	1.04	0.94	0.00	0.36	0.42	0.00		0.41	0.00		0.83
Uniform Delay (d_1), s/veh	21.2	25.9	25.8	3.2	4.4	4.6	0.0		16.8	0.0		26.5
Incremental Delay (d_2), s/veh	0.0	1.3	3.0	0.0	3.0	7.7	0.0		0.3	0.0		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
Control Delay (*d*), s/veh	21.2	27.1	28.8	3.2	7.4	12.3	0.0		17.1	0.0		29.0
Level of Service (LOS)	C	C	C	A	A	B			B			C
Approach Delay, s/veh / LOS	27.6	C		8.9	A		17.1	B		29.0	C	
Intersection Delay, s/veh / LOS	17.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.1	A	1.6	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

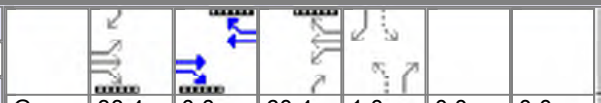
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & I-229 NB Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build AM				

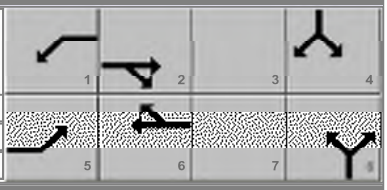


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	720	140	1	1480	470	0		470	0		300

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	66	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	38.4	0.0	60.4	1.0	0.0	0.0
Yellow	3.6	0.0	3.6	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	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	2.0	4.0		5.0		5.0
Phase Duration, s	44.0	44.0	65.0	65.0		1.0		1.0
Change Period, (Y+R_c), s	5.6	0.0	4.6	4.6		0.0		0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.0		2.0			3.0		3.0
Green Extension Time (g_e), s	0.0	0.0	20.2	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.11			1.00		1.00

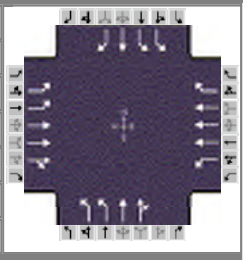
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	1	731	336	1	1573	720	0		553	0		353
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1554	1617	1698	1492	1617		1274	1617		1439
Queue Service Time (g_s), s	0.0	8.0	8.1	0.0	28.9	21.8	0.0		0.5	0.0		0.5
Cycle Queue Clearance Time (g_c), s	0.0	8.0	8.1	0.0	28.9	21.8	0.0		0.5	0.0		0.5
Green Ratio (*g*/*C*)	0.35	0.40	0.40	0.55	0.55	0.55	0.01		0.55	0.01		0.35
Capacity (*c*), veh/h	565	1358	621	888	1865	819	65		1399	65		502
Volume-to-Capacity Ratio (*X*)	0.002	0.538	0.541	0.001	0.844	0.878	0.000		0.395	0.000		0.703
Available Capacity (c_a), veh/h	565	1358	621	888	1865	819	65		1399	65		502
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	3.9	4.1	0.0	6.8	4.7	0.0		6.7	0.0		13.1
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.29	0.31	0.00	0.45	0.31	0.00		0.50	0.00		0.81
Uniform Delay (d_1), s/veh	10.5	7.1	7.1	2.2	6.7	2.8	0.0		14.3	0.0		30.9
Incremental Delay (d_2), s/veh	0.0	1.3	2.9	0.0	2.2	6.2	0.0		0.2	0.0		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
Control Delay (*d*), s/veh	10.5	8.4	10.0	2.2	8.9	9.0	0.0		14.5	0.0		35.2
Level of Service (LOS)	B	A	B	A	A	A			B			D
Approach Delay, s/veh / LOS	8.9	A		8.9	A		14.5	B		35.2	D	
Intersection Delay, s/veh / LOS	11.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.8	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

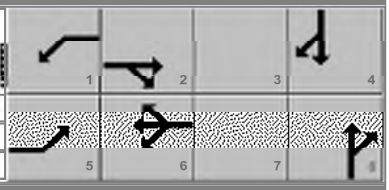
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build 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	120	40	1360	300	250	320	110	250	250	340

Signal Information												
Cycle, s	110.0	Reference Phase	2									
Offset, s	44	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
				Green	3.1	5.2	43.9	11.0	1.0	19.6		
				Yellow	3.0	3.0	3.6	3.0	0.0	3.6		
				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	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	18.3	59.7	8.1	49.5	16.0	25.2	17.0	26.2
Change Period, ($Y+R_c$), s	5.0	5.6	5.0	5.6	5.0	5.6	5.0	5.6
Max Allow Headway (*MAH*), s	4.2	0.0	4.1	0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	13.6		3.9		11.8	17.2	11.7	19.9
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	1.4	0.3	0.8
Phase Call Probability	1.00		0.76		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	1.00

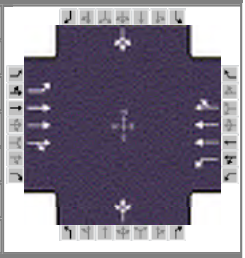
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	347	728	345	47	1600	345	294	250	235	294	294	271
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1603	1617	1542	1439	1632	1765	1630	1632	1765	1496
Queue Service Time (g_s), s	11.6	7.3	7.3	1.9	34.9	16.9	9.8	14.9	15.2	9.7	17.9	16.8
Cycle Queue Clearance Time (g_c), s	11.6	7.3	7.3	1.9	34.9	16.9	9.8	14.9	15.2	9.7	17.9	16.8
Green Ratio (*g/C*)	0.12	0.49	0.49	0.43	0.40	0.51	0.10	0.18	0.18	0.11	0.19	0.31
Capacity (*c*), veh/h	379	1671	789	311	1846	731	326	315	291	356	331	461
Volume-to-Capacity Ratio (*X*)	0.916	0.436	0.438	0.151	0.867	0.471	0.901	0.792	0.808	0.827	0.889	0.587
Available Capacity (c_a), veh/h	379	1671	789	337	1846	731	326	327	302	415	343	471
Back of Queue (*Q*), veh/ln (95th percentile)	7.4	3.9	3.9	1.3	18.6	9.4	8.9	12.0	11.7	8.0	15.0	10.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.97	0.22	0.23	0.17	0.46	1.23	1.13	0.34	0.33	0.25	0.38	1.76
Uniform Delay (d_1), s/veh	35.0	6.4	6.4	18.5	30.0	17.3	49.0	43.2	43.4	48.0	43.6	32.1
Incremental Delay (d_2), s/veh	21.2	0.6	1.3	0.2	4.9	1.8	26.6	12.1	14.5	11.4	23.1	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	0.0	0.0
Control Delay (*d*), s/veh	56.2	7.0	7.7	18.7	34.9	19.1	75.5	55.3	57.9	59.4	66.6	34.0
Level of Service (LOS)	E	A	A	B	C	B	E	E	E	E	E	C
Approach Delay, s/veh / LOS	19.2	B		31.8	C		63.7	E		53.9	D	
Intersection Delay, s/veh / LOS	36.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.1	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	1.3	A	1.6	A	1.1	A	1.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

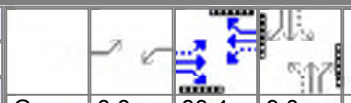
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build AM				

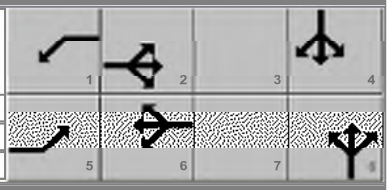


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	1040	40	50	1640	80	30	10	20	40	10	30

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	49	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.3	83.4	9.0	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	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		8.0		8.0
Phase Duration, s	6.4	89.0	6.3	89.0		14.6		14.6
Change Period, (Y+R_c), s	3.0	5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.9		2.9			7.3		9.0
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.1		0.1
Phase Call Probability	0.85		0.83			0.99		0.99
Max Out Probability	0.21		1.00			1.00		1.00

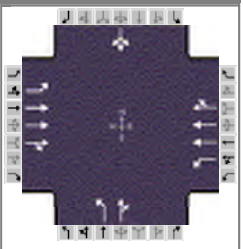
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	61	888	435	59	1359	665		71			94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1664	1617	1698	1656		1410			1449	
Queue Service Time (g_s), s	0.9	6.0	5.6	0.9	10.2	10.1		0.0			1.8	
Cycle Queue Clearance Time (g_c), s	0.9	6.0	5.6	0.9	10.2	10.1		5.3			7.0	
Green Ratio (*g*/*C*)	0.79	0.76	0.76	0.79	0.76	0.76		0.08			0.08	
Capacity (*c*), veh/h	250	2576	1263	387	2575	1255		165			168	
Volume-to-Capacity Ratio (*X*)	0.245	0.345	0.345	0.152	0.528	0.530		0.429			0.560	
Available Capacity (c_a), veh/h	323	2576	1263	417	2575	1255		183			186	
Back of Queue (*Q*), veh/ln (95th percentile)	0.4	2.7	2.6	0.4	3.8	4.1		3.5			4.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.08	0.07	0.07	0.07	0.08	0.08		0.18			0.24	
Uniform Delay (d_1), s/veh	3.3	2.4	2.2	3.0	2.3	2.2		48.6			49.5	
Incremental Delay (d_2), s/veh	0.4	0.3	0.6	0.1	0.6	1.3		1.8			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	3.7	2.7	2.8	3.1	3.0	3.6		50.4			52.5	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	2.8	A		3.2	A		50.4	D		52.5	D	
Intersection Delay, s/veh / LOS	5.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.2	A	1.6	A	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

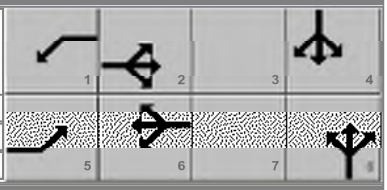
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build 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	36	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On	Green	2.1	0.5	80.1	13.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.0	0.0	3.6	3.6	0.0	0.0		
				Red	0.0	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	1.1	4.0	1.1	4.0		6.0		8.0
Phase Duration, s	5.1	85.7	5.6	86.3		18.6		18.6
Change Period, (Y+R_c), s	3.0	5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.4		2.6			13.5		6.3
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.1		0.4
Phase Call Probability	0.53		0.66			1.00		1.00
Max Out Probability	1.00		1.00			1.00		0.07

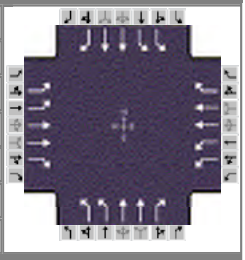
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	24	887	433	35	1345	667	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1656	1617	1698	1682	1382	1543			1486	
Queue Service Time (g_s), s	0.4	11.5	11.6	0.6	16.9	17.1	7.4	3.9			0.0	
Cycle Queue Clearance Time (g_c), s	0.4	11.5	11.6	0.6	16.9	17.1	11.5	3.9			4.3	
Green Ratio (*g/C*)	0.75	0.73	0.73	0.76	0.73	0.73	0.12	0.12			0.12	
Capacity (*c*), veh/h	213	2491	1215	357	2508	1242	170	175			212	
Volume-to-Capacity Ratio (*X*)	0.115	0.356	0.356	0.099	0.536	0.537	0.553	0.337			0.167	
Available Capacity (c_a), veh/h	278	2491	1215	414	2508	1242	195	202			239	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	6.7	6.8	0.3	6.1	6.2	4.8	2.8			1.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.13	0.13	0.05	0.05	0.05	0.82	0.14			0.08	
Uniform Delay (d_1), s/veh	5.0	6.2	6.2	3.8	5.2	5.3	50.4	45.0			44.2	
Incremental Delay (d_2), s/veh	0.2	0.4	0.8	0.0	0.2	0.4	2.8	1.1			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	
Control Delay (*d*), s/veh	5.3	6.5	7.0	3.8	5.4	5.7	53.2	46.1			44.5	
Level of Service (LOS)	A	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	6.7	A		5.5	A		50.5	D		44.5	D	
Intersection Delay, s/veh / LOS	8.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.2	A	1.6	A	0.7	A	0.5	A

Copyright © 2016 University of Florida, All Rights Reserved.

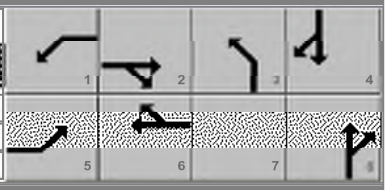
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th5_AM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build 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	81	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On	Green	8.0	5.3	44.6	4.5	6.3	13.4		
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	3.6	0.0	3.6	3.6	3.6	3.6		
				Red	2.0	0.0	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	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	18.8	55.4	13.6	50.2	21.9	30.9	10.1	19.0
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	13.0		7.6		15.4	20.3	4.7	13.7
Green Extension Time (g_e), s	0.2	0.0	0.4	0.0	0.9	2.2	0.1	0.0
Phase Call Probability	1.00		0.99		1.00	1.00	0.92	1.00
Max Out Probability	1.00		0.00		0.42	0.84	0.02	1.00

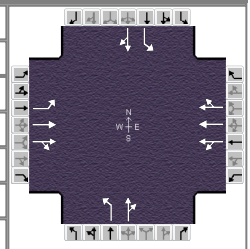
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	317	842	134	165	1271	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	11.0	18.9	3.7	5.6	41.7	5.3	13.4	18.3	5.1	2.7	11.7	0.0
Cycle Queue Clearance Time (g_c), s	11.0	18.9	3.7	5.6	41.7	5.3	13.4	18.3	5.1	2.7	11.7	0.0
Green Ratio (*g/C*)	0.12	0.45	0.60	0.07	0.41	0.45	0.15	0.23	0.30	0.04	0.12	0.24
Capacity (*c*), veh/h	379	1466	866	229	1311	642	485	772	452	132	409	363
Volume-to-Capacity Ratio (*X*)	0.838	0.575	0.155	0.721	0.969	0.220	0.850	0.793	0.221	0.622	0.891	0.000
Available Capacity (c_a), veh/h	415	1466	866	558	1311	642	635	774	453	368	411	363
Back of Queue (*Q*), veh/ln (95th percentile)	8.9	10.6	2.1	4.1	23.2	3.2	9.6	12.1	3.2	2.1	9.8	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.56	0.09	0.31	0.61	0.61	0.83	1.08	0.31	0.55	0.43	0.25	0.00
Uniform Delay (d_1), s/veh	51.5	17.9	7.7	48.6	24.6	14.2	42.9	35.8	25.7	51.2	45.3	0.0
Incremental Delay (d_2), s/veh	12.5	1.6	0.4	4.2	18.5	0.8	8.4	5.6	0.2	4.7	20.7	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	0.0	0.0
Control Delay (*d*), s/veh	64.0	19.5	8.0	52.8	43.1	15.0	51.3	41.4	25.9	55.9	66.1	0.0
Level of Service (LOS)	E	B	A	D	D	B	D	D	C	E	E	
Approach Delay, s/veh / LOS	29.2	C		41.6	D		43.7	D		64.2	E	
Intersection Delay, s/veh / LOS	40.8						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

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

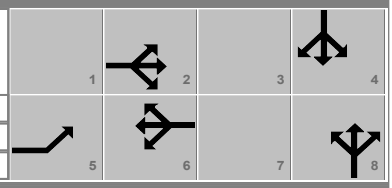


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1600	20	20	960	40	40	10	20	40	10	60

Signal Information			
Cycle, s	100.0	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	3.6	72.8	9.4	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		8.3		6.0		6.0
Phase Duration, s	6.6	85.0		78.4		15.0		15.0
Change Period, (Y+R_c), s	3.0	5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.3	0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s	3.2					9.9		6.9
Green Extension Time (g_e), s	0.0	0.0		0.0		0.0		0.2
Phase Call Probability	0.91					1.00		1.00
Max Out Probability	1.00					1.00		1.00

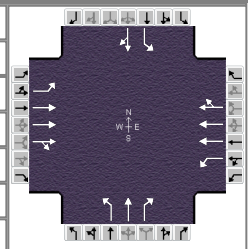
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	872	870	359	382	374	43	32		43	75	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1691	1438	1545	1513	1319	1576		1371	1529	
Queue Service Time (g_s), s	1.2	0.0	0.0	0.0	9.3	9.2	3.2	1.9		3.0	4.7	
Cycle Queue Clearance Time (g_c), s	1.2	0.0	0.0	7.5	9.3	9.2	7.9	1.9		4.9	4.7	
Green Ratio (*g*/*C*)	0.78	0.79	0.79	0.73	0.73	0.73	0.09	0.09		0.09	0.09	
Capacity (*c*), veh/h	444	1348	1342	1084	1124	1101	134	148		175	144	
Volume-to-Capacity Ratio (*X*)	0.194	0.647	0.648	0.331	0.340	0.340	0.321	0.218		0.246	0.524	
Available Capacity (c_a), veh/h	450	1348	1342	1084	1124	1101	134	148		175	144	
Back of Queue (*Q*), veh/ln (95th percentile)	0.6	1.6	1.6	4.8	5.4	5.2	2.0	1.4		1.9	3.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.04	0.04	0.17	0.19	0.18	0.67	0.07		0.64	0.17	
Uniform Delay (d_1), s/veh	3.2	0.0	0.0	4.9	5.2	5.1	46.9	41.9		44.2	43.2	
Incremental Delay (d_2), s/veh	0.2	2.4	2.4	0.8	0.8	0.8	1.4	0.7		0.7	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	
Control Delay (*d*), s/veh	3.4	2.4	2.4	5.7	6.0	5.9	48.3	42.6		44.9	46.6	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	2.5	A		5.9	A		45.9	D		46.0	D	
Intersection Delay, s/veh / LOS	6.4						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

Copyright © 2016 University of Florida, All Rights Reserved.

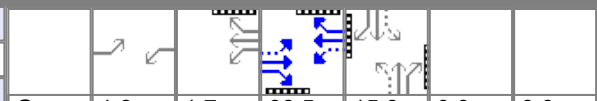
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

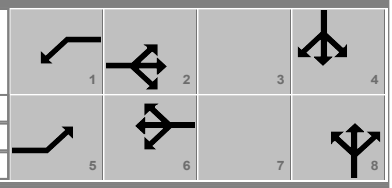


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1490	150	70	920	60	70	30	60	50	100	30

Signal Information			
Cycle, s	100.0	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	1.8	1.7	66.5	15.8	0.0	0.0
Yellow	3.0	0.0	3.6	3.6	0.0	0.0
Red	0.0	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	1.1	4.0	1.1	4.0		5.0		6.0
Phase Duration, s	4.8	72.1	6.5	73.8		21.4		21.4
Change Period, (Y+R_c), s	3.0	5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.3	0.0	4.3	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.4		3.4			15.5		9.6
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.3		0.9
Phase Call Probability	0.45		0.88			1.00		1.00
Max Out Probability	1.00		1.00			1.00		0.19

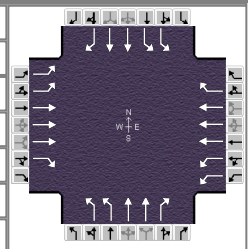
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	1194	569	77	723	350	75	32	65	54	140	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1616	1617	1698	1643	1244	1765	1496	1371	1694	
Queue Service Time (g_s), s	0.4	21.1	21.2	1.4	5.9	5.7	5.9	1.6	3.8	3.5	7.6	
Cycle Queue Clearance Time (g_c), s	0.4	21.1	21.2	1.4	5.9	5.7	13.5	1.6	3.8	5.1	7.6	
Green Ratio (*g*/*C*)	0.68	0.66	0.66	0.71	0.68	0.68	0.16	0.16	0.16	0.16	0.16	
Capacity (*c*), veh/h	404	2257	1074	247	2316	1120	174	279	236	267	268	
Volume-to-Capacity Ratio (*X*)	0.053	0.529	0.530	0.311	0.312	0.313	0.433	0.116	0.273	0.202	0.522	
Available Capacity (c_a), veh/h	466	2257	1074	281	2316	1120	194	307	260	288	295	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	12.3	12.2	0.9	3.3	3.3	3.4	1.2	2.6	2.2	5.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.43	0.43	0.16	0.12	0.12	0.35	0.06	0.52	0.55	0.30	
Uniform Delay (d_1), s/veh	5.3	11.3	11.4	8.1	3.9	3.8	44.9	36.1	37.0	38.3	38.6	
Incremental Delay (d_2), s/veh	0.0	0.7	1.4	0.6	0.3	0.6	1.7	0.2	0.6	0.4	1.6	
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	5.3	11.9	12.8	8.7	4.2	4.4	46.6	36.3	37.7	38.7	40.2	
Level of Service (LOS)	A	B	B	A	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	12.1	B		4.6	A		41.3	D		39.8	D	
Intersection Delay, s/veh / LOS	12.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.5	A	1.1	A	0.8	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

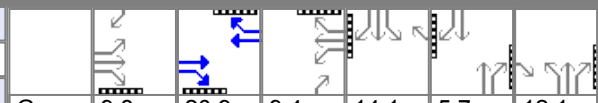
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

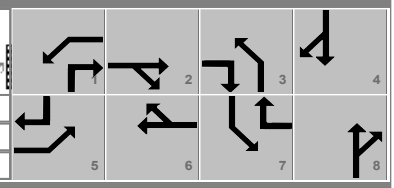


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	220	1180	200	240	680	210	210	520	360	360	530	160

Signal Information			
Cycle, s	100.0	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	9.8	20.9	9.4	14.1	5.7	12.1
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
Red	2.0	2.1	2.0	2.0	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	15.4	42.0	15.0	41.6	17.7	23.3	19.7	25.3
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	9.3		10.4		8.5	18.6	13.6	18.4
Green Extension Time (g_e), s	0.5	0.0	0.0	0.0	1.3	0.0	0.5	1.2
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	0.32		1.00		1.00	1.00	1.00	1.00

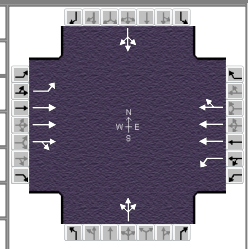
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1269	0	265	752	228	226	559	0	387	570	142
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1542	1439	1570	1542	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	7.3	19.6	0.0	8.4	12.1	9.1	6.5	16.6	0.0	11.6	16.4	7.1
Cycle Queue Clearance Time (g_c), s	7.3	19.6	0.0	8.4	12.1	9.1	6.5	16.6	0.0	11.6	16.4	7.1
Green Ratio (*g/C*)	0.10	0.36	0.48	0.09	0.36	0.50	0.12	0.18	0.27	0.14	0.20	0.29
Capacity (*c*), veh/h	309	1680	695	292	1660	719	386	586	399	455	653	436
Volume-to-Capacity Ratio (*X*)	0.766	0.755	0.000	0.908	0.453	0.317	0.585	0.954	0.000	0.852	0.873	0.325
Available Capacity (c_a), veh/h	485	1680	695	292	1660	719	387	587	399	530	742	476
Back of Queue (*Q*), veh/ln (95th percentile)	5.5	9.0	0.0	7.8	7.9	6.8	4.7	13.1	0.0	8.7	11.4	2.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.71	0.33	0.00	0.82	0.16	0.80	0.69	0.38	0.00	1.49	0.51	0.69
Uniform Delay (d_1), s/veh	43.9	15.8	0.0	44.7	23.4	14.1	39.7	37.9	0.0	39.6	35.7	4.7
Incremental Delay (d_2), s/veh	3.4	2.7	0.0	29.0	0.8	1.1	2.2	26.1	0.0	11.2	10.2	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	0.0
Control Delay (*d*), s/veh	47.3	18.6	0.0	73.8	24.3	15.2	42.0	64.0	0.0	50.8	45.9	5.1
Level of Service (LOS)	D	B		E	C	B	D	E		D	D	A
Approach Delay, s/veh / LOS	23.1	C		33.2	C		57.7	E		42.4	D	
Intersection Delay, s/veh / LOS	36.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.6	D	3.1	C	3.5	C	3.8	D
Bicycle LOS Score / LOS	1.3	A	1.2	A	1.1	A	1.4	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

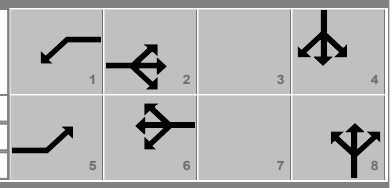


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	1760	90	60	1070	40	20	10	30	50	20	40

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	48	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.1	0.3	72.9	9.5	0.0	0.0
Yellow	3.0	0.0	3.6	3.6	0.0	0.0
Red	0.0	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	1.1	4.0	1.1	4.0		8.0		8.0
Phase Duration, s	6.1	78.5	6.4	78.8		15.1		15.1
Change Period, (Y+R_c), s	3.0	5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.3	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.8		3.0			5.8		9.5
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.2		0.1
Phase Call Probability	0.78		0.84			0.99		0.99
Max Out Probability	1.00		1.00			0.82		1.00

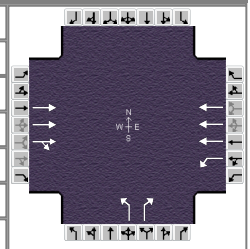
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	1336	653	66	824	404		65			118	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1654	1617	1698	1665		1515			1523	
Queue Service Time (g_s), s	0.8	29.2	29.8	1.0	6.9	6.8		0.0			3.7	
Cycle Queue Clearance Time (g_c), s	0.8	29.2	29.8	1.0	6.9	6.8		3.8			7.5	
Green Ratio (*g*/*C*)	0.76	0.73	0.73	0.76	0.73	0.73		0.10			0.10	
Capacity (*c*), veh/h	402	2476	1206	218	2485	1218		192			197	
Volume-to-Capacity Ratio (*X*)	0.134	0.540	0.542	0.305	0.332	0.332		0.335			0.599	
Available Capacity (c_a), veh/h	430	2476	1206	242	2485	1218		205			210	
Back of Queue (*Q*), veh/ln (95th percentile)	0.4	17.0	17.2	1.0	3.5	3.6		2.8			5.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.09	0.34	0.34	0.27	0.09	0.09		0.14			0.28	
Uniform Delay (d_1), s/veh	3.3	16.1	16.6	9.5	3.5	3.5		42.6			44.2	
Incremental Delay (d_2), s/veh	0.1	0.5	0.9	0.7	0.3	0.7		1.0			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	
Control Delay (*d*), s/veh	3.4	16.5	17.6	10.3	3.9	4.2		43.6			48.4	
Level of Service (LOS)	A	B	B	B	A	A		D			D	
Approach Delay, s/veh / LOS	16.5	B		4.3	A		43.6	D		48.4	D	
Intersection Delay, s/veh / LOS	13.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.2	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

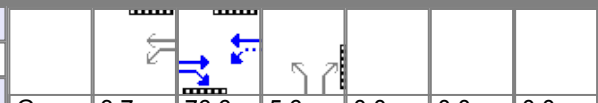
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

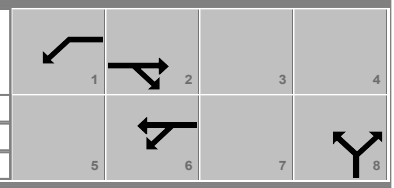


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1720	120	80	1110		60		40			

Signal Information			
Cycle, s	100.0	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	3.7	76.6	5.6	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		2	1	6		8		
Case Number		8.3	1.0	4.0		9.0		
Phase Duration, s		82.2	6.7	88.8		11.2		
Change Period, (*Y*+*Rc*), s		5.6	3.0	5.6		5.6		
Max Allow Headway (*MAH*), s		0.0	4.2	0.0		4.3		
Queue Clearance Time (g_s), s			3.0			5.8		
Green Extension Time (g_e), s		0.0	0.1	0.0		0.1		
Phase Call Probability			0.91			0.95		
Max Out Probability			0.55			1.00		

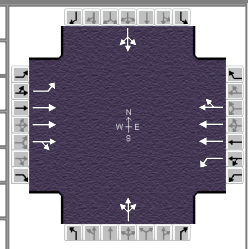
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		1333	646	89	1231		65		43			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1639	1617	1542		1681		1496			
Queue Service Time (g_s), s		17.8	10.0	1.0	5.8		3.8		2.8			
Cycle Queue Clearance Time (g_c), s		17.8	10.0	1.0	5.8		3.8		2.8			
Green Ratio (*g*/*C*)		0.77	0.77	0.82	0.83		0.06		0.06			
Capacity (*c*), veh/h		2601	1255	255	3850		94		83			
Volume-to-Capacity Ratio (*X*)		0.512	0.515	0.348	0.320		0.689		0.516			
Available Capacity (c_a), veh/h		2601	1255	322	3850		158		141			
Back of Queue (*Q*), veh/ln (95th percentile)		3.8	4.2	0.8	1.8		3.2		2.1			
Queue Storage Ratio (*RQ*) (95th percentile)		0.10	0.11	0.14	0.03		0.41		0.26			
Uniform Delay (d_1), s/veh		2.4	2.4	5.1	1.8		46.4		45.9			
Incremental Delay (d_2), s/veh		0.6	1.3	0.7	0.2		8.7		4.9			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		3.0	3.6	5.8	2.0		55.0		50.8			
Level of Service (LOS)		A	A	A	A		E		D			
Approach Delay, s/veh / LOS	3.2	A		2.2	A		53.3	D		0.0		
Intersection Delay, s/veh / LOS	4.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	0.6	A	3.3	C	3.2	C
Bicycle LOS Score / LOS	1.6	A	1.2	A		F		

Copyright © 2016 University of Florida, All Rights Reserved.

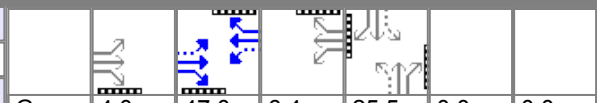
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

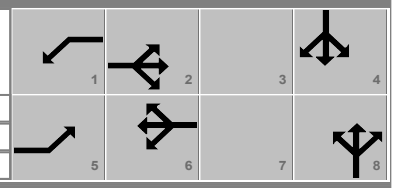


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1650	80	110	1120	110	20	20	160	130	40	120

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	50	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.0	47.0	6.4	25.5	0.0	0.0
Yellow	3.0	3.6	3.0	3.5	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	1	6		8		4
Case Number	1.2	4.0	1.3	4.0		8.0		8.0
Phase Duration, s	7.0	59.6	9.4	62.0		31.0		31.0
Change Period, (Y+R_c), s	3.0	5.6	5.6	5.6		5.5		5.5
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.4		4.4
Queue Clearance Time (g_s), s	4.6		2.0			14.1		27.5
Green Extension Time (g_e), s	0.0	0.0	1.3	0.0		1.8		0.0
Phase Call Probability	0.90		0.96			1.00		1.00
Max Out Probability	1.00		1.00			0.10		1.00

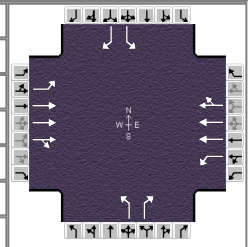
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	84	1215	593	116	879	419		215			312	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1656	1617	1698	1617		1561			1106	
Queue Service Time (g_s), s	2.6	28.9	29.0	0.0	16.1	16.1		0.0			13.4	
Cycle Queue Clearance Time (g_c), s	2.6	28.9	29.0	0.0	16.1	16.1		12.1			25.5	
Green Ratio (*g*/*C*)	0.53	0.54	0.54	0.49	0.56	0.56		0.26			0.26	
Capacity (*c*), veh/h	262	1832	894	191	1915	912		438			334	
Volume-to-Capacity Ratio (*X*)	0.319	0.663	0.664	0.607	0.459	0.459		0.491			0.933	
Available Capacity (c_a), veh/h	262	1832	894	194	1915	912		438			334	
Back of Queue (*Q*), veh/ln (95th percentile)	1.7	17.5	17.7	5.5	9.6	9.4		8.0			16.1	
Queue Storage Ratio (*RQ*) (95th percentile)	0.29	0.28	0.28	0.96	0.59	0.58		0.20			0.41	
Uniform Delay (d_1), s/veh	13.7	22.0	22.1	42.4	14.0	14.0		32.2			39.7	
Incremental Delay (d_2), s/veh	0.6	1.6	3.3	3.7	0.6	1.2		0.9			32.4	
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	14.3	23.6	25.4	46.1	14.6	15.2		33.1			72.1	
Level of Service (LOS)	B	C	C	D	B	B		C			E	
Approach Delay, s/veh / LOS	23.8	C		17.3	B		33.1	C		72.1	E	
Intersection Delay, s/veh / LOS	25.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.3	A	0.8	A	1.0	A

Copyright © 2016 University of Florida, All Rights Reserved.

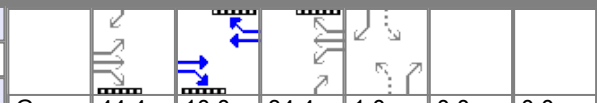
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 SB Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

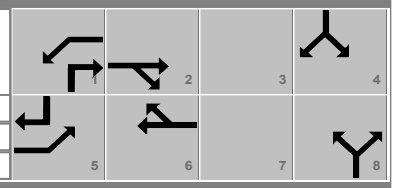


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	1520	370	1	1050	410	0		410	0		220

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	18	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	44.4	10.0	34.4	1.0	0.0	0.0
Yellow	3.6	0.0	3.6	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	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	2.0	4.0		5.0		5.0
Phase Duration, s	50.0	60.0	39.0	49.0		1.0		1.0
Change Period, (Y+R_c), s	5.6	0.0	4.6	4.6		0.0		0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.0		2.0			3.0		3.0
Green Extension Time (g_e), s	0.0	0.0	9.0	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.06			1.00		1.00

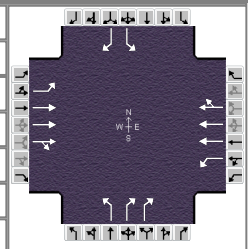
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	1	1418	649	1	1093	468	0		441	0		237
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1527	1617	1698	1453	1617		1439	1617		1439
Queue Service Time (g_s), s	0.0	26.7	26.7	0.0	12.9	12.9	0.0		0.5	0.0		0.5
Cycle Queue Clearance Time (g_c), s	0.0	26.7	26.7	0.0	12.9	12.9	0.0		0.5	0.0		0.5
Green Ratio (*g*/*C*)	0.44	0.60	0.60	0.34	0.44	0.44	0.01		0.35	0.01		0.45
Capacity (*c*), veh/h	718	2038	916	556	1508	645	72		495	72		639
Volume-to-Capacity Ratio (*X*)	0.002	0.696	0.708	0.002	0.725	0.725	0.000		0.891	0.000		0.370
Available Capacity (c_a), veh/h	718	2038	916	556	1508	645	72		495	72		639
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	13.0	12.0	0.0	4.6	4.9	0.0		17.6	0.0		6.3
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.97	0.90	0.01	0.35	0.37	0.00		1.15	0.00		0.41
Uniform Delay (d_1), s/veh	9.0	11.7	11.0	9.5	5.3	5.3	0.0		31.0	0.0		18.5
Incremental Delay (d_2), s/veh	0.0	1.4	3.2	0.0	2.3	5.2	0.0		18.0	0.0		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
Control Delay (*d*), s/veh	9.0	13.1	14.2	9.5	7.6	10.5	0.0		49.0	0.0		18.9
Level of Service (LOS)	A	B	B	A	A	B			D			B
Approach Delay, s/veh / LOS	13.4	B		8.5	A		49.0	D		18.9	B	
Intersection Delay, s/veh / LOS	15.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.4	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

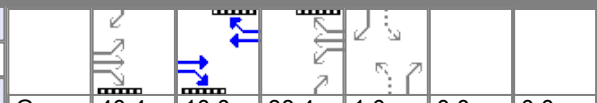
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 NB Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

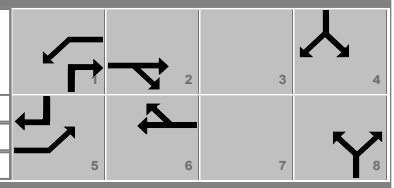


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	1610	320	1	1110	280	0		500	0		350

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	10	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	40.4	10.0	38.4	1.0	0.0	0.0
Yellow	3.6	0.0	3.6	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	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	2.0	4.0		5.0		5.0
Phase Duration, s	46.0	56.0	43.0	53.0		1.0		1.0
Change Period, (Y+R_c), s	5.6	0.0	4.6	4.6		0.0		0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.0		2.0			3.0		3.0
Green Extension Time (g_e), s	0.0	0.0	8.5	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.03			1.00		1.00

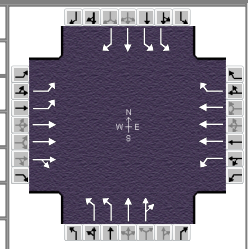
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	1	1435	667	1	1026	459	0		538	0		376
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1552	1617	1698	1520	1617		1274	1617		1439
Queue Service Time (g_s), s	0.0	23.8	24.8	0.0	14.7	11.9	0.0		0.5	0.0		0.5
Cycle Queue Clearance Time (g_c), s	0.0	23.8	24.8	0.0	14.7	11.9	0.0		0.5	0.0		0.5
Green Ratio (*g*/*C*)	0.40	0.56	0.56	0.38	0.48	0.48	0.01		0.39	0.01		0.41
Capacity (*c*), veh/h	653	1902	869	621	1644	736	72		978	72		581
Volume-to-Capacity Ratio (*X*)	0.002	0.755	0.767	0.002	0.624	0.624	0.000		0.550	0.000		0.647
Available Capacity (c_a), veh/h	653	1902	869	621	1644	736	72		978	72		581
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	8.1	8.3	0.0	6.6	5.1	0.0		8.4	0.0		11.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.61	0.62	0.01	0.43	0.34	0.00		0.63	0.00		0.71
Uniform Delay (d_1), s/veh	14.3	8.1	8.3	18.3	8.7	6.2	0.0		24.0	0.0		24.1
Incremental Delay (d_2), s/veh	0.0	1.7	3.9	0.0	1.3	2.9	0.0		0.7	0.0		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
Control Delay (*d*), s/veh	14.3	9.9	12.2	18.3	10.1	9.1	0.0		24.7	0.0		26.6
Level of Service (LOS)	B	A	B	B	B	A			C			C
Approach Delay, s/veh / LOS	10.6	B		9.8	A		24.7	C		26.6	C	
Intersection Delay, s/veh / LOS	13.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.3	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

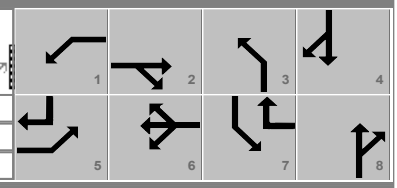
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build 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	300	40	970	360	170	190	220	450	310	250

Signal Information			
Cycle, s	100.0	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	2.8	4.5	33.3	7.6	4.7	15.9	
Yellow	3.0	3.0	3.6	3.0	3.0	3.6	
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	2.0	4.0	1.1	3.0	2.0	4.0	2.0	3.0
Phase Duration, s	17.3	48.4	7.8	38.9	12.6	21.5	22.3	31.2
Change Period, ($Y+R_c$), s	5.0	5.6	5.0	5.6	5.0	5.6	5.0	5.6
Max Allow Headway (*MAH*), s	4.2	0.0	4.1	0.0	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	13.7		3.7		7.5	15.7	16.4	19.3
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.2	0.2	0.9	2.3
Phase Call Probability	1.00		0.69		0.99	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	0.84	0.65

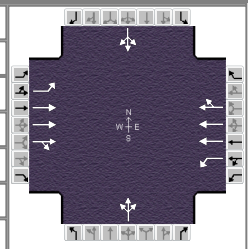
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	369	1264	585	43	1035	354	183	204	210	484	333	225
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1564	1617	1542	1439	1632	1765	1496	1632	1765	1496
Queue Service Time (g_s), s	11.7	26.0	26.5	1.7	16.2	13.9	5.5	11.0	13.7	14.4	17.3	11.0
Cycle Queue Clearance Time (g_c), s	11.7	26.0	26.5	1.7	16.2	13.9	5.5	11.0	13.7	14.4	17.3	11.0
Green Ratio (*g/C*)	0.12	0.43	0.43	0.36	0.33	0.51	0.08	0.16	0.16	0.17	0.26	0.38
Capacity (*c*), veh/h	387	1454	670	152	1539	728	248	280	237	566	452	567
Volume-to-Capacity Ratio (*X*)	0.955	0.869	0.874	0.280	0.672	0.486	0.737	0.730	0.884	0.855	0.738	0.396
Available Capacity (c_a), veh/h	387	1454	670	175	1539	728	326	283	240	685	455	570
Back of Queue (*Q*), veh/ln (95th percentile)	7.8	7.0	7.4	1.3	8.0	6.0	4.3	9.3	11.3	10.5	12.7	7.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.02	0.41	0.43	0.16	0.20	0.78	0.55	0.26	0.32	0.32	0.32	1.18
Uniform Delay (d_1), s/veh	40.8	9.7	9.7	23.7	19.2	10.8	45.2	40.0	41.2	40.1	34.1	22.7
Incremental Delay (d_2), s/veh	20.3	3.4	7.3	0.9	2.1	2.0	6.0	9.1	29.5	8.9	6.2	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	0.0
Control Delay (*d*), s/veh	61.1	13.1	17.0	24.6	21.3	12.8	51.2	49.1	70.7	49.0	40.3	23.1
Level of Service (LOS)	E	B	B	C	C	B	D	D	E	D	D	C
Approach Delay, s/veh / LOS	22.1	C		19.3	B		57.3	E		40.6	D	
Intersection Delay, s/veh / LOS	29.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	1.8	A	1.3	A	1.0	A	2.2	B

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

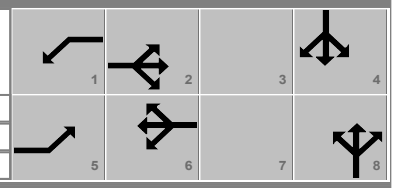


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	150	1830	140	40	1260	130	40	10	50	120	10	70

Signal Information			
Cycle, s	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	2.8	2.2	66.4	14.4	0.0	0.0
Yellow	3.0	0.0	3.6	3.6	0.0	0.0
Red	0.0	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	1.1	4.0	1.1	4.0		8.0		8.0
Phase Duration, s	8.0	74.2	5.8	72.0		20.0		20.0
Change Period, ($Y+R_c$), s	3.0	5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0		4.3		4.3
Queue Clearance Time (g_s), s	4.9		2.8			8.6		16.4
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0		0.6		0.0
Phase Call Probability	0.99		0.70			1.00		1.00
Max Out Probability	1.00		1.00			0.49		1.00

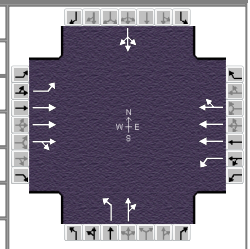
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	162	1433	695	43	1013	481		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1634	1617	1698	1614		1442			1264	
Queue Service Time (g_s), s	2.9	24.2	23.9	0.8	8.1	8.1		0.0			7.8	
Cycle Queue Clearance Time (g_c), s	2.9	24.2	23.9	0.8	8.1	8.1		6.6			14.4	
Green Ratio (*g/C*)	0.73	0.69	0.69	0.69	0.66	0.66		0.14			0.14	
Capacity (*c*), veh/h	349	2330	1121	194	2256	1072		258			240	
Volume-to-Capacity Ratio (*X*)	0.464	0.615	0.620	0.222	0.449	0.449		0.417			0.898	
Available Capacity (c_a), veh/h	382	2330	1121	214	2256	1072		258			240	
Back of Queue (*Q*), veh/ln (95th percentile)	1.6	10.8	10.3	0.5	3.7	3.9		4.5			12.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.27	0.27	0.26	0.09	0.07	0.08		0.23			0.61	
Uniform Delay (d_1), s/veh	5.2	9.5	9.1	8.9	3.6	3.6		39.4			44.3	
Incremental Delay (d_2), s/veh	0.4	0.5	1.0	0.5	0.6	1.2		1.1			32.4	
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	5.6	9.9	10.0	9.4	4.1	4.8		40.4			76.7	
Level of Service (LOS)	A	A	B	A	A	A		D			E	
Approach Delay, s/veh / LOS	9.7	A		4.5	A		40.4	D		76.7	E	
Intersection Delay, s/veh / LOS	12.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.7	A	1.3	A	0.7	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

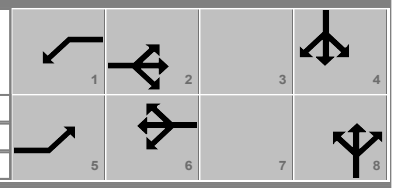
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Bahnson Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build 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	100.0	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	2.4	0.4	68.6	14.4	0.0	0.0
Yellow	3.0	0.0	3.6	3.6	0.0	0.0
Red	0.0	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	1.1	4.0	1.1	4.0		6.0		8.0
Phase Duration, s	5.4	74.2	5.8	74.6		20.0		20.0
Change Period, (Y+R_c), s	3.0	5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s	4.1	0.0	4.1	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.6		2.8			14.7		8.4
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.0		0.4
Phase Call Probability	0.59		0.70			1.00		1.00
Max Out Probability	1.00		1.00			1.00		0.33

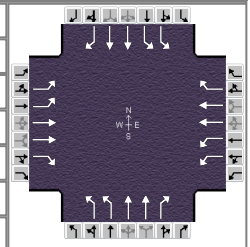
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	32	1434	694	43	986	487	86	75			54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1630	1617	1698	1678	1385	1529			1133	
Queue Service Time (g_s), s	0.6	20.3	20.7	0.8	17.8	17.9	6.1	4.4			1.9	
Cycle Queue Clearance Time (g_c), s	0.6	20.3	20.7	0.8	17.8	17.9	12.7	4.4			6.4	
Green Ratio (*g*/*C*)	0.71	0.69	0.69	0.71	0.69	0.69	0.14	0.14			0.14	
Capacity (*c*), veh/h	280	2331	1119	205	2345	1159	179	220			220	
Volume-to-Capacity Ratio (*X*)	0.116	0.615	0.620	0.210	0.420	0.420	0.480	0.343			0.244	
Available Capacity (c_a), veh/h	307	2331	1119	225	2345	1159	180	220			221	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	8.9	9.1	0.4	10.4	10.5	3.9	3.1			2.2	
Queue Storage Ratio (*RQ*) (95th percentile)	0.05	0.18	0.18	0.07	0.09	0.09	0.67	0.16			0.11	
Uniform Delay (d_1), s/veh	6.4	6.8	6.9	7.0	11.7	11.8	45.4	38.6			39.5	
Incremental Delay (d_2), s/veh	0.1	0.9	1.9	0.3	0.3	0.7	2.0	0.9			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	
Control Delay (*d*), s/veh	6.6	7.7	8.8	7.3	12.1	12.4	47.4	39.5			40.0	
Level of Service (LOS)	A	A	A	A	B	B	D	D			D	
Approach Delay, s/veh / LOS	8.1	A		12.0	B		43.7	D		40.0	D	
Intersection Delay, s/veh / LOS	11.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.1	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.7	A	1.3	A	0.8	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

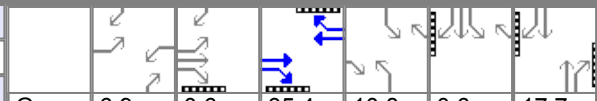
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th5_PM_6_Lanes_pm+pt_Lefts.xus				
Project Description	2035 Build PM				

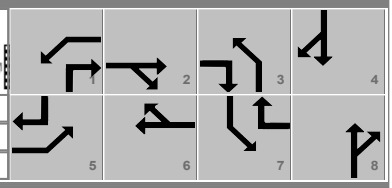


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	340	1230	340	150	760	70	270	390	270	310	440	380

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	64	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.9	0.6	35.4	10.8	0.6	17.7	
Yellow	3.6	3.6	3.6	3.6	0.0	3.6	
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	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	18.7	47.2	12.5	41.0	16.4	23.3	17.0	23.9
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	13.5		7.0		10.7	16.9	12.1	15.4
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.1	0.9	0.0	1.8
Phase Call Probability	1.00		0.99		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	1.00

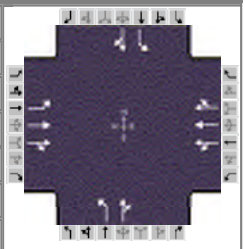
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	367	1328	326	161	817	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	11.5	40.9	15.3	5.0	20.1	2.3	8.7	11.7	14.9	10.1	13.4	0.0
Cycle Queue Clearance Time (g_c), s	11.5	40.9	15.3	5.0	20.1	2.3	8.7	11.7	14.9	10.1	13.4	0.0
Green Ratio (*g/C*)	0.13	0.42	0.52	0.07	0.35	0.47	0.11	0.18	0.25	0.11	0.18	0.31
Capacity (*c*), veh/h	411	1344	753	218	1145	674	352	595	368	372	615	469
Volume-to-Capacity Ratio (*X*)	0.894	0.989	0.433	0.741	0.714	0.107	0.824	0.705	0.668	0.896	0.769	0.000
Available Capacity (c_a), veh/h	411	1344	753	223	1145	674	372	618	379	372	638	480
Back of Queue (*Q*), veh/ln (95th percentile)	8.5	25.8	9.0	4.1	11.4	1.4	7.5	8.8	9.7	9.0	9.9	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.49	0.22	1.34	0.61	0.30	0.36	0.84	0.22	1.64	1.83	0.25	0.00
Uniform Delay (d_1), s/veh	41.7	33.2	17.5	44.5	22.4	12.1	43.7	38.7	34.0	43.7	38.8	0.0
Incremental Delay (d_2), s/veh	17.4	19.0	1.4	12.2	3.8	0.3	13.4	3.5	4.3	23.3	5.5	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	59.1	52.1	18.9	56.7	26.2	12.4	57.1	42.2	38.3	67.0	44.3	0.0
Level of Service (LOS)	E	D	B	E	C	B	E	D	D	E	D	
Approach Delay, s/veh / LOS	48.0	D		29.9	C		45.7	D		53.7	D	
Intersection Delay, s/veh / LOS	44.6						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

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build AM				

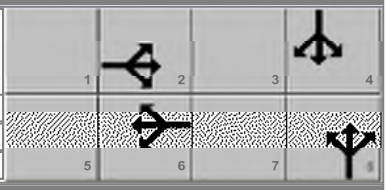


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	650	40	10	1420	50	20	10	10	20	10	70

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	83.5	10.3	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		8.0		6.0		6.0
Phase Duration, s		89.1		89.1		15.9		15.9
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						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						1.00		0.27

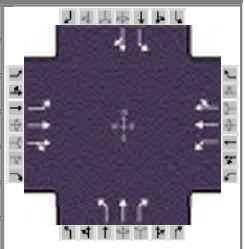
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	410	402	618	568	558	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	268	1698	1663	1680	1545	1516	1297	1619		1382	1525	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	7.8	7.5	1.9	1.4		1.7	6.2	
Cycle Queue Clearance Time (g_c), s	11.2	0.0	0.0	7.6	7.8	7.5	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	262	1351	1323	1371	1229	1206	117	159		184	149	
Volume-to-Capacity Ratio (*X*)	0.269	0.304	0.304	0.451	0.462	0.463	0.202	0.148		0.128	0.630	
Available Capacity (c_a), veh/h	262	1351	1323	1371	1229	1206	167	222		238	209	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	0.4	0.4	3.4	3.2	3.0	1.1	1.0		1.1	4.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.01	0.01	0.12	0.11	0.11	0.38	0.05		0.36	0.23	
Uniform Delay (d_1), s/veh	0.5	0.0	0.0	1.7	1.7	1.6	49.6	43.4		44.9	45.5	
Incremental Delay (d_2), s/veh	2.5	0.6	0.6	0.8	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	3.0	0.6	0.6	2.5	2.6	2.6	50.4	43.8		45.2	49.9	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	0.8	A		2.6	A		47.1	D		48.9	D	
Intersection Delay, s/veh / LOS	4.7						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	1.2	A	1.4	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build AM				

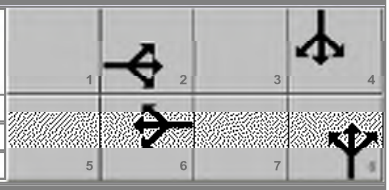


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	600	50	60	1290	30	160	40	20	30	30	30

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	95	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	73.4	20.4	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		79.0		79.0		26.0		26.0
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						20.5		6.6
Green Extension Time (g_e), s		0.0		0.0		0.0		1.1
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.01

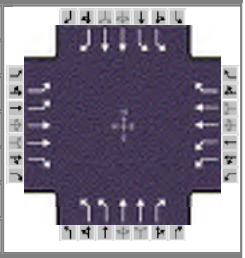
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	387	377	71	780	776	188	47	24	35	71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	318	1698	1652	673	1698	1684	1324	1765	1496	1353	1619	
Queue Service Time (g_s), s	7.0	11.1	11.1	1.3	13.4	13.3	14.7	2.3	1.4	2.3	3.9	
Cycle Queue Clearance Time (g_c), s	19.9	11.1	11.1	13.9	13.4	13.3	18.5	2.3	1.4	4.6	3.9	
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	250	1187	1155	468	1187	1177	277	343	291	302	315	
Volume-to-Capacity Ratio (*X*)	0.141	0.326	0.327	0.151	0.657	0.659	0.679	0.137	0.081	0.117	0.224	
Available Capacity (c_a), veh/h	250	1187	1155	468	1187	1177	277	343	291	302	315	
Back of Queue (*Q*), veh/ln (95th percentile)	1.0	7.7	7.6	0.5	4.9	4.8	9.0	1.8	0.9	1.4	2.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.18	0.27	0.27	0.09	0.18	0.17	0.92	0.09	0.18	0.36	0.14	
Uniform Delay (d_1), s/veh	13.5	7.8	7.9	3.2	2.6	2.6	43.4	35.0	34.6	36.9	35.6	
Incremental Delay (d_2), s/veh	1.1	0.7	0.7	0.4	1.6	1.6	6.5	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	14.6	8.5	8.6	3.5	4.2	4.1	50.0	35.2	34.7	37.1	36.0	
Level of Service (LOS)	B	A	A	A	A	A	D	D	C	D	D	
Approach Delay, s/veh / LOS	8.8	A		4.1	A		45.9	D		36.4	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

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build 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	95	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	27.8	16.5	8.1	2.6	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	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	12.0	45.5	22.1	55.6	15.5	23.7	13.7	22.0
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	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	6.3		13.3		7.4	16.1	7.9	15.2
Green Extension Time (g_e), s	0.2	0.0	3.9	0.0	2.0	1.9	0.2	1.1
Phase Call Probability	0.98		1.00		0.99	1.00	1.00	1.00
Max Out Probability	0.34		0.83		0.67	0.75	1.00	0.71

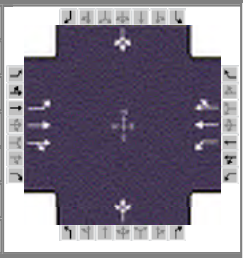
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	471	165	366	1286	209	176	471	212	188	435	98
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	4.3	9.6	6.0	11.3	37.0	8.4	5.4	14.1	11.6	5.9	13.2	5.6
Cycle Queue Clearance Time (g_c), s	4.3	9.6	6.0	11.3	37.0	8.4	5.4	14.1	11.6	5.9	13.2	5.6
Green Ratio (*g/C*)	0.06	0.38	0.47	0.16	0.48	0.55	0.09	0.17	0.33	0.08	0.15	0.22
Capacity (*c*), veh/h	191	1225	679	490	1537	795	300	571	485	250	516	319
Volume-to-Capacity Ratio (*X*)	0.679	0.384	0.243	0.746	0.837	0.263	0.588	0.825	0.437	0.753	0.844	0.306
Available Capacity (c_a), veh/h	356	1225	679	607	1537	795	408	681	534	348	640	375
Back of Queue (*Q*), veh/ln (95th percentile)	3.4	6.4	3.7	7.0	20.4	7.0	4.0	10.0	3.7	4.6	9.6	2.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.45	0.23	0.64	0.73	0.40	0.81	0.58	0.29	0.24	0.42	0.43	0.70
Uniform Delay (d_1), s/veh	51.1	19.0	12.9	37.4	25.7	13.2	44.1	39.0	6.4	46.1	40.4	1.7
Incremental Delay (d_2), s/veh	4.0	0.9	0.8	2.7	3.9	0.5	1.8	7.0	0.6	5.8	8.4	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	0.0
Control Delay (*d*), s/veh	55.2	19.9	13.7	40.1	29.6	13.8	45.9	46.0	7.1	51.9	48.8	2.3
Level of Service (LOS)	E	B	B	D	C	B	D	D	A	D	D	A
Approach Delay, s/veh / LOS	24.5	C		29.9	C		36.4	D		43.3	D	
Intersection Delay, s/veh / LOS	32.6						C					

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	1.1	A	2.0	B	1.2	A	1.1	A

Copyright © 2016 University of Florida, All Rights Reserved.

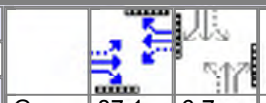
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build AM				

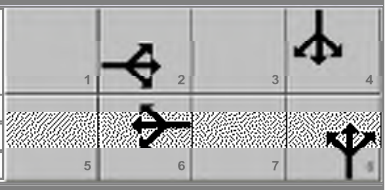


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	720	10	20	1580	30	10	10	30	30	10	20

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	87.1	6.7	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		92.7		92.7		12.3		12.3
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						5.7		6.8
Green Extension Time (g_e), s		0.0		0.0		0.1		0.1
Phase Call Probability						0.98		0.98
Max Out Probability						1.00		1.00

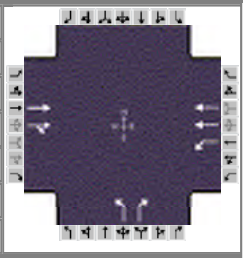
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	430	428	24	950	949		59			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	228	1698	1690	616	1698	1687		1614			1496	
Queue Service Time (g_s), s	1.3	8.6	8.5	1.3	25.0	25.4		0.0			1.1	
Cycle Queue Clearance Time (g_c), s	27.4	8.6	8.5	9.8	25.0	25.4		3.7			4.8	
Green Ratio (*g/C*)	0.83	0.83	0.83	0.83	0.83	0.83		0.06			0.06	
Capacity (*c*), veh/h	202	1408	1401	529	1408	1399		145			147	
Volume-to-Capacity Ratio (*X*)	0.058	0.306	0.306	0.045	0.674	0.679		0.407			0.479	
Available Capacity (c_a), veh/h	202	1408	1401	529	1408	1399		183			184	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	4.9	4.8	0.3	10.1	10.1		2.8			3.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.10	0.10	0.05	0.26	0.27		0.14			0.17	
Uniform Delay (d_1), s/veh	6.9	3.3	3.3	4.1	4.2	4.2		47.7			48.2	
Incremental Delay (d_2), s/veh	0.5	0.5	0.5	0.1	1.7	1.7		1.8			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	7.3	3.8	3.8	4.2	5.9	6.0		49.6			50.6	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	3.8	A		5.9	A		49.6	D		50.6	D	
Intersection Delay, s/veh / LOS	7.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.2	A	2.1	B	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

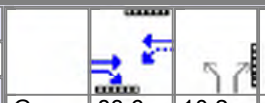
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build 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	8	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	83.6	10.2	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		89.2		89.2		15.8		
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 (*gs*), s						9.9		
Green Extension Time (*ge*), s		0.0		0.0		0.4		
Phase Call Probability						1.00		
Max Out Probability						0.23		

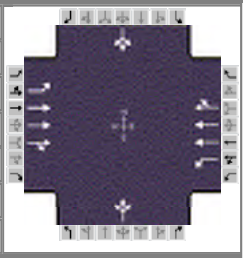
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		462	456	35	1793		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1675	583	1617		1681		1496			
Queue Service Time (*gs*), s		10.3	6.7	0.2	6.0		7.9		4.7			
Cycle Queue Clearance Time (*gc*), s		10.3	6.7	11.4	6.0		7.9		4.7			
Green Ratio (*g/C*)		0.80	0.80	0.80	0.80		0.10		0.10			
Capacity (*c*), veh/h		1351	1333	475	2573		164		146			
Volume-to-Capacity Ratio (*X*)		0.342	0.342	0.074	0.697		0.790		0.484			
Available Capacity (*ca*), veh/h		1351	1333	475	2573		263		234			
Back of Queue (*Q*), veh/ln (95th percentile)		3.1	3.1	0.1	1.7		6.6		3.3			
Queue Storage Ratio (*RQ*) (95th percentile)		0.08	0.08	0.02	0.03		0.84		0.42			
Uniform Delay (*d1*), s/veh		2.3	2.3	1.2	0.5		46.3		44.9			
Incremental Delay (*d2*), s/veh		0.7	0.7	0.2	1.3		8.2		2.5			
Initial Queue Delay (*d3*), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		3.0	3.0	1.5	1.8		54.5		47.4			
Level of Service (LOS)		A	A	A	A		D		D			
Approach Delay, s/veh / LOS	3.0	A		1.7	A		52.0	D		0.0		
Intersection Delay, s/veh / LOS	5.6						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		

Copyright © 2016 University of Florida, All Rights Reserved.

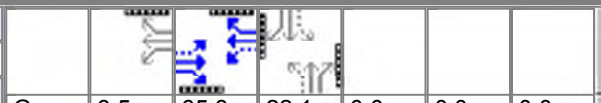
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build AM				

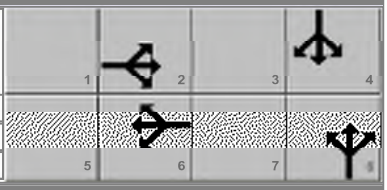


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	760	30	60	1490	120	20	40	120	70	30	90

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	81	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.5	65.3	22.1	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		70.9	6.5	77.4		27.6		27.6
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		4.4		4.4
Queue Clearance Time (g_s), s			3.5			15.0		22.0
Green Extension Time (g_e), s		0.0	0.0	0.0		1.1		0.1
Phase Call Probability			0.86			1.00		1.00
Max Out Probability			1.00			0.30		1.00

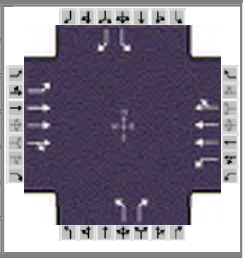
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	616	302	68	1239	597		212			224	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	242	1698	1664	1617	1698	1631		1540			1172	
Queue Service Time (g_s), s	7.9	9.9	10.0	1.5	0.0	0.0		0.0			7.0	
Cycle Queue Clearance Time (g_c), s	8.0	9.9	10.0	1.5	0.0	0.0		13.0			20.0	
Green Ratio (*g/C*)	0.62	0.62	0.62	0.67	0.68	0.68		0.21			0.21	
Capacity (*c*), veh/h	219	2112	1034	429	2321	1114		363			294	
Volume-to-Capacity Ratio (*X*)	0.159	0.292	0.292	0.160	0.534	0.535		0.583			0.760	
Available Capacity (c_a), veh/h	219	2112	1034	489	2321	1114		368			299	
Back of Queue (*Q*), veh/ln (95th percentile)	0.9	6.7	6.9	0.9	0.2	0.3		8.9			10.7	
Queue Storage Ratio (*RQ*) (95th percentile)	0.16	0.11	0.11	0.16	0.01	0.02		0.23			0.27	
Uniform Delay (d_1), s/veh	11.0	10.7	10.9	6.8	0.0	0.0		37.8			40.8	
Incremental Delay (d_2), s/veh	1.5	0.3	0.7	0.1	0.3	0.6		2.3			10.6	
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	12.4	11.1	11.6	6.9	0.3	0.6		40.1			51.5	
Level of Service (LOS)	B	B	B	A	A	A		D			D	
Approach Delay, s/veh / LOS	11.3	B		0.6	A		40.1	D		51.5	D	
Intersection Delay, s/veh / LOS	9.7						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.6	A	0.8	A	0.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

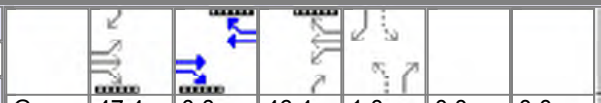
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & I-229 SB Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build AM				

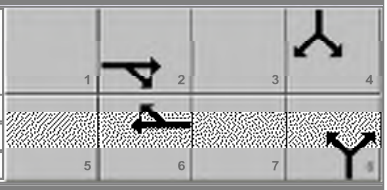


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	660	280	1	1300	480	0		200	0		320

Signal Information			
Cycle, s	105.0	Reference Phase	6
Offset, s	77	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	47.4	0.0	46.4	1.0	0.0	0.0
Yellow	3.6	0.0	3.6	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	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	2.0	4.0		5.0		5.0
Phase Duration, s	53.0	53.0	51.0	51.0		1.0		1.0
Change Period, ($Y+R_c$), s	5.6	0.0	4.6	4.6		0.0		0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.1		2.0			3.0		3.0
Green Extension Time (g_e), s	0.0	0.0	15.7	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.12			1.00		1.00

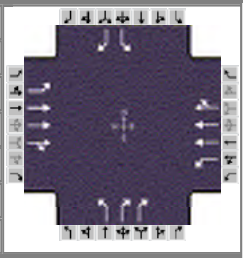
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	1	774	331	1	1450	642	0		235	0		376
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1440	1617	1698	1466	1617		1439	1617		1439
Queue Service Time (g_s), s	0.1	18.7	19.2	0.0	38.5	44.1	0.0		0.5	0.0		0.5
Cycle Queue Clearance Time (g_c), s	0.1	18.7	19.2	0.0	38.5	44.1	0.0		0.5	0.0		0.5
Green Ratio (*g/C*)	0.45	0.50	0.50	0.44	0.44	0.44	0.01		0.45	0.01		0.46
Capacity (*c*), veh/h	730	1714	727	715	1501	648	69		636	69		650
Volume-to-Capacity Ratio (*X*)	0.002	0.452	0.456	0.002	0.966	0.991	0.000		0.370	0.000		0.580
Available Capacity (c_a), veh/h	730	1714	727	715	1501	648	69		636	69		650
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	12.6	11.7	0.0	7.9	9.7	0.0		6.7	0.0		10.9
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.95	0.87	0.00	0.59	0.73	0.00		0.44	0.00		0.72
Uniform Delay (d_1), s/veh	19.4	23.4	24.1	5.0	8.3	8.8	0.0		19.5	0.0		21.4
Incremental Delay (d_2), s/veh	0.0	0.8	1.9	0.0	9.3	21.4	0.0		0.4	0.0		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
Control Delay (*d*), s/veh	19.4	24.2	26.1	5.0	17.6	30.2	0.0		19.9	0.0		22.7
Level of Service (LOS)	B	C	C	A	B	C			B			C
Approach Delay, s/veh / LOS	24.7	C		21.4	C		19.9	B		22.7	C	
Intersection Delay, s/veh / LOS	22.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.1	A	1.6	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & I-229 NB Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build 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	1	720	140	1	1480	470	0		470	0		300

Signal Information												
Cycle, s	105.0	Reference Phase	6									
Offset, s	63	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
				Green	37.4	0.0	56.4	1.0	0.0	0.0		
				Yellow	3.6	0.0	3.6	0.0	0.0	0.0		
				Red	2.0	0.0	1.0	0.0	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	2.0	4.0		5.0		5.0
Phase Duration, s	43.0	43.0	61.0	61.0		1.0		1.0
Change Period, (Y+R_c), s	5.6	0.0	4.6	4.6		0.0		0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.0		2.0			3.0		3.0
Green Extension Time (g_e), s	0.0	0.0	19.8	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.13			1.00		1.00

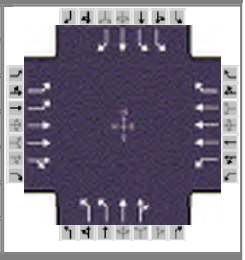
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	1	691	319	1	1573	720	0		553	0		353
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1554	1617	1698	1492	1617		1274	1617		1439
Queue Service Time (g_s), s	0.0	6.3	6.4	0.0	28.2	21.2	0.0		0.5	0.0		0.5
Cycle Queue Clearance Time (g_c), s	0.0	6.3	6.4	0.0	28.2	21.2	0.0		0.5	0.0		0.5
Green Ratio (*g*/*C*)	0.36	0.41	0.41	0.54	0.54	0.54	0.01		0.54	0.01		0.36
Capacity (*c*), veh/h	576	1391	636	869	1824	801	69		1368	69		513
Volume-to-Capacity Ratio (*X*)	0.002	0.497	0.501	0.001	0.862	0.898	0.000		0.404	0.000		0.689
Available Capacity (c_a), veh/h	576	1391	636	869	1824	801	69		1368	69		513
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	3.2	3.4	0.0	6.0	4.4	0.0		6.5	0.0		12.3
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.24	0.25	0.00	0.39	0.28	0.00		0.49	0.00		0.76
Uniform Delay (d_1), s/veh	7.9	5.9	6.0	1.9	6.1	2.4	0.0		14.4	0.0		28.8
Incremental Delay (d_2), s/veh	0.0	1.2	2.5	0.0	2.3	6.6	0.0		0.2	0.0		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	7.9	7.1	8.5	1.9	8.4	9.0	0.0		14.6	0.0		32.7
Level of Service (LOS)	A	A	A	A	A	A			B			C
Approach Delay, s/veh / LOS	7.5	A		8.6	A		14.6	B		32.7	C	
Intersection Delay, s/veh / LOS	11.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.2	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.0	A	1.8	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build 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	120	40	1360	300	250	320	110	250	250	340

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	33	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	12.9	39.1	12.0	0.2	19.6	0.0
Yellow	3.0	3.6	3.0	0.0	3.6	0.0
Red	2.0	2.0	2.0	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	4.0		5.3	2.0	4.0	2.0	3.0
Phase Duration, s	17.9	62.6		44.7	17.1	25.4	17.0	25.2
Change Period, (Y+R_c), s	5.0	5.6		5.6	5.0	5.6	5.0	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	12.5				11.2	16.4	11.2	19.1
Green Extension Time (g_e), s	0.4	0.0		0.0	0.9	1.7	0.7	0.6
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				0.01	1.00	0.12	1.00

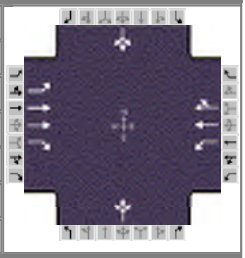
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	335	704	334	47	1600	345	294	250	235	294	294	271
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1603	521	1542	1439	1632	1765	1630	1632	1765	1496
Queue Service Time (g_s), s	10.5	0.0	0.0	7.7	35.5	18.6	9.2	14.0	14.4	9.2	17.1	16.0
Cycle Queue Clearance Time (g_c), s	10.5	0.0	0.0	7.7	35.5	18.6	9.2	14.0	14.4	9.2	17.1	16.0
Green Ratio (*g*/*C*)	0.12	0.54	0.54	0.37	0.37	0.49	0.12	0.19	0.19	0.11	0.19	0.31
Capacity (*c*), veh/h	387	1846	871	263	1723	700	377	332	307	372	329	463
Volume-to-Capacity Ratio (*X*)	0.866	0.381	0.383	0.179	0.929	0.492	0.779	0.751	0.766	0.791	0.893	0.584
Available Capacity (c_a), veh/h	471	1846	871	263	1723	700	715	343	317	591	340	473
Back of Queue (*Q*), veh/ln (95th percentile)	6.4	0.2	0.4	1.9	19.3	10.6	7.0	11.1	10.8	7.0	14.6	9.9
Queue Storage Ratio (*RQ*) (95th percentile)	0.83	0.01	0.02	0.24	0.48	1.39	0.89	0.31	0.31	0.22	0.37	1.68
Uniform Delay (d_1), s/veh	33.6	0.0	0.0	28.2	38.8	22.8	45.1	40.3	40.4	45.3	41.7	30.5
Incremental Delay (d_2), s/veh	10.5	0.4	1.0	0.8	5.9	1.3	3.5	8.7	10.4	3.8	24.0	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	0.0	0.0
Control Delay (*d*), s/veh	44.1	0.5	1.0	29.0	44.7	24.1	48.6	48.9	50.8	49.1	65.7	32.3
Level of Service (LOS)	D	A	A	C	D	C	D	D	D	D	E	C
Approach Delay, s/veh / LOS	11.3	B		40.7	D		49.4	D		49.5	D	
Intersection Delay, s/veh / LOS	35.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.1	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	1.3	A	1.6	A	1.1	A	1.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

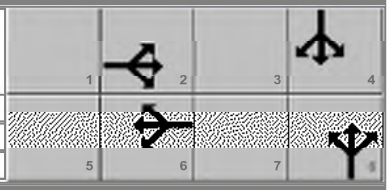
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build 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	50	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	3.3	78.8	8.7	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	3.0		6.3		8.0		8.0
Phase Duration, s	6.3	90.7		84.4		14.3		14.3
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		4.3		4.3
Queue Clearance Time (g_s), s	2.8					7.0		8.6
Green Extension Time (g_e), s	0.1	0.0		0.0		0.2		0.2
Phase Call Probability	0.83					0.99		0.99
Max Out Probability	0.00					0.42		1.00

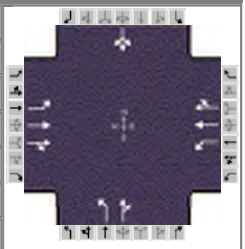
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	60	1244	48	59	1012	1012		71			94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	429	1698	1670		1426			1463	
Queue Service Time (g_s), s	0.8	6.3	0.1	1.9	27.8	29.1		0.0			1.7	
Cycle Queue Clearance Time (g_c), s	0.8	6.3	0.1	2.0	27.8	29.1		5.0			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	215	2621	1167	390	1275	1254		169			172	
Volume-to-Capacity Ratio (*X*)	0.279	0.475	0.041	0.151	0.794	0.807		0.417			0.546	
Available Capacity (c_a), veh/h	345	2621	1167	390	1275	1254		221			224	
Back of Queue (*Q*), veh/ln (95th percentile)	1.0	1.9	0.1	0.3	7.4	7.5		3.3			4.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.17	0.05	0.00	0.05	0.15	0.15		0.17			0.23	
Uniform Delay (d_1), s/veh	9.2	1.2	0.2	1.6	3.8	3.9		46.3			47.2	
Incremental Delay (d_2), s/veh	0.6	0.5	0.1	0.5	3.1	3.4		1.6			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	9.8	1.7	0.3	2.1	6.9	7.2		48.0			49.8	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	2.0	A		6.9	A		48.0	D		49.8	D	
Intersection Delay, s/veh / LOS	7.0						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.0	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	1.6	A	2.2	B	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build AM				

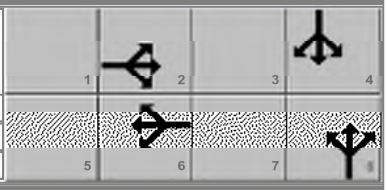


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1030	50	30	1680	30	80	10	40	10	10	10

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	33	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	81.8	12.0	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		6.0		6.0		8.0
Phase Duration, s		87.4		87.4		17.6		17.6
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		5.9
Green Extension Time (g_e), s		0.0		0.0		0.1		0.4
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.11

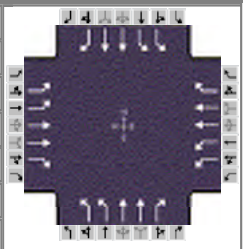
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	24	650	640	35	1006	1006	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	204	1698	1670	410	1698	1687	1382	1543			1518	
Queue Service Time (g_s), s	5.2	15.3	15.4	0.3	12.2	12.4	7.1	3.7			0.0	
Cycle Queue Clearance Time (g_c), s	16.9	15.3	15.4	17.1	12.2	12.4	10.6	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	205	1331	1309	331	1331	1323	174	169			212	
Volume-to-Capacity Ratio (*X*)	0.117	0.488	0.489	0.107	0.755	0.760	0.541	0.349			0.167	
Available Capacity (c_a), veh/h	205	1331	1309	331	1331	1323	199	197			239	
Back of Queue (*Q*), veh/ln (95th percentile)	0.5	7.6	7.6	0.2	2.2	2.2	4.6	2.6			1.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.08	0.15	0.15	0.03	0.02	0.02	0.78	0.13			0.08	
Uniform Delay (d_1), s/veh	7.2	4.5	4.6	2.0	1.0	1.0	48.1	43.3			42.6	
Incremental Delay (d_2), s/veh	1.0	1.1	1.1	0.1	0.9	1.0	2.6	1.2			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	
Control Delay (*d*), s/veh	8.2	5.7	5.7	2.2	1.9	1.9	50.7	44.5			42.9	
Level of Service (LOS)	A	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	5.7	A		1.9	A		48.3	D		42.9	D	
Intersection Delay, s/veh / LOS	5.7						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

Copyright © 2016 University of Florida, All Rights Reserved.

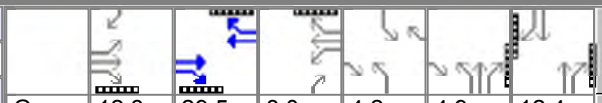
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th-5B&C_AM.xus				
Project Description	2035 Build AM				

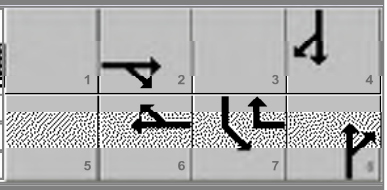


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	260	690	130	140	1080	130	350	520	100	70	310	310

Signal Information			
Cycle, s	105.0	Reference Phase	2
Offset, s	82	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	12.3	29.5	8.0	4.2	4.9	12.4
Yellow	3.6	3.6	3.6	3.6	3.6	3.6
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	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	17.9	53.0	13.6	48.7	20.3	28.5	9.8	18.0
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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		14.9	19.9	4.6	13.2
Green Extension Time (g_e), s	0.3	0.0	0.8	0.0	0.0	1.5	0.0	0.0
Phase Call Probability	1.00		0.99		1.00	1.00	0.91	1.00
Max Out Probability	1.00		1.00		1.00	1.00	1.00	1.00

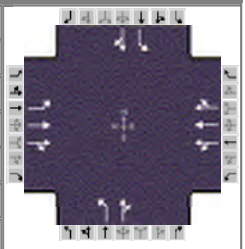
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	311	824	131	165	1271	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	10.0	16.5	3.2	5.3	39.2	5.0	12.9	17.9	4.9	2.6	11.2	0.0
Cycle Queue Clearance Time (g_c), s	10.0	16.5	3.2	5.3	39.2	5.0	12.9	17.9	4.9	2.6	11.2	0.0
Green Ratio (*g/C*)	0.12	0.45	0.59	0.08	0.41	0.45	0.14	0.22	0.30	0.04	0.12	0.24
Capacity (*c*), veh/h	368	1459	851	241	1328	649	458	734	442	131	398	352
Volume-to-Capacity Ratio (*X*)	0.844	0.565	0.154	0.684	0.957	0.218	0.898	0.833	0.226	0.628	0.917	0.000
Available Capacity (c_a), veh/h	430	1459	851	251	1328	649	458	734	442	210	398	352
Back of Queue (*Q*), veh/ln (95th percentile)	7.2	8.7	0.7	4.0	21.5	3.0	10.3	12.1	2.4	2.0	9.8	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.26	0.07	0.11	0.61	0.56	0.78	1.16	0.31	0.40	0.41	0.25	0.00
Uniform Delay (d_1), s/veh	41.4	15.3	2.9	45.9	22.9	13.2	41.9	35.4	4.0	48.9	43.7	0.0
Incremental Delay (d_2), s/veh	11.2	1.4	0.3	7.1	16.3	0.8	20.2	8.1	0.3	4.9	25.8	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	52.6	16.6	3.2	53.0	39.2	14.0	62.2	43.6	4.3	53.8	69.5	0.0
Level of Service (LOS)	D	B	A	D	D	B	E	D	A	D	E	
Approach Delay, s/veh / LOS	24.1	C		38.4	D		46.9	D		66.6	E	
Intersection Delay, s/veh / LOS	39.3						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

Copyright © 2016 University of Florida, All Rights Reserved.

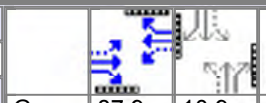
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build PM				

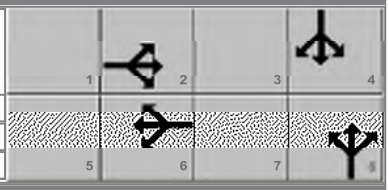


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1600	20	20	960	40	40	10	20	40	10	60

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	87.9	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		7.5
Green Extension Time (g_e), s		0.0		0.0		0.2		0.4
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.17

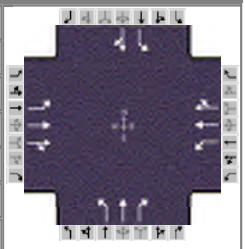
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	872	870	350	379	372	43	32		43	75	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	501	1698	1691	1412	1545	1514	1319	1576		1371	1529	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	6.0	6.1	3.5	2.1		3.3	5.1	
Cycle Queue Clearance Time (g_c), s	7.6	0.0	0.0	4.8	6.0	6.1	8.8	2.1		5.5	5.1	
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	439	1357	1351	1163	1235	1210	133	156		174	151	
Volume-to-Capacity Ratio (*X*)	0.196	0.642	0.644	0.301	0.307	0.307	0.324	0.207		0.247	0.498	
Available Capacity (c_a), veh/h	439	1357	1351	1163	1235	1210	175	206		218	200	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	1.6	1.6	2.7	3.0	2.9	2.2	1.5		2.1	3.7	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.04	0.04	0.09	0.10	0.10	0.74	0.08		0.71	0.19	
Uniform Delay (d_1), s/veh	0.3	0.0	0.0	2.2	2.3	2.3	51.2	45.6		48.2	47.0	
Incremental Delay (d_2), s/veh	1.0	2.3	2.4	0.6	0.6	0.6	1.4	0.6		0.7	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	
Control Delay (*d*), s/veh	1.3	2.3	2.4	2.8	2.9	2.9	52.6	46.2		48.9	49.5	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	2.3	A		2.9	A		49.9	D		49.3	D	
Intersection Delay, s/veh / LOS	5.4						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

Copyright © 2016 University of Florida, All Rights Reserved.

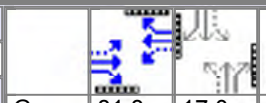
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build PM				

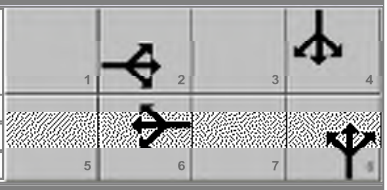


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1490	150	70	920	60	70	30	60	50	100	30

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	90	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	81.8	17.0	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		6.0		5.0		6.0
Phase Duration, s		87.4		87.4		22.6		22.6
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						16.9		10.4
Green Extension Time (g_e), s		0.0		0.0		0.1		0.8
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.27

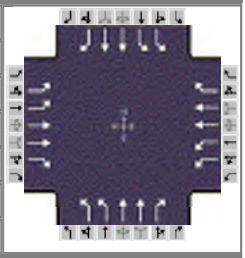
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	887	877	76	535	523	75	32	65	54	140	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	511	1698	1644	260	1698	1661	1244	1765	1496	1371	1694	
Queue Service Time (g_s), s	1.6	30.9	32.4	12.6	8.5	8.0	6.5	1.7	4.2	3.9	8.4	
Cycle Queue Clearance Time (g_c), s	10.1	30.9	32.4	55.1	8.5	8.0	14.9	1.7	4.2	5.6	8.4	
Green Ratio (*g/C*)	0.74	0.74	0.74	0.74	0.74	0.74	0.15	0.15	0.15	0.15	0.15	
Capacity (*c*), veh/h	406	1263	1222	182	1263	1235	163	273	231	255	262	
Volume-to-Capacity Ratio (*X*)	0.053	0.702	0.717	0.414	0.424	0.424	0.462	0.118	0.279	0.210	0.534	
Available Capacity (c_a), veh/h	406	1263	1222	182	1263	1235	167	279	237	261	268	
Back of Queue (*Q*), veh/ln (95th percentile)	0.4	15.6	15.8	2.9	4.5	4.1	3.8	1.4	2.9	2.4	6.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.06	0.54	0.55	0.50	0.16	0.15	0.39	0.07	0.58	0.61	0.33	
Uniform Delay (d_1), s/veh	6.5	7.6	7.8	16.5	2.9	2.7	49.7	40.1	41.1	42.5	42.9	
Incremental Delay (d_2), s/veh	0.2	2.4	2.7	5.6	0.9	0.9	2.0	0.2	0.7	0.4	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	
Control Delay (*d*), s/veh	6.7	10.1	10.5	22.1	3.8	3.6	51.8	40.2	41.7	42.9	44.8	
Level of Service (LOS)	A	B	B	C	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	10.2	B		4.9	A		45.8	D		44.3	D	
Intersection Delay, s/veh / LOS	12.3						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	2.0	A	1.4	A	0.8	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build 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	100	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On									
Force Mode	Fixed	Simult. Gap N/S	On									
				Green	9.4	28.3	10.4	14.4	1.4	12.3		
				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	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	15.0	49.0	16.0	50.0	17.9	25.0	20.0	27.1
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	10.3		11.0		9.2	21.3	14.9	20.1
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	1.6	0.0	0.0	1.3
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	0.98

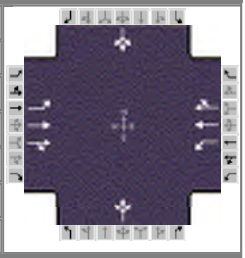
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1269	215	260	736	223	226	559	387	387	570	142
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	8.3	43.0	7.8	9.0	19.8	9.6	7.2	18.2	19.3	12.9	18.1	8.0
Cycle Queue Clearance Time (g_c), s	8.3	43.0	7.8	9.0	19.8	9.6	7.2	18.2	19.3	12.9	18.1	8.0
Green Ratio (*g/C*)	0.09	0.39	0.50	0.09	0.40	0.53	0.11	0.18	0.27	0.13	0.19	0.28
Capacity (*c*), veh/h	268	1273	726	294	1302	768	359	584	399	423	647	415
Volume-to-Capacity Ratio (*X*)	0.881	0.997	0.296	0.883	0.565	0.290	0.630	0.958	0.971	0.915	0.881	0.342
Available Capacity (c_a), veh/h	268	1273	726	294	1302	768	359	584	399	423	735	454
Back of Queue (*Q*), veh/ln (95th percentile)	7.1	24.6	4.4	7.9	12.5	7.8	5.4	14.2	15.2	10.5	12.6	3.7
Queue Storage Ratio (*RQ*) (95th percentile)	0.93	0.89	0.78	0.82	0.25	0.91	0.79	0.42	0.97	0.98	0.56	0.94
Uniform Delay (d_1), s/veh	53.7	26.8	11.5	49.6	26.5	14.7	44.7	41.7	5.1	44.8	39.5	2.9
Incremental Delay (d_2), s/veh	20.1	20.1	0.7	23.4	1.6	0.9	3.5	27.0	37.4	24.3	11.0	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	0.0
Control Delay (*d*), s/veh	73.8	46.9	12.2	73.0	28.1	15.5	48.2	68.7	42.5	69.1	50.5	3.4
Level of Service (LOS)	E	D	B	E	C	B	D	E	D	E	D	A
Approach Delay, s/veh / LOS	46.2	D		35.4	D		56.1	E		51.0	D	
Intersection Delay, s/veh / LOS	46.9						D					

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	1.9	A	1.5	A	1.5	A	1.4	A

Copyright © 2016 University of Florida, All Rights Reserved.

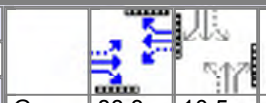
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build PM				

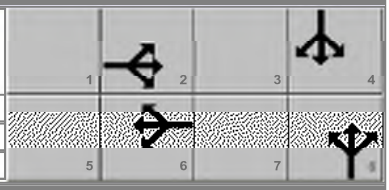


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	1760	90	60	1070	40	20	10	30	50	20	40

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	51	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	88.3	10.5	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		8.0		8.0
Phase Duration, s		93.9		93.9		16.1		16.1
Change Period, (Y+R_c), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						6.2		10.4
Green Extension Time (g_e), s		0.0		0.0		0.3		0.1
Phase Call Probability						1.00		1.00
Max Out Probability						0.27		1.00

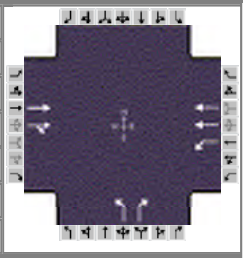
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	995	995	65	605	597		65			118	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	446	1698	1669	209	1698	1676		1497			1504	
Queue Service Time (g_s), s	10.1	40.9	43.0	34.2	13.4	13.5		0.0			4.2	
Cycle Queue Clearance Time (g_c), s	21.1	40.9	43.0	72.6	13.4	13.5		4.2			8.4	
Green Ratio (*g/C*)	0.80	0.80	0.80	0.80	0.80	0.80		0.10			0.10	
Capacity (*c*), veh/h	368	1363	1340	151	1363	1345		187			191	
Volume-to-Capacity Ratio (*X*)	0.146	0.730	0.742	0.429	0.444	0.444		0.346			0.619	
Available Capacity (c_a), veh/h	368	1363	1340	151	1363	1345		212			217	
Back of Queue (*Q*), veh/ln (95th percentile)	1.4	18.0	18.7	3.2	7.1	7.1		3.1			6.1	
Queue Storage Ratio (*RQ*) (95th percentile)	0.25	0.35	0.37	0.56	0.19	0.19		0.16			0.31	
Uniform Delay (d_1), s/veh	13.0	10.0	10.7	29.7	4.0	4.0		46.9			48.7	
Incremental Delay (d_2), s/veh	0.1	0.5	0.6	7.7	0.9	0.9		1.1			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	
Control Delay (*d*), s/veh	13.1	10.5	11.2	37.4	4.9	4.9		48.0			53.0	
Level of Service (LOS)	B	B	B	D	A	A		D			D	
Approach Delay, s/veh / LOS	10.9	B		6.6	A		48.0	D		53.0	D	
Intersection Delay, s/veh / LOS	11.5						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	2.2	B	1.5	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build 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	2	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On	Green	92.7	6.1	0.0	0.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	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		98.3		98.3		11.7		
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						6.1		
Green Extension Time (g_e), s		0.0		0.0		0.2		
Phase Call Probability						0.96		
Max Out Probability						0.03		

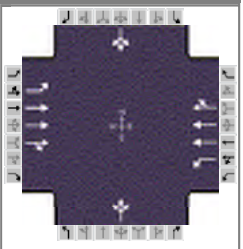
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		989	989	87	1202		65		43			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1659	211	1617		1681		1496			
Queue Service Time (g_s), s		36.7	36.8	52.7	14.1		4.1		3.1			
Cycle Queue Clearance Time (g_c), s		36.7	36.8	76.0	14.1		4.1		3.1			
Green Ratio (*g*/*C*)		0.84	0.84	0.84	0.84		0.06		0.06			
Capacity (*c*), veh/h		1431	1398	172	2725		93		83			
Volume-to-Capacity Ratio (*X*)		0.691	0.707	0.503	0.441		0.692		0.519			
Available Capacity (c_a), veh/h		1431	1398	172	2725		220		196			
Back of Queue (*Q*), veh/ln (95th percentile)		16.7	17.2	4.2	6.7		3.6		2.3			
Queue Storage Ratio (*RQ*) (95th percentile)		0.44	0.45	0.74	0.11		0.45		0.29			
Uniform Delay (d_1), s/veh		7.1	7.4	26.7	3.6		51.0		50.5			
Incremental Delay (d_2), s/veh		1.7	1.9	9.0	0.5		8.8		4.9			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		8.8	9.3	35.8	4.0		59.9		55.5			
Level of Service (LOS)		A	A	D	A		E		E			
Approach Delay, s/veh / LOS	9.0	A		6.2	A		58.1	E		0.0		
Intersection Delay, s/veh / LOS	9.5						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		

Copyright © 2016 University of Florida, All Rights Reserved.

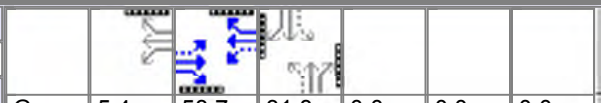
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build PM				

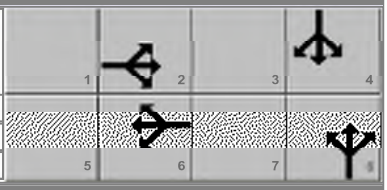


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1650	80	110	1120	110	20	20	160	130	40	120

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	39	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.4	58.7	31.8	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		64.3	8.4	72.7		37.3		37.3
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		4.4		4.4
Queue Clearance Time (g_s), s			5.5			14.7		31.6
Green Extension Time (g_e), s		0.0	0.1	0.0		2.1		0.2
Phase Call Probability			0.97			1.00		1.00
Max Out Probability			1.00			0.01		1.00

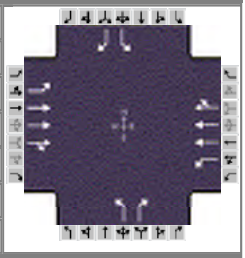
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	84	1215	593	112	847	404		215			312	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	426	1698	1656	1617	1698	1617		1554			1152	
Queue Service Time (g_s), s	10.6	26.0	26.0	3.5	5.8	5.8		0.0			16.9	
Cycle Queue Clearance Time (g_c), s	10.6	26.0	26.0	3.5	5.8	5.8		12.7			29.6	
Green Ratio (*g/C*)	0.53	0.53	0.53	0.60	0.61	0.61		0.29			0.29	
Capacity (*c*), veh/h	293	1812	884	218	2070	986		486			381	
Volume-to-Capacity Ratio (*X*)	0.286	0.671	0.672	0.512	0.409	0.409		0.443			0.819	
Available Capacity (c_a), veh/h	293	1812	884	252	2070	986		495			389	
Back of Queue (*Q*), veh/ln (95th percentile)	1.9	13.3	13.4	1.9	2.9	2.9		8.4			14.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.33	0.21	0.21	0.33	0.12	0.12		0.21			0.37	
Uniform Delay (d_1), s/veh	11.7	15.1	15.0	13.5	3.3	3.3		32.3			39.7	
Incremental Delay (d_2), s/veh	1.6	1.3	2.7	1.2	0.4	0.8		0.6			12.7	
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	13.4	16.4	17.7	14.7	3.7	4.2		32.9			52.4	
Level of Service (LOS)	B	B	B	B	A	A		C			D	
Approach Delay, s/veh / LOS	16.7	B		4.8	A		32.9	C		52.4	D	
Intersection Delay, s/veh / LOS	16.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.3	A	0.8	A	1.0	A

Copyright © 2016 University of Florida, All Rights Reserved.

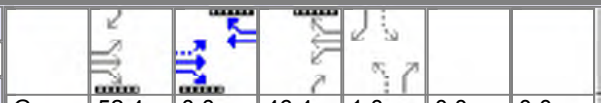
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 SB Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build 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	1	1520	370	1	1050	410	0		410	0		220

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	18	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	52.4	0.0	46.4	1.0	0.0	0.0
Yellow	3.6	0.0	3.6	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	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	2.0	4.0		5.0		5.0
Phase Duration, s	58.0	58.0	51.0	51.0		1.0		1.0
Change Period, (Y+R_c), s	5.6	0.0	4.6	4.6		0.0		0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.0		2.0			3.0		3.0
Green Extension Time (g_e), s	0.0	0.0	9.5	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.02			1.00		1.00

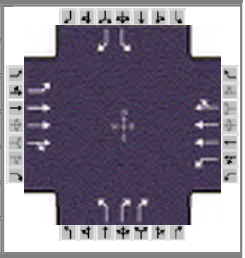
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	1	1398	638	1	1096	469	0		441	0		237
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1527	1617	1698	1453	1617		1439	1617		1439
Queue Service Time (g_s), s	0.0	29.2	29.0	0.0	22.3	22.3	0.0		0.5	0.0		0.5
Cycle Queue Clearance Time (g_c), s	0.0	29.2	29.0	0.0	22.3	22.3	0.0		0.5	0.0		0.5
Green Ratio (*g*/*C*)	0.49	0.53	0.53	0.42	0.42	0.42	0.01		0.43	0.01		0.48
Capacity (*c*), veh/h	836	1791	805	682	1433	613	65		607	65		686
Volume-to-Capacity Ratio (*X*)	0.001	0.780	0.793	0.002	0.765	0.766	0.000		0.726	0.000		0.345
Available Capacity (c_a), veh/h	836	1791	805	682	1433	613	65		607	65		686
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	12.1	11.0	0.0	8.3	8.0	0.0		15.0	0.0		6.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.91	0.82	0.01	0.62	0.60	0.00		0.98	0.00		0.43
Uniform Delay (d_1), s/veh	6.7	11.6	10.6	9.0	12.2	12.2	0.0		26.5	0.0		18.0
Incremental Delay (d_2), s/veh	0.0	2.5	5.7	0.0	2.6	5.9	0.0		4.3	0.0		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
Control Delay (*d*), s/veh	6.7	14.0	16.2	9.0	14.8	18.1	0.0		30.8	0.0		18.3
Level of Service (LOS)	A	B	B	A	B	B			C			B
Approach Delay, s/veh / LOS	14.7	B		15.8	B		30.8	C		18.3	B	
Intersection Delay, s/veh / LOS	17.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.4	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

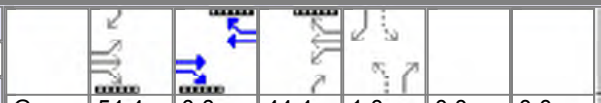
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 NB Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build PM				

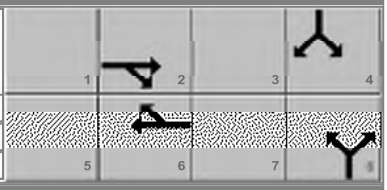


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	1	1610	320	1	1110	280	0		500	0		350

Signal Information			
Cycle, s	110.0	Reference Phase	6
Offset, s	26	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	54.4	0.0	44.4	1.0	0.0	0.0
Yellow	3.6	0.0	3.6	0.0	0.0	0.0
Red	2.0	0.0	1.0	0.0	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	2.0	4.0		5.0		5.0
Phase Duration, s	60.0	60.0	49.0	49.0		1.0		1.0
Change Period, ($Y+R_c$), s	5.6	0.0	4.6	4.6		0.0		0.0
Max Allow Headway (*MAH*), s	4.2	0.0	4.2	0.0		4.3		4.3
Queue Clearance Time (g_s), s	2.0		2.0			3.0		3.0
Green Extension Time (g_e), s	0.0	0.0	8.7	0.0		0.0		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.02			1.00		1.00

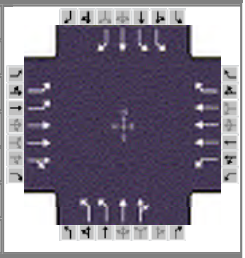
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (*v*), veh/h	1	1419	658	1	1029	461	0		538	0		376
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1552	1617	1698	1520	1617		1274	1617		1439
Queue Service Time (g_s), s	0.0	12.0	12.7	0.0	25.3	24.4	0.0		0.5	0.0		0.5
Cycle Queue Clearance Time (g_c), s	0.0	12.0	12.7	0.0	25.3	24.4	0.0		0.5	0.0		0.5
Green Ratio (*g/C*)	0.49	0.55	0.55	0.40	0.40	0.40	0.01		0.41	0.01		0.50
Capacity (*c*), veh/h	800	1852	847	653	1371	613	65		1028	65		712
Volume-to-Capacity Ratio (*X*)	0.001	0.766	0.778	0.002	0.751	0.751	0.000		0.523	0.000		0.529
Available Capacity (c_a), veh/h	800	1852	847	653	1371	613	65		1028	65		712
Back of Queue (*Q*), veh/ln (95th percentile)	0.0	3.3	4.0	0.0	13.2	11.8	0.0		8.9	0.0		10.4
Queue Storage Ratio (*RQ*) (95th percentile)	0.00	0.25	0.30	0.01	0.86	0.77	0.00		0.66	0.00		0.64
Uniform Delay (d_1), s/veh	4.2	2.4	2.4	14.2	20.0	18.2	0.0		24.8	0.0		19.0
Incremental Delay (d_2), s/veh	0.0	1.7	3.9	0.0	2.9	6.3	0.0		0.5	0.0		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
Control Delay (*d*), s/veh	4.2	4.1	6.3	14.2	22.9	24.4	0.0		25.3	0.0		19.8
Level of Service (LOS)	A	A	A	B	C	C			C			B
Approach Delay, s/veh / LOS	4.8	A		23.4	C		25.3	C		19.8	B	
Intersection Delay, s/veh / LOS	14.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	1.6	A	1.3	A		F		F

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build 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	300	40	970	360	170	190	220	450	310	250

Signal Information			
Cycle, s	110.0	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	13.3	38.3	8.1	6.2	17.9	0.0
Yellow	3.0	3.6	3.0	3.0	3.6	0.0
Red	2.0	2.0	2.0	2.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	4.0		5.3	2.0	4.0	2.0	3.0
Phase Duration, s	18.3	62.2		43.9	13.1	23.5	24.3	34.7
Change Period, ($Y+R_c$), s	5.0	5.6		5.6	5.0	5.6	5.0	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	14.8				8.0	17.0	17.8	20.8
Green Extension Time (g_e), s	0.0	0.0		0.0	0.1	0.9	1.5	2.9
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	1.00	0.12	0.37

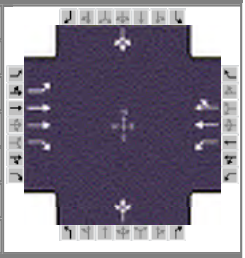
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	370	1266	586	43	1040	356	183	204	210	484	333	225
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1698	1564	238	1542	1439	1632	1765	1496	1632	1765	1496
Queue Service Time (g_s), s	12.8	10.4	10.5	10.7	15.4	13.2	6.0	12.1	15.0	15.8	18.8	11.9
Cycle Queue Clearance Time (g_c), s	12.8	10.4	10.5	10.9	15.4	13.2	6.0	12.1	15.0	15.8	18.8	11.9
Green Ratio (*g/C*)	0.12	0.51	0.51	0.35	0.35	0.52	0.07	0.16	0.16	0.18	0.26	0.39
Capacity (*c*), veh/h	383	1747	805	148	1606	752	242	287	244	572	466	577
Volume-to-Capacity Ratio (*X*)	0.967	0.725	0.729	0.290	0.647	0.473	0.757	0.711	0.861	0.845	0.715	0.389
Available Capacity (c_a), veh/h	383	1747	805	148	1606	752	297	306	260	801	485	594
Back of Queue (*Q*), veh/ln (95th percentile)	8.0	3.1	3.4	1.0	6.6	4.7	4.9	9.7	11.5	11.1	13.5	7.7
Queue Storage Ratio (*RQ*) (95th percentile)	1.04	0.12	0.13	0.14	0.17	0.62	0.63	0.27	0.32	0.34	0.34	1.30
Uniform Delay (d_1), s/veh	41.0	2.7	2.7	15.1	16.0	8.7	50.0	43.6	44.8	43.9	36.7	24.4
Incremental Delay (d_2), s/veh	22.9	1.2	2.6	3.3	1.4	1.4	8.6	7.0	23.3	6.0	4.7	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	0.0
Control Delay (*d*), s/veh	64.0	3.9	5.3	18.4	17.4	10.1	58.5	50.6	68.1	49.9	41.5	24.8
Level of Service (LOS)	E	A	A	B	B	B	E	D	E	D	D	C
Approach Delay, s/veh / LOS	14.3	B		15.6	B		59.2	E		41.8	D	
Intersection Delay, s/veh / LOS	25.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	1.8	A	1.3	A	1.0	A	2.2	B

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

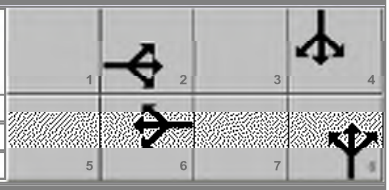
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build 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	78	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.2	73.2	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	3.0		6.3		8.0		8.0
Phase Duration, s	8.2	87.0		78.8		23.0		23.0
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	5.2					9.2		19.4
Green Extension Time (g_e), s	0.1	0.0		0.0		0.8		0.0
Phase Call Probability	0.99					1.00		1.00
Max Out Probability	1.00					0.15		1.00

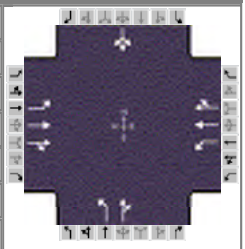
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	162	1980	151	43	756	738		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1617	1439	211	1698	1642		1433			1275	
Queue Service Time (g_s), s	3.2	46.8	3.5	23.0	32.2	32.9		0.0			10.2	
Cycle Queue Clearance Time (g_c), s	3.2	46.8	3.5	58.3	32.2	32.9		7.2			17.4	
Green Ratio (*g/C*)	0.73	0.74	0.74	0.67	0.67	0.67		0.16			0.16	
Capacity (*c*), veh/h	266	2393	1065	132	1130	1092		272			254	
Volume-to-Capacity Ratio (*X*)	0.611	0.827	0.142	0.326	0.669	0.676		0.395			0.847	
Available Capacity (c_a), veh/h	292	2393	1065	132	1130	1092		272			254	
Back of Queue (*Q*), veh/ln (95th percentile)	4.2	18.9	1.6	2.2	17.5	17.4		4.9			12.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.73	0.47	0.04	0.38	0.35	0.34		0.25			0.61	
Uniform Delay (d_1), s/veh	15.9	10.6	4.3	36.4	13.4	13.6		41.9			47.3	
Incremental Delay (d_2), s/veh	1.8	2.0	0.2	5.2	2.5	2.7		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	17.7	12.6	4.5	41.6	15.9	16.3		42.8			69.7	
Level of Service (LOS)	B	B	A	D	B	B		D			E	
Approach Delay, s/veh / LOS	12.4	B		16.8	B		42.8	D		69.7	E	
Intersection Delay, s/veh / LOS	17.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.1	B	2.9	C	3.0	C
Bicycle LOS Score / LOS	2.4	B	1.8	A	0.7	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

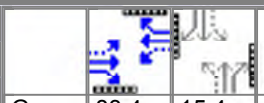
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build PM				

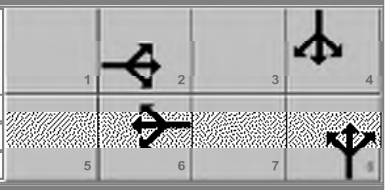


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	1820	150	40	1340	30	80	10	60	30	10	10

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	99	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		6.0		8.0
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						16.1		9.2
Green Extension Time (g_e), s		0.0		0.0		0.0		0.4
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.29

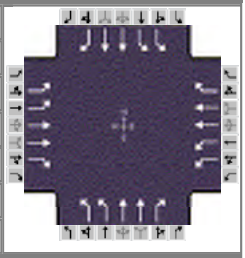
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	32	1065	1065	43	739	734	86	75			54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	344	1698	1653	182	1698	1685	1385	1529			1111	
Queue Service Time (g_s), s	0.7	21.9	23.9	1.5	7.3	7.2	6.8	4.9			2.3	
Cycle Queue Clearance Time (g_c), s	8.7	21.9	23.9	34.9	7.3	7.2	14.1	4.9			7.2	
Green Ratio (*g/C*)	0.76	0.76	0.76	0.76	0.76	0.76	0.14	0.14			0.14	
Capacity (*c*), veh/h	304	1288	1253	164	1288	1278	166	214			208	
Volume-to-Capacity Ratio (*X*)	0.107	0.827	0.850	0.262	0.574	0.575	0.518	0.352			0.259	
Available Capacity (c_a), veh/h	304	1288	1253	164	1288	1278	166	214			208	
Back of Queue (*Q*), veh/ln (95th percentile)	0.1	4.8	4.9	0.8	2.7	2.6	4.4	3.4			2.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.02	0.09	0.10	0.14	0.02	0.02	0.75	0.17			0.13	
Uniform Delay (d_1), s/veh	1.3	1.8	1.8	5.7	1.2	1.2	50.4	42.8			44.0	
Incremental Delay (d_2), s/veh	0.3	3.1	3.7	2.5	1.2	1.2	2.8	1.0			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	
Control Delay (*d*), s/veh	1.7	4.9	5.5	8.3	2.4	2.4	53.2	43.8			44.7	
Level of Service (LOS)	A	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	5.1	A		2.6	A		48.8	D		44.7	D	
Intersection Delay, s/veh / LOS	6.5						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	2.3	B	1.7	A	0.8	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th-5B&C_PM.xus				
Project Description	2035 Build 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	64	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.5	0.6	41.4	12.5	20.1	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	2.0	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	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	19.3	53.2	13.1	47.0	18.1	25.7	18.0	25.7
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	14.7		7.5		11.5	19.7	13.1	16.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.9	0.4	0.0	1.8
Phase Call Probability	1.00		0.99		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		0.01	1.00	1.00	1.00

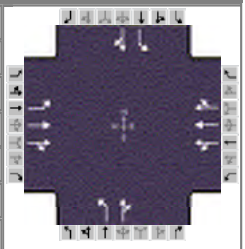
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	368	1330	326	161	817	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	12.7	43.0	16.2	5.5	20.9	2.9	9.5	12.8	17.7	11.1	14.7	0.0
Cycle Queue Clearance Time (g_c), s	12.7	43.0	16.2	5.5	20.9	2.9	9.5	12.8	17.7	11.1	14.7	0.0
Green Ratio (*g/C*)	0.12	0.43	0.43	0.07	0.38	0.38	0.11	0.18	0.18	0.11	0.18	0.18
Capacity (*c*), veh/h	392	1400	623	213	1216	541	370	614	273	368	612	273
Volume-to-Capacity Ratio (*X*)	0.939	0.950	0.524	0.756	0.672	0.133	0.785	0.683	0.901	0.906	0.773	0.000
Available Capacity (c_a), veh/h	392	1400	623	220	1216	541	694	623	277	368	621	276
Back of Queue (*Q*), veh/ln (95th percentile)	8.4	20.8	7.5	4.5	11.8	1.9	7.3	9.4	13.6	9.7	10.8	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.47	0.17	1.13	0.67	0.31	0.49	0.82	0.24	2.30	1.98	0.27	0.00
Uniform Delay (d_1), s/veh	45.8	25.8	18.4	49.1	22.3	17.8	47.5	42.0	44.0	48.2	42.8	0.0
Incremental Delay (d_2), s/veh	18.3	8.5	1.5	13.6	3.0	0.5	3.7	3.0	29.6	25.2	5.9	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	64.0	34.3	19.9	62.7	25.3	18.3	51.2	45.0	73.6	73.4	48.7	0.0
Level of Service (LOS)	E	C	B	E	C	B	D	D	E	E	D	
Approach Delay, s/veh / LOS	37.3	D		30.6	C		54.2	D		58.9	E	
Intersection Delay, s/veh / LOS	42.8						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

Copyright © 2016 University of Florida, All Rights Reserved.

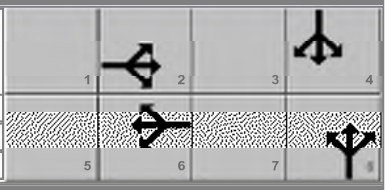
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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	40	10	1230	50	20	10	10	20	10	70

Signal Information					EB			WB			NB			SB		
Cycle, s	100.0	Reference Phase	2		L	T	R	L	T	R	L	T	R	L	T	R
Offset, s	106	Reference Point	Begin	Green	78.9	9.9		0.0	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			0.0	
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0		0.0	0.0	0.0		0.0			0.0	



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		8.0		6.0		6.0
Phase Duration, s		84.5		84.5		15.5		15.5
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						9.9		7.9
Green Extension Time (g_e), s		0.0		0.0		0.2		0.3
Phase Call Probability						0.99		0.99
Max Out Probability						0.89		0.21

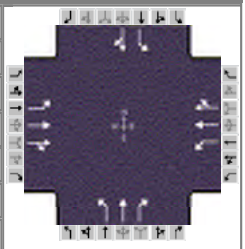
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	71	357	349	538	495	484	24	24		24	94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	334	1698	1658	1681	1545	1512	1297	1619		1382	1525	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	6.5	6.3	1.8	1.3		1.6	5.9	
Cycle Queue Clearance Time (g_c), s	8.7	0.0	0.0	6.4	6.5	6.3	7.9	1.3		3.1	5.9	
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	314	1340	1308	1363	1219	1193	121	160		188	151	
Volume-to-Capacity Ratio (*X*)	0.225	0.266	0.267	0.395	0.406	0.406	0.194	0.147		0.125	0.624	
Available Capacity (c_a), veh/h	314	1340	1308	1363	1219	1193	180	233		250	220	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	0.3	0.3	3.0	2.9	2.7	1.1	1.0		1.0	4.3	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.01	0.01	0.11	0.10	0.09	0.36	0.05		0.34	0.22	
Uniform Delay (d_1), s/veh	0.4	0.0	0.0	1.8	1.8	1.7	47.1	41.2		42.7	43.3	
Incremental Delay (d_2), s/veh	1.7	0.5	0.5	0.7	0.8	0.8	0.8	0.4		0.3	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	2.0	0.5	0.5	2.5	2.6	2.6	47.9	41.6		43.0	47.4	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	0.6	A		2.6	A		44.8	D		46.6	D	
Intersection Delay, s/veh / LOS	4.9						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	1.1	A	1.3	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build AM				

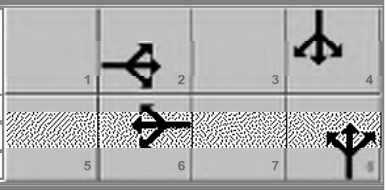


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	510	50	60	1100	30	160	40	20	30	30	30

Signal Information			
Cycle, s	100.0	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	68.5	20.3	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		5.0		6.0
Phase Duration, s		74.1		74.1		25.9		25.9
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						19.6		6.6
Green Extension Time (g_e), s		0.0		0.0		0.7		1.3
Phase Call Probability						1.00		1.00
Max Out Probability						0.50		0.00

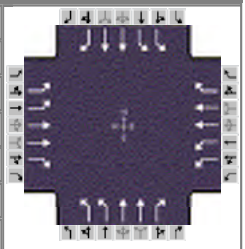
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	334	325	71	667	662	188	47	24	35	71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	395	1698	1644	743	1698	1682	1324	1765	1496	1353	1619	
Queue Service Time (g_s), s	5.3	9.1	9.2	1.1	12.5	12.2	13.8	2.2	1.3	2.2	3.6	
Cycle Queue Clearance Time (g_c), s	16.4	9.1	9.2	11.1	12.5	12.2	17.6	2.2	1.3	4.6	3.6	
Green Ratio (*g/C*)	0.68	0.68	0.68	0.68	0.68	0.68	0.20	0.20	0.20	0.20	0.20	
Capacity (*c*), veh/h	297	1162	1126	514	1162	1151	291	359	304	315	329	
Volume-to-Capacity Ratio (*X*)	0.119	0.287	0.288	0.137	0.574	0.575	0.647	0.131	0.077	0.112	0.214	
Available Capacity (c_a), veh/h	297	1162	1126	514	1162	1151	358	448	380	384	411	
Back of Queue (*Q*), veh/ln (95th percentile)	0.9	6.4	6.3	0.4	5.7	5.5	8.2	1.7	0.8	1.3	2.6	
Queue Storage Ratio (*RQ*) (95th percentile)	0.16	0.22	0.22	0.07	0.21	0.20	0.84	0.09	0.17	0.34	0.13	
Uniform Delay (d_1), s/veh	12.7	7.7	7.8	2.7	3.6	3.5	40.6	32.6	32.2	34.5	33.2	
Incremental Delay (d_2), s/veh	0.8	0.6	0.6	0.4	1.4	1.4	2.9	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	13.5	8.3	8.4	3.0	5.1	5.0	43.5	32.8	32.3	34.7	33.5	
Level of Service (LOS)	B	A	A	A	A	A	D	C	C	C	C	
Approach Delay, s/veh / LOS	8.7	A		4.9	A		40.5	D		33.9	C	
Intersection Delay, s/veh / LOS	11.0						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	1.6	A	0.9	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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	310	140	310	900	210	150	400	180	160	370	140

Signal Information			
Cycle, s	100.0	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	6.3	23.0	16.8	8.2	2.5	9.3
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	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	11.9	40.7	22.4	51.2	14.9	23.1	13.8	22.0
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	6.1		13.0		7.2	15.4	7.6	14.4
Green Extension Time (g_e), s	0.4	0.0	4.5	0.0	2.0	2.0	0.6	1.9
Phase Call Probability	0.97		1.00		0.99	1.00	0.99	1.00
Max Out Probability	0.00		0.49		0.15	0.15	0.00	0.03

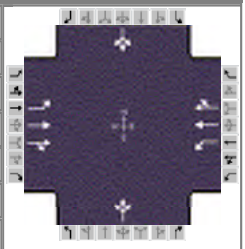
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	129	365	0	365	1058	208	176	471	0	188	435	98
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	4.1	7.2	0.0	11.0	28.0	8.8	5.2	13.4	0.0	5.6	12.4	5.2
Cycle Queue Clearance Time (g_c), s	4.1	7.2	0.0	11.0	28.0	8.8	5.2	13.4	0.0	5.6	12.4	5.2
Green Ratio (*g/C*)	0.06	0.35	0.44	0.17	0.45	0.54	0.09	0.17	0.34	0.08	0.16	0.23
Capacity (*c*), veh/h	199	1131	636	525	1470	772	298	579	505	265	542	335
Volume-to-Capacity Ratio (*X*)	0.650	0.323	0.000	0.694	0.720	0.270	0.593	0.812	0.000	0.710	0.802	0.291
Available Capacity (c_a), veh/h	662	1131	636	795	1470	772	545	834	619	742	927	507
Back of Queue (*Q*), veh/ln (95th percentile)	3.2	4.9	0.0	7.5	16.5	7.7	3.8	9.2	0.0	4.2	8.6	2.3
Queue Storage Ratio (*RQ*) (95th percentile)	0.42	0.18	0.00	0.79	0.33	0.89	0.55	0.27	0.00	0.47	0.38	0.59
Uniform Delay (d_1), s/veh	48.3	19.6	0.0	40.3	25.9	14.7	42.1	36.8	0.0	43.4	37.6	3.8
Incremental Delay (d_2), s/veh	3.5	0.7	0.0	1.3	2.4	0.7	1.9	4.1	0.0	3.5	2.8	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	0.0
Control Delay (*d*), s/veh	51.8	20.4	0.0	41.6	28.2	15.4	44.0	40.9	0.0	46.9	40.4	4.3
Level of Service (LOS)	D	C		D	C	B	D	D		D	D	A
Approach Delay, s/veh / LOS	28.6	C		29.6	C		41.7	D		37.2	D	
Intersection Delay, s/veh / LOS	33.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.1	C	3.1	C	3.3	C
Bicycle LOS Score / LOS	0.9	A	1.8	A	1.0	A	1.1	A

Copyright © 2016 University of Florida, All Rights Reserved.

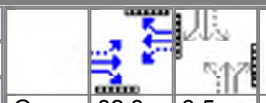
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build AM				

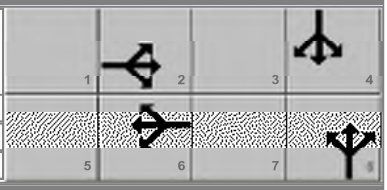


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	10	630	10	20	1390	30	10	10	30	30	10	20

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	82.3	6.5	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		8.0		8.0
Phase Duration, s		87.9		87.9		12.1		12.1
Change Period, ($Y+R_c$), s		5.6		5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0		0.0		4.3		4.3
Queue Clearance Time (g_s), s						5.5		6.5
Green Extension Time (g_e), s		0.0		0.0		0.2		0.2
Phase Call Probability						0.97		0.97
Max Out Probability						0.26		0.61

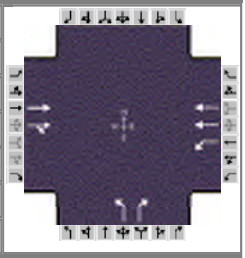
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	12	377	375	24	836	833		59			71	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	285	1698	1689	681	1698	1685		1618			1513	
Queue Service Time (g_s), s	0.1	1.4	1.4	0.4	13.1	13.1		0.0			1.0	
Cycle Queue Clearance Time (g_c), s	13.9	1.4	1.4	1.8	13.1	13.1		3.5			4.5	
Green Ratio (*g/C*)	0.82	0.82	0.82	0.82	0.82	0.82		0.06			0.06	
Capacity (*c*), veh/h	269	1399	1391	623	1399	1388		147			151	
Volume-to-Capacity Ratio (*X*)	0.044	0.270	0.270	0.038	0.598	0.600		0.399			0.466	
Available Capacity (c_a), veh/h	269	1399	1391	623	1399	1388		222			224	
Back of Queue (*Q*), veh/ln (95th percentile)	0.1	0.8	0.8	0.1	4.4	4.4		2.7			3.2	
Queue Storage Ratio (*RQ*) (95th percentile)	0.01	0.02	0.01	0.01	0.12	0.11		0.14			0.16	
Uniform Delay (d_1), s/veh	1.3	0.4	0.4	1.0	2.0	1.9		45.4			45.8	
Incremental Delay (d_2), s/veh	0.3	0.4	0.4	0.1	1.4	1.4		1.7			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	1.6	0.9	0.9	1.1	3.4	3.4		47.2			48.0	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	0.9	A		3.3	A		47.2	D		48.0	D	
Intersection Delay, s/veh / LOS	4.8						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	1.1	A	1.9	A	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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		660	30	30	1330		110		60			

Signal Information												
Cycle, s	100.0	Reference Phase	2									
Offset, s	3	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On	Green	79.1	9.7	0.0	0.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	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		84.7		84.7		15.3		
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 (*gs*), s						9.5		
Green Extension Time (*ge*), s		0.0		0.0		0.2		
Phase Call Probability						1.00		
Max Out Probability						1.00		

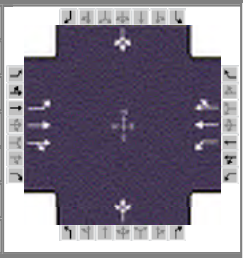
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		409	403	35	1564		129		71			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1672	644	1617		1681		1496			
Queue Service Time (*gs*), s		7.8	7.4	0.7	9.6		7.5		4.5			
Cycle Queue Clearance Time (*gc*), s		7.8	7.4	8.9	9.6		7.5		4.5			
Green Ratio (*g*/*C*)		0.79	0.79	0.79	0.79		0.10		0.10			
Capacity (*c*), veh/h		1343	1322	531	2556		164		146			
Volume-to-Capacity Ratio (*X*)		0.305	0.305	0.066	0.612		0.791		0.485			
Available Capacity (*ca*), veh/h		1343	1322	531	2556		225		200			
Back of Queue (*Q*), veh/ln (95th percentile)		3.7	3.7	0.2	2.7		6.6		3.1			
Queue Storage Ratio (*RQ*) (95th percentile)		0.10	0.10	0.03	0.04		0.84		0.40			
Uniform Delay (*d1*), s/veh		3.3	3.3	2.0	1.3		44.1		42.8			
Incremental Delay (*d2*), s/veh		0.6	0.6	0.2	0.8		12.3		2.5			
Initial Queue Delay (*d3*), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		3.9	3.9	2.2	2.2		56.4		45.3			
Level of Service (LOS)		A	A	A	A		E		D			
Approach Delay, s/veh / LOS	3.9	A		2.2	A		52.5	D		0.0		
Intersection Delay, s/veh / LOS	6.6						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	1.8	A		F		

Copyright © 2016 University of Florida, All Rights Reserved.

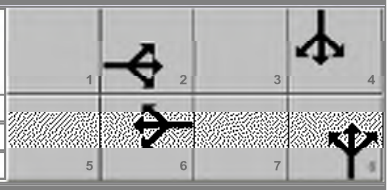
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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	670	20	60	1300	80	20	40	40	40	30	40

Signal Information					EB			WB			NB			SB		
Cycle, s	100.0	Reference Phase	6													
Offset, s	80	Reference Point	Begin	Green	68.4	6.0		11.4	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		74.0	9.0	83.1		16.9		16.9
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			9.1		11.1
Green Extension Time (g_e), s		0.0	1.5	0.0		0.5		0.3
Phase Call Probability			0.86			1.00		1.00
Max Out Probability			1.00			0.29		0.94

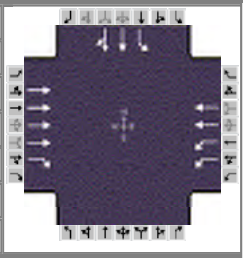
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	35	408	404	71	816	807		118			129	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	298	1698	1680	1617	1698	1663		1557			1406	
Queue Service Time (g_s), s	9.8	11.2	11.2	0.0	28.6	29.4		0.0			1.9	
Cycle Queue Clearance Time (g_c), s	37.7	11.2	11.2	0.0	28.6	29.4		7.1			9.1	
Green Ratio (*g/C*)	0.68	0.68	0.68	0.70	0.77	0.77		0.11			0.11	
Capacity (*c*), veh/h	189	1162	1150	484	1316	1289		221			210	
Volume-to-Capacity Ratio (*X*)	0.187	0.351	0.351	0.146	0.620	0.626		0.533			0.617	
Available Capacity (c_a), veh/h	189	1162	1150	493	1316	1289		284			270	
Back of Queue (*Q*), veh/ln (95th percentile)	1.3	7.3	7.3	1.3	15.3	15.5		5.2			5.9	
Queue Storage Ratio (*RQ*) (95th percentile)	0.23	0.12	0.12	0.22	0.80	0.81		0.13			0.15	
Uniform Delay (d_1), s/veh	23.8	7.7	7.8	9.8	9.1	9.5		42.3			43.2	
Incremental Delay (d_2), s/veh	2.1	0.8	0.8	0.1	1.5	1.6		2.0			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	25.9	8.5	8.6	9.9	10.7	11.0		44.3			46.1	
Level of Service (LOS)	C	A	A	A	B	B		D			D	
Approach Delay, s/veh / LOS	9.3	A		10.8	B		44.3	D		46.1	D	
Intersection Delay, s/veh / LOS	13.4						B					

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	1.2	A	1.9	A	0.7	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

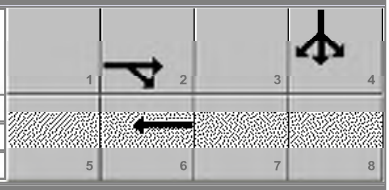
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & I-229 SB Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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		610	210	260	1190					120	290	210

Signal Information					EB			WB			NB			SB		
Cycle, s	100.0	Reference Phase	6		L	T	R	L	T	R	L	T	R	L	T	R
Offset, s	64	Reference Point	Begin	Green	12.8	46.9		23.4	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	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	1	6				4
Case Number		7.3	2.0	4.0				10.0
Phase Duration, s		52.5	18.4	71.0				29.0
Change Period, (*Y*+*Rc*), s		5.6	5.6	5.6				5.6
Max Allow Headway (*MAH*), s		0.0	4.2	0.0				4.1
Queue Clearance Time (*gs*), s			11.6					20.7
Green Extension Time (*ge*), s		0.0	1.2	0.0				2.8
Phase Call Probability			1.00					1.00
Max Out Probability			0.00					0.00

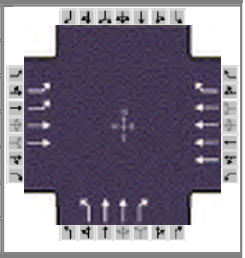
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		718	247	306	1399					141	312	276
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1057	1394	1508	1657					1549	1627	1406
Queue Service Time (*gs*), s		10.4	11.2	9.6	14.9					7.7	18.2	18.7
Cycle Queue Clearance Time (*gc*), s		10.4	11.2	9.6	14.9					7.7	18.2	18.7
Green Ratio (*g*/*C*)		0.47	0.47	0.13	0.65					0.23	0.23	0.23
Capacity (*c*), veh/h		1985	654	386	2166					363	382	330
Volume-to-Capacity Ratio (*X*)		0.361	0.378	0.792	0.646					0.389	0.819	0.836
Available Capacity (*ca*), veh/h		1985	654	1005	2166					781	820	709
Back of Queue (*Q*), veh/ln (95th percentile)		4.4	6.7	6.1	5.6					5.1	11.8	10.9
Queue Storage Ratio (*RQ*) (95th percentile)		0.39	0.44	1.27	1.17					0.45	0.21	0.19
Uniform Delay (*d1*), s/veh		15.9	16.6	37.9	4.0					32.2	36.3	36.4
Incremental Delay (*d2*), s/veh		0.5	1.6	2.9	1.2					0.7	4.4	5.6
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		16.4	18.2	40.9	5.2					32.9	40.6	42.1
Level of Service (LOS)		B	B	D	A					C	D	D
Approach Delay, s/veh / LOS	16.8	B		11.6	B		0.0			39.7	D	
Intersection Delay, s/veh / LOS	19.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	1.9	A	3.6	D	3.1	C
Bicycle LOS Score / LOS	0.9	A	1.9	A			1.1	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

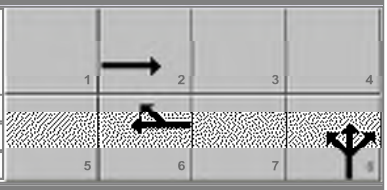
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	AM Peak	PHF	0.85
Intersection	10th St & I-229 NB Ramps	Analysis Year	2035	Analysis Period	1> 7:15
File Name	2035_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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	620			1250	350	200	370	200			

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	39	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	6.5	55.7	21.1	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	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		8		
Case Number	2.0	4.0		7.3		9.0		
Phase Duration, s	12.1	73.3		61.3		26.7		
Change Period, (*Y*+*Rc*), s	5.6	5.6		5.6		5.6		
Max Allow Headway (*MAH*), s	4.2	0.0		0.0		4.1		
Queue Clearance Time (g_s), s	6.2					17.8		
Green Extension Time (g_e), s	0.5	0.0		0.0		3.2		
Phase Call Probability	0.97					1.00		
Max Out Probability	0.00					0.08		

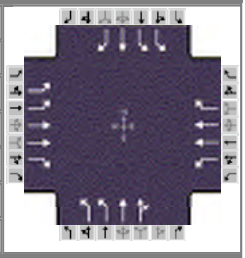
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	129	729			1469	411	235	435	235			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1484	1584			1176	1424	1576	1576	1408			
Queue Service Time (g_s), s	4.2	13.2			25.1	24.0	13.9	12.7	15.8			
Cycle Queue Clearance Time (g_c), s	4.2	13.2			25.1	24.0	13.9	12.7	15.8			
Green Ratio (*g*/*C*)	0.06	0.68			0.56	0.56	0.21	0.21	0.21			
Capacity (*c*), veh/h	193	2146			2618	792	332	664	297			
Volume-to-Capacity Ratio (*X*)	0.671	0.340			0.561	0.519	0.709	0.656	0.793			
Available Capacity (c_a), veh/h	972	2146			2618	792	511	1021	456			
Back of Queue (*Q*), veh/ln (95th percentile)	2.8	8.4			10.3	14.1	9.2	8.4	9.6			
Queue Storage Ratio (*RQ*) (95th percentile)	0.59	1.76			0.83	0.78	0.80	0.49	0.84			
Uniform Delay (d_1), s/veh	43.1	10.6			22.3	23.9	36.6	36.1	37.4			
Incremental Delay (d_2), s/veh	3.8	0.4			0.4	1.0	2.8	1.1	5.3			
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	46.8	11.0			22.7	24.9	39.4	37.3	42.7			
Level of Service (LOS)	D	B			C	C	D	D	D			
Approach Delay, s/veh / LOS	16.4	B		23.2	C		39.2	D		0.0		
Intersection Delay, s/veh / LOS	25.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.4	B	3.1	C	3.6	D
Bicycle LOS Score / LOS	1.2	A	1.3	A	1.2	A		

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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	680	90	40	1140	320	220	320	50	250	250	240

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	40	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	4.7	43.1	10.4	1.2	19.5	0.0
Yellow	3.0	3.6	3.0	0.0	3.6	0.0
Red	2.0	2.0	2.0	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	3.0
Phase Duration, s	9.7	58.4		48.7	15.4	25.1	16.5	26.2
Change Period, (Y+R_c), s	5.0	5.6		5.6	5.0	5.6	5.0	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	4.9				9.7	13.0	10.8	17.9
Green Extension Time (g_e), s	0.1	0.0		0.0	0.7	3.1	0.8	2.8
Phase Call Probability	0.93				1.00	1.00	1.00	1.00
Max Out Probability	0.03				0.07	0.09	0.09	0.21

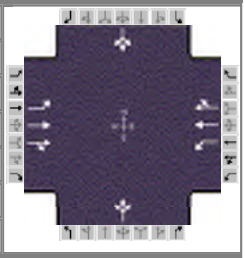
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	94	800	80	47	1340	368	259	209	205	294	294	191
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	651	1698	1439	1632	1765	1708	1632	1765	1496
Queue Service Time (g_s), s	2.9	19.8	3.5	3.7	34.9	12.5	7.7	10.8	11.0	8.8	15.9	10.9
Cycle Queue Clearance Time (g_c), s	2.9	19.8	3.5	14.4	34.9	12.5	7.7	10.8	11.0	8.8	15.9	10.9
Green Ratio (*g*/*C*)	0.05	0.53	0.53	0.43	0.43	0.55	0.10	0.19	0.19	0.12	0.21	0.25
Capacity (*c*), veh/h	148	1707	760	287	1463	786	339	344	333	376	364	379
Volume-to-Capacity Ratio (*X*)	0.635	0.469	0.105	0.164	0.916	0.468	0.765	0.609	0.615	0.781	0.808	0.503
Available Capacity (c_a), veh/h	389	1707	760	287	1463	786	587	492	476	620	512	505
Back of Queue (*Q*), veh/ln (95th percentile)	2.2	12.7	3.7	1.1	15.8	5.0	5.9	8.4	8.3	6.6	11.9	7.2
Queue Storage Ratio (*RQ*) (95th percentile)	0.29	0.58	0.65	0.19	0.39	0.66	0.75	0.24	0.23	0.20	0.30	1.22
Uniform Delay (d_1), s/veh	47.0	22.7	15.3	17.0	18.1	9.1	43.6	36.8	36.8	43.0	37.8	31.9
Incremental Delay (d_2), s/veh	4.0	0.8	0.2	0.8	7.3	1.3	3.6	1.7	1.9	3.6	6.4	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	51.0	23.5	15.5	17.8	25.4	10.4	47.2	38.5	38.7	46.6	44.2	33.0
Level of Service (LOS)	D	C	B	B	C	B	D	D	D	D	D	C
Approach Delay, s/veh / LOS	25.5	C		22.0	C		41.9	D		42.4	D	
Intersection Delay, s/veh / LOS	29.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	3.0	C	3.1	C
Bicycle LOS Score / LOS	1.3	A	1.9	A	1.0	A	1.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

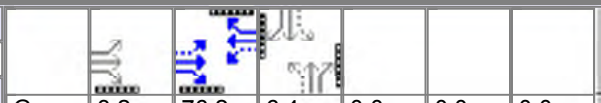
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build AM				

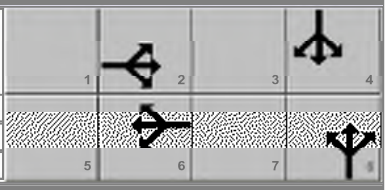


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	890	40	50	1440	80	30	10	20	40	10	30

Signal Information			
Cycle, s	100.0	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	3.2	76.2	6.4	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	6.2	88.0		81.8		12.0		12.0
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	2.7					7.2		8.4
Green Extension Time (g_e), s	0.0	0.0		0.0		0.0		0.0
Phase Call Probability	0.80					0.99		0.99
Max Out Probability	1.00					1.00		1.00

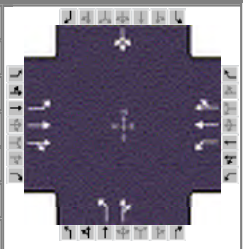
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	59	551	543	59	897	892		71			94	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1672	494	1698	1666		1340			1380	
Queue Service Time (g_s), s	0.7	3.8	3.9	3.7	28.4	29.3		0.0			1.2	
Cycle Queue Clearance Time (g_c), s	0.7	3.8	3.9	3.7	28.4	29.3		5.2			6.4	
Green Ratio (*g/C*)	0.81	0.82	0.82	0.76	0.76	0.76		0.06			0.06	
Capacity (*c*), veh/h	243	1399	1378	448	1294	1269		140			142	
Volume-to-Capacity Ratio (*X*)	0.242	0.394	0.394	0.131	0.693	0.702		0.505			0.661	
Available Capacity (c_a), veh/h	272	1399	1378	448	1294	1269		140			142	
Back of Queue (*Q*), veh/ln (95th percentile)	0.8	1.3	1.3	0.6	12.7	12.9		3.3			5.0	
Queue Storage Ratio (*RQ*) (95th percentile)	0.15	0.03	0.03	0.10	0.25	0.26		0.17			0.25	
Uniform Delay (d_1), s/veh	8.4	0.8	0.8	3.8	6.9	7.0		46.1			47.0	
Incremental Delay (d_2), s/veh	0.4	0.7	0.7	0.4	2.1	2.3		2.9			10.8	
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	8.8	1.5	1.5	4.2	9.0	9.3		49.0			57.8	
Level of Service (LOS)	A	A	A	A	A	A		D			E	
Approach Delay, s/veh / LOS	1.9	A		9.0	A		49.0	D		57.8	E	
Intersection Delay, s/veh / LOS	8.8						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	1.4	A	2.0	B	0.6	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

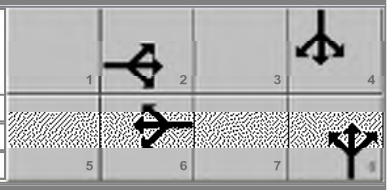
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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	880	50	30	1480	30	80	10	40	10	10	10

Signal Information											
Cycle, s	100.0	Reference Phase	2								
Offset, s	38	Reference Point	Begin								
Uncoordinated	No	Simult. Gap E/W	On	Green	76.8	12.0	0.0	0.0	0.0	0.0	
Force Mode	Fixed	Simult. Gap N/S	On	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		82.4		82.4		17.6		17.6
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						12.4		6.0
Green Extension Time (g_e), s		0.0		0.0		0.2		0.4
Phase Call Probability						0.99		0.99
Max Out Probability						1.00		0.01

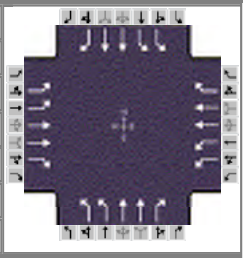
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	24	552	542	35	889	887	94	59			35	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	257	1698	1666	494	1698	1686	1382	1543			1515	
Queue Service Time (g_s), s	2.0	6.6	6.6	1.5	15.2	15.5	6.7	3.5			0.0	
Cycle Queue Clearance Time (g_c), s	15.8	6.6	6.6	7.0	15.2	15.5	10.4	3.5			4.0	
Green Ratio (*g/C*)	0.77	0.77	0.77	0.77	0.77	0.77	0.12	0.12			0.12	
Capacity (*c*), veh/h	237	1315	1290	428	1315	1306	178	175			220	
Volume-to-Capacity Ratio (*X*)	0.099	0.420	0.420	0.082	0.676	0.679	0.529	0.336			0.161	
Available Capacity (c_a), veh/h	237	1315	1290	428	1315	1306	248	253			296	
Back of Queue (*Q*), veh/ln (95th percentile)	0.3	2.8	2.7	0.2	3.8	3.9	4.4	2.5			1.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.05	0.06	0.05	0.04	0.03	0.03	0.74	0.13			0.07	
Uniform Delay (d_1), s/veh	4.3	1.9	1.9	2.9	2.2	2.2	45.8	40.9			40.2	
Incremental Delay (d_2), s/veh	0.8	0.9	0.9	0.1	1.0	1.0	2.4	1.1			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	5.1	2.8	2.8	3.0	3.2	3.2	48.2	42.0			40.5	
Level of Service (LOS)	A	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	2.8	A		3.2	A		45.8	D		40.5	D	
Intersection Delay, s/veh / LOS	5.6						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	1.4	A	2.0	A	0.7	A	0.5	A

Copyright © 2016 University of Florida, All Rights Reserved.

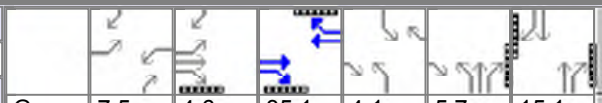
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 15, 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_Build_10th_St_10th9_AM.xus				
Project Description	2035 Build 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	540	130	140	880	130	350	520	100	70	310	310

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	84	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.5	4.6	35.1	4.1	5.7	15.1
Yellow	3.6	0.0	3.6	3.6	3.6	3.6
Red	2.0	0.0	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	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	17.7	45.3	13.1	40.7	20.9	31.9	9.7	20.7
Change Period, ($Y+R_c$), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	11.6		7.1		14.1	17.6	4.5	12.1
Green Extension Time (g_e), s	0.6	0.0	0.5	0.0	1.2	4.0	0.1	2.9
Phase Call Probability	1.00		0.99		1.00	1.00	0.90	1.00
Max Out Probability	0.50		0.00		0.09	0.17	1.00	0.53

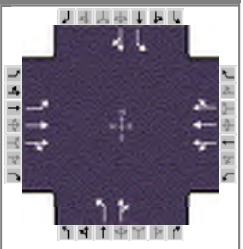
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	306	635	129	165	1035	141	412	612	100	82	365	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	9.6	14.9	4.6	5.1	29.7	5.6	12.1	15.6	4.3	2.5	10.1	0.0
Cycle Queue Clearance Time (g_c), s	9.6	14.9	4.6	5.1	29.7	5.6	12.1	15.6	4.3	2.5	10.1	0.0
Green Ratio (*g/C*)	0.12	0.40	0.55	0.07	0.35	0.39	0.15	0.26	0.34	0.04	0.15	0.27
Capacity (*c*), veh/h	381	1285	792	236	1135	564	500	883	505	133	505	407
Volume-to-Capacity Ratio (*X*)	0.802	0.495	0.163	0.699	0.912	0.250	0.823	0.692	0.198	0.620	0.722	0.000
Available Capacity (c_a), veh/h	529	1285	792	686	1135	564	764	1032	572	242	654	473
Back of Queue (*Q*), veh/ln (95th percentile)	7.2	9.5	4.2	3.6	17.2	3.4	8.4	9.9	2.7	1.9	7.5	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.26	0.08	0.63	0.55	0.45	0.90	0.95	0.25	0.45	0.39	0.19	0.00
Uniform Delay (d_1), s/veh	44.6	23.2	11.6	43.9	25.2	16.6	38.5	29.0	20.6	46.5	38.0	0.0
Incremental Delay (d_2), s/veh	5.6	1.2	0.4	3.7	12.5	1.1	4.4	1.6	0.2	4.7	2.8	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	50.2	24.4	12.0	47.6	37.7	17.6	42.9	30.6	20.7	51.2	40.8	0.0
Level of Service (LOS)	D	C	B	D	D	B	D	C	C	D	D	
Approach Delay, s/veh / LOS	30.3	C		36.8	D		34.3	C		42.7	D	
Intersection Delay, s/veh / LOS	35.0						C					

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	1.4	A	1.6	A	1.4	A	0.9	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build PM				

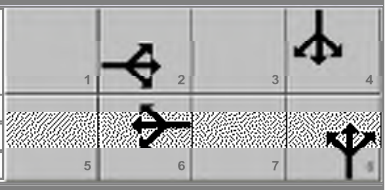


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80	1390	20	20	810	40	40	10	20	40	10	60

Signal Information			
Cycle, s	100.0	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	78.8	10.0	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		84.4		84.4		15.6		15.6
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						9.9		6.9
Green Extension Time (g_e), s		0.0		0.0		0.2		0.3
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.47

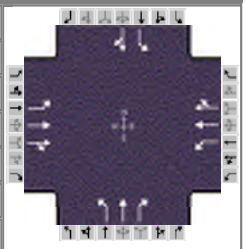
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	759	757	303	320	313	43	32		43	75	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	585	1698	1689	1433	1545	1508	1319	1576		1371	1529	
Queue Service Time (g_s), s	0.0	0.0	0.0	0.0	3.7	3.6	3.2	1.9		3.0	4.7	
Cycle Queue Clearance Time (g_c), s	4.3	0.0	0.0	3.0	3.7	3.6	7.9	1.9		4.9	4.7	
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	513	1338	1332	1168	1218	1189	141	157		182	153	
Volume-to-Capacity Ratio (*X*)	0.168	0.567	0.568	0.259	0.262	0.263	0.305	0.205		0.236	0.493	
Available Capacity (c_a), veh/h	513	1338	1332	1168	1218	1189	173	195		215	190	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	1.2	1.2	1.6	1.8	1.7	2.0	1.4		1.9	3.3	
Queue Storage Ratio (*RQ*) (95th percentile)	0.00	0.03	0.03	0.06	0.06	0.06	0.66	0.07		0.63	0.17	
Uniform Delay (d_1), s/veh	0.1	0.0	0.0	1.6	1.7	1.6	46.4	41.4		43.7	42.6	
Incremental Delay (d_2), s/veh	0.7	1.7	1.8	0.5	0.5	0.5	1.2	0.6		0.7	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	
Control Delay (*d*), s/veh	0.8	1.7	1.8	2.1	2.2	2.2	47.6	42.0		44.3	45.1	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	1.7	A		2.2	A		45.2	D		44.8	D	
Intersection Delay, s/veh / LOS	4.9						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	1.8	A	1.0	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build PM				

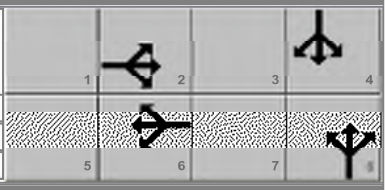


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	1280	150	70	770	60	70	30	60	50	100	30

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	84	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	72.7	16.1	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		78.3		78.3		21.7		21.7
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						15.6		9.5
Green Extension Time (g_e), s		0.0		0.0		0.5		1.0
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.07

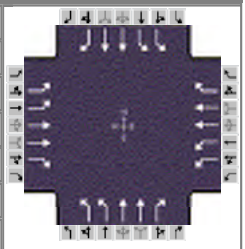
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	778	759	75	452	440	75	32	65	54	140	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	597	1698	1636	323	1698	1654	1244	1765	1496	1371	1694	
Queue Service Time (g_s), s	1.5	26.8	27.5	5.1	4.5	4.4	5.9	1.6	3.8	3.5	7.5	
Cycle Queue Clearance Time (g_c), s	5.5	26.8	27.5	40.8	4.5	4.4	13.6	1.6	3.8	5.2	7.5	
Green Ratio (*g/C*)	0.73	0.73	0.73	0.73	0.73	0.73	0.16	0.16	0.16	0.16	0.16	
Capacity (*c*), veh/h	482	1235	1190	220	1235	1203	176	284	240	269	272	
Volume-to-Capacity Ratio (*X*)	0.045	0.630	0.638	0.342	0.366	0.366	0.427	0.114	0.268	0.200	0.513	
Available Capacity (c_a), veh/h	482	1235	1190	220	1235	1203	218	342	290	315	329	
Back of Queue (*Q*), veh/ln (95th percentile)	0.4	15.2	15.1	2.0	2.4	2.3	3.4	1.2	2.6	2.2	5.8	
Queue Storage Ratio (*RQ*) (95th percentile)	0.06	0.53	0.53	0.36	0.09	0.08	0.35	0.06	0.52	0.55	0.30	
Uniform Delay (d_1), s/veh	6.6	9.3	9.4	10.6	1.8	1.8	44.7	35.9	36.8	38.1	38.4	
Incremental Delay (d_2), s/veh	0.1	2.0	2.1	3.6	0.7	0.7	1.6	0.2	0.6	0.4	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	0.0	
Control Delay (*d*), s/veh	6.8	11.3	11.6	14.3	2.5	2.5	46.3	36.1	37.4	38.5	39.9	
Level of Service (LOS)	A	B	B	B	A	A	D	D	D	D	D	
Approach Delay, s/veh / LOS	11.4	B		3.4	A		41.0	D		39.5	D	
Intersection Delay, s/veh / LOS	12.3						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	1.8	A	1.3	A	0.8	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

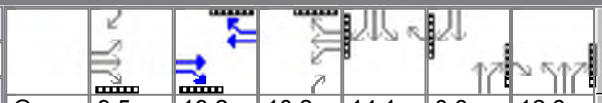
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build PM				

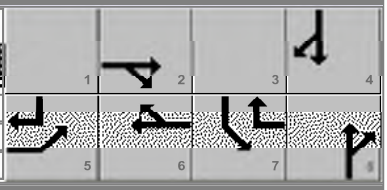


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	220	970	200	240	530	210	210	520	360	360	530	160

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	9.5	19.2	10.2	14.1	0.6	12.6
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	3.0	2.0	3.0	2.0	3.0
Phase Duration, s	15.1	40.0	15.8	40.7	18.2	24.5	19.7	26.0
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	4.2	4.2	4.2	4.2
Queue Clearance Time (g_s), s	9.4		9.9		8.4	20.8	13.6	18.2
Green Extension Time (g_e), s	0.1	0.0	0.2	0.0	2.1	0.0	0.5	2.1
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	0.29

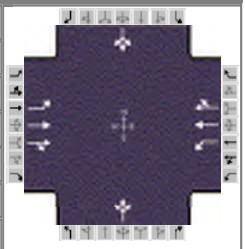
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	237	1043	215	258	570	222	226	559	387	387	570	142
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1616	1664	1481	1616	1664	1481
Queue Service Time (g_s), s	7.4	31.6	10.3	7.9	13.5	9.0	6.4	16.2	18.8	11.6	16.2	7.1
Cycle Queue Clearance Time (g_c), s	7.4	31.6	10.3	7.9	13.5	9.0	6.4	16.2	18.8	11.6	16.2	7.1
Green Ratio (*g/C*)	0.09	0.34	0.47	0.10	0.35	0.49	0.13	0.19	0.29	0.14	0.20	0.30
Capacity (*c*), veh/h	298	1109	674	318	1132	707	404	625	428	455	675	441
Volume-to-Capacity Ratio (*X*)	0.793	0.940	0.319	0.813	0.503	0.313	0.559	0.894	0.904	0.850	0.845	0.322
Available Capacity (c_a), veh/h	327	1109	674	323	1132	707	404	626	428	536	882	533
Back of Queue (*Q*), veh/ln (95th percentile)	6.0	20.4	6.7	6.2	9.0	6.8	4.6	11.9	11.9	8.7	10.8	3.0
Queue Storage Ratio (*RQ*) (95th percentile)	0.78	0.74	0.88	0.65	0.18	0.79	0.67	0.35	0.94	0.99	0.48	0.77
Uniform Delay (d_1), s/veh	45.0	35.8	19.8	39.8	24.2	14.7	39.1	36.5	4.6	39.6	35.0	3.7
Incremental Delay (d_2), s/veh	9.1	13.1	1.0	13.4	1.5	1.1	1.7	15.4	22.3	10.9	6.0	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	0.0
Control Delay (*d*), s/veh	54.1	48.9	20.8	53.2	25.7	15.7	40.9	51.9	26.9	50.5	40.9	4.1
Level of Service (LOS)	D	D	C	D	C	B	D	D	C	D	D	A
Approach Delay, s/veh / LOS	45.7	D		30.4	C		41.5	D		39.5	D	
Intersection Delay, s/veh / LOS	39.9						D					

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	1.4	A	1.5	A	1.4	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build PM				

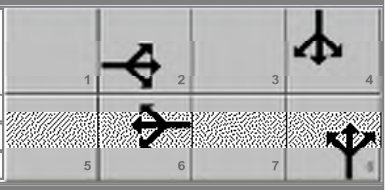


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	50	1550	90	60	920	40	20	10	30	50	20	40

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	54	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	79.2	9.6	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		8.0		8.0
Phase Duration, s		84.8		84.8		15.2		15.2
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						5.8		9.5
Green Extension Time (g_e), s		0.0		0.0		0.3		0.2
Phase Call Probability						0.99		0.99
Max Out Probability						0.20		1.00

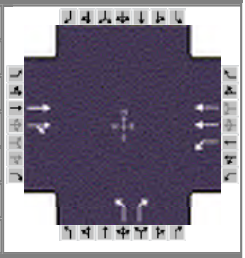
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	54	885	879	65	520	512		65			118	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	524	1698	1665	260	1698	1673		1518			1525	
Queue Service Time (g_s), s	0.9	23.1	23.0	16.8	10.1	10.1		0.0			3.7	
Cycle Queue Clearance Time (g_c), s	12.1	23.1	23.0	38.3	10.1	10.1		3.8			7.5	
Green Ratio (*g/C*)	0.79	0.79	0.79	0.79	0.79	0.79		0.10			0.10	
Capacity (*c*), veh/h	434	1345	1319	218	1345	1325		194			199	
Volume-to-Capacity Ratio (*X*)	0.124	0.658	0.666	0.296	0.387	0.387		0.333			0.595	
Available Capacity (c_a), veh/h	434	1345	1319	218	1345	1325		235			240	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	9.0	8.6	1.9	5.1	5.1		2.8			5.4	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.18	0.17	0.33	0.13	0.13		0.14			0.27	
Uniform Delay (d_1), s/veh	1.9	4.7	4.5	14.3	3.6	3.6		42.6			44.2	
Incremental Delay (d_2), s/veh	0.2	0.7	0.8	3.2	0.8	0.8		1.0			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	2.0	5.4	5.3	17.5	4.3	4.4		43.6			47.0	
Level of Service (LOS)	A	A	A	B	A	A		D			D	
Approach Delay, s/veh / LOS	5.2	A		5.1	A		43.6	D		47.0	D	
Intersection Delay, s/veh / LOS	7.6						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	2.0	A	1.4	A	0.6	A	0.7	A

Copyright © 2016 University of Florida, All Rights Reserved.

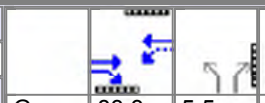
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build PM				

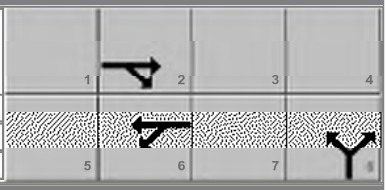


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1510	120	80	960		60		40			

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	80	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	83.3	5.5	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		
Case Number		8.0		6.0		9.0		
Phase Duration, s		88.9		88.9		11.1		
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						5.8		
Green Extension Time (g_e), s		0.0		0.0		0.0		
Phase Call Probability						0.95		
Max Out Probability						1.00		

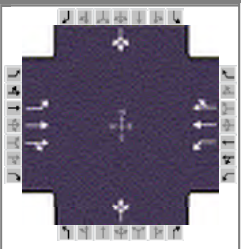
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		880	872	86	1032		65		43			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1698	1654	263	1617		1681		1496			
Queue Service Time (g_s), s		20.3	13.4	1.6	1.0		3.8		2.8			
Cycle Queue Clearance Time (g_c), s		20.3	13.4	34.0	1.0		3.8		2.8			
Green Ratio (*g*/*C*)		0.83	0.83	0.83	0.83		0.06		0.06			
Capacity (*c*), veh/h		1414	1377	237	2692		93		83			
Volume-to-Capacity Ratio (*X*)		0.623	0.633	0.363	0.383		0.695		0.521			
Available Capacity (c_a), veh/h		1414	1377	237	2692		124		111			
Back of Queue (*Q*), veh/ln (95th percentile)		3.9	3.9	1.4	0.4		3.3		2.1			
Queue Storage Ratio (*RQ*) (95th percentile)		0.10	0.10	0.24	0.01		0.42		0.26			
Uniform Delay (d_1), s/veh		1.7	1.7	4.6	0.2		46.4		46.0			
Incremental Delay (d_2), s/veh		1.5	1.6	3.8	0.4		10.1		5.0			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		3.2	3.3	8.3	0.5		56.5		50.9			
Level of Service (LOS)		A	A	A	A		E		D			
Approach Delay, s/veh / LOS	3.2	A		1.1	A		54.3	D		0.0		
Intersection Delay, s/veh / LOS	4.3						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	1.9	A	1.4	A		F		

Copyright © 2016 University of Florida, All Rights Reserved.

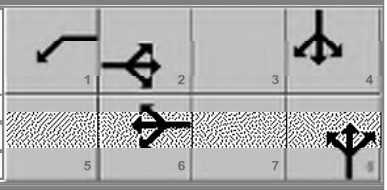
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build 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	1440	30	110	970	50	20	20	80	80	40	50

Signal Information												
Cycle, s	100.0	Reference Phase	6									
Offset, s	50	Reference Point	Begin									
Uncoordinated	No	Simult. Gap E/W	On	Green	4.2	65.6	16.1	0.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	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		71.2	7.2	78.4		21.6		21.6
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			4.2			9.5		15.8
Green Extension Time (g_e), s		0.0	0.1	0.0		0.8		0.3
Phase Call Probability			0.96			1.00		1.00
Max Out Probability			1.00			0.09		1.00

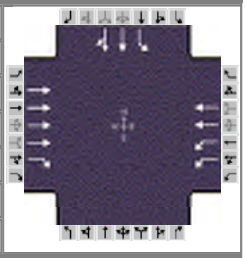
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	86	792	789	118	553	544		129			183	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	493	1698	1686	1617	1698	1668		1545			1314	
Queue Service Time (g_s), s	11.1	32.6	32.8	2.2	17.6	17.7		0.0			6.3	
Cycle Queue Clearance Time (g_c), s	20.9	32.6	32.8	2.2	17.6	17.7		7.5			13.8	
Green Ratio (*g/C*)	0.66	0.66	0.66	0.72	0.73	0.73		0.16			0.16	
Capacity (*c*), veh/h	343	1113	1105	242	1236	1214		291			265	
Volume-to-Capacity Ratio (*X*)	0.250	0.711	0.713	0.490	0.448	0.448		0.443			0.690	
Available Capacity (c_a), veh/h	343	1113	1105	309	1236	1214		327			299	
Back of Queue (*Q*), veh/ln (95th percentile)	2.3	17.7	17.7	2.5	10.8	10.8		5.3			8.3	
Queue Storage Ratio (*RQ*) (95th percentile)	0.40	0.28	0.28	0.43	0.57	0.56		0.14			0.21	
Uniform Delay (d_1), s/veh	14.5	13.5	13.5	14.0	8.8	8.9		38.3			41.1	
Incremental Delay (d_2), s/veh	1.3	2.9	3.0	1.3	1.0	1.0		1.1			5.7	
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	15.8	16.4	16.5	15.3	9.8	10.0		39.4			46.8	
Level of Service (LOS)	B	B	B	B	A	A		D			D	
Approach Delay, s/veh / LOS	16.4	B		10.4	B		39.4	D		46.8	D	
Intersection Delay, s/veh / LOS	16.8						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.0	B	2.8	C	2.8	C
Bicycle LOS Score / LOS	1.9	A	1.5	A	0.7	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

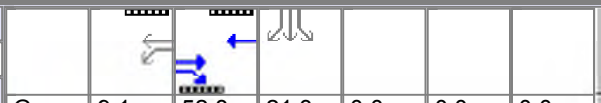
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 SB Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build PM				

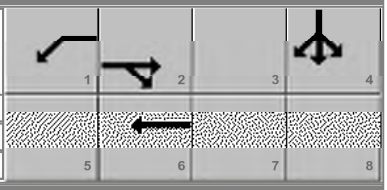


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1390	240	190	940					260	350	140

Signal Information			
Cycle, s	100.0	Reference Phase	6
Offset, s	26	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	9.1	52.8	21.3	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	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	1	6				4
Case Number		7.3	2.0	4.0				10.0
Phase Duration, s		58.4	14.7	73.1				26.9
Change Period, (*Y*+*Rc*), s		5.6	5.6	5.6				5.6
Max Allow Headway (*MAH*), s		0.0	4.2	0.0				4.1
Queue Clearance Time (*gs*), s			8.6					18.8
Green Extension Time (*ge*), s		0.0	0.6	0.0				2.5
Phase Call Probability			1.00					1.00
Max Out Probability			0.01					0.11

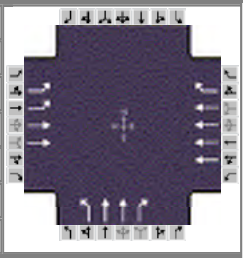
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		1495	258	204	1011					280	274	253
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1325	1396	1494	1614					1589	1668	1511
Queue Service Time (*gs*), s		22.3	14.0	6.6	13.5					16.8	15.5	15.8
Cycle Queue Clearance Time (*gc*), s		22.3	14.0	6.6	13.5					16.8	15.5	15.8
Green Ratio (*g*/*C*)		0.53	0.53	0.09	0.67					0.21	0.21	0.21
Capacity (*c*), veh/h		2799	737	272	2178					339	356	322
Volume-to-Capacity Ratio (*X*)		0.534	0.350	0.751	0.464					0.826	0.770	0.786
Available Capacity (*ca*), veh/h		2799	737	582	2178					499	524	474
Back of Queue (*Q*), veh/ln (95th percentile)		11.0	8.3	4.4	7.2					11.3	10.6	10.1
Queue Storage Ratio (*RQ*) (95th percentile)		0.96	0.54	0.92	1.50					0.98	0.19	0.18
Uniform Delay (*d1*), s/veh		22.2	20.6	41.6	6.7					37.6	37.0	37.2
Incremental Delay (*d2*), s/veh		0.5	0.9	3.7	0.6					7.2	4.1	5.2
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		22.7	21.5	45.3	7.3					44.7	41.1	42.4
Level of Service (LOS)		C	C	D	A					D	D	D
Approach Delay, s/veh / LOS	22.5	C		13.7	B		0.0			42.8	D	
Intersection Delay, s/veh / LOS	24.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	1.9	A	3.6	D	3.1	C
Bicycle LOS Score / LOS	1.2	A	1.5	A			1.2	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

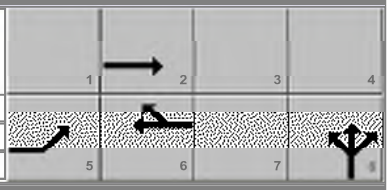
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & I-229 NB Ramps	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build 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	1430			890	180	240	410	200			

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	10.5	51.6	21.1	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	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		8		
Case Number	2.0	4.0		7.3		9.0		
Phase Duration, s	16.1	73.3		57.2		26.7		
Change Period, (*Y*+*Rc*), s	5.6	5.6		5.6		5.6		
Max Allow Headway (*MAH*), s	4.2	0.0		0.0		4.1		
Queue Clearance Time (g_s), s	9.5					17.4		
Green Extension Time (g_e), s	1.0	0.0		0.0		3.8		
Phase Call Probability	1.00					1.00		
Max Out Probability	0.00					0.00		

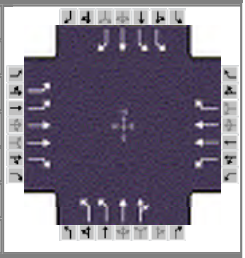
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2			6	16	3	8	18			
Adjusted Flow Rate (*v*), veh/h	237	1538			957	194	258	441	215			
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1498	1673			1286	1384	1583	1582	1414			
Queue Service Time (g_s), s	7.5	14.6			15.2	12.5	15.4	12.8	14.1			
Cycle Queue Clearance Time (g_c), s	7.5	14.6			15.2	12.5	15.4	12.8	14.1			
Green Ratio (*g*/*C*)	0.11	0.68			0.52	0.52	0.21	0.21	0.21			
Capacity (*c*), veh/h	315	2264			2653	714	334	669	299			
Volume-to-Capacity Ratio (*X*)	0.751	0.679			0.361	0.271	0.772	0.659	0.720			
Available Capacity (c_a), veh/h	1338	2264			2653	714	703	1405	628			
Back of Queue (*Q*), veh/ln (95th percentile)	4.9	4.9			8.4	8.1	10.1	8.5	8.6			
Queue Storage Ratio (*RQ*) (95th percentile)	1.02	1.03			0.68	0.45	0.88	0.49	0.75			
Uniform Delay (d_1), s/veh	40.1	3.1			23.5	26.1	37.2	36.1	36.7			
Incremental Delay (d_2), s/veh	2.9	1.3			0.3	0.8	3.8	1.1	3.3			
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	43.0	4.4			23.8	26.8	41.0	37.3	39.9			
Level of Service (LOS)	D	A			C	C	D	D	D			
Approach Delay, s/veh / LOS	9.5	A		24.3	C		38.9	D		0.0		
Intersection Delay, s/veh / LOS	21.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.4	B	3.1	C	3.6	D
Bicycle LOS Score / LOS	2.0	A	1.0	A	1.2	A		

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

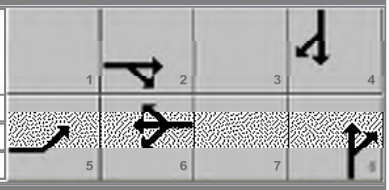
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cleveland Ave	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build 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	100	1310	240	40	770	360	150	190	140	450	310	150

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	94	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.2	42.1	6.9	6.1	13.5	0.0
Yellow	3.0	3.6	3.0	3.0	3.6	0.0
Red	2.0	2.0	2.0	2.0	2.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	3.0		5.3	2.0	4.0	2.0	3.0
Phase Duration, s	10.2	57.9		47.7	11.9	19.1	23.0	30.2
Change Period, (Y+R_c), s	5.0	5.6		5.6	5.0	5.6	5.0	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	5.3				6.8	11.8	16.3	19.6
Green Extension Time (g_e), s	0.1	0.0		0.0	0.1	1.7	1.7	2.2
Phase Call Probability	0.95				0.99	1.00	1.00	1.00
Max Out Probability	0.24				1.00	0.71	0.04	0.31

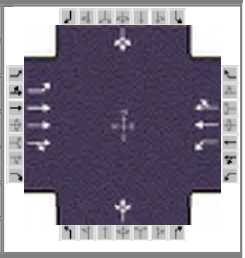
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	108	1409	228	43	828	357	161	170	158	484	333	134
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	366	1698	1439	1632	1765	1546	1632	1765	1496
Queue Service Time (g_s), s	3.3	36.9	8.2	4.8	10.1	6.8	4.8	9.2	9.8	14.3	17.6	6.9
Cycle Queue Clearance Time (g_c), s	3.3	36.9	8.2	37.2	10.1	6.8	4.8	9.2	9.8	14.3	17.6	6.9
Green Ratio (*g*/*C*)	0.05	0.52	0.52	0.42	0.42	0.60	0.07	0.13	0.13	0.18	0.25	0.30
Capacity (*c*), veh/h	164	1693	753	129	1431	865	225	238	208	587	433	445
Volume-to-Capacity Ratio (*X*)	0.656	0.832	0.303	0.333	0.579	0.413	0.718	0.716	0.758	0.825	0.769	0.302
Available Capacity (c_a), veh/h	345	1693	753	129	1431	865	294	307	269	914	503	505
Back of Queue (*Q*), veh/ln (95th percentile)	2.4	18.8	6.1	1.7	4.7	2.4	3.8	7.8	7.6	9.9	12.9	4.5
Queue Storage Ratio (*RQ*) (95th percentile)	0.32	0.86	1.06	0.30	0.12	0.31	0.49	0.22	0.21	0.31	0.33	0.76
Uniform Delay (d_1), s/veh	46.1	20.4	12.0	22.5	7.8	3.5	45.6	41.4	41.7	39.5	35.1	27.1
Incremental Delay (d_2), s/veh	3.0	3.4	0.7	5.1	1.3	1.1	5.7	5.5	8.8	3.6	6.1	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	0.0
Control Delay (*d*), s/veh	49.0	23.7	12.7	27.6	9.0	4.5	51.3	47.0	50.5	43.1	41.2	27.5
Level of Service (LOS)	D	C	B	C	A	A	D	D	D	D	D	C
Approach Delay, s/veh / LOS	23.9	C		8.4	A		49.5	D		40.2	D	
Intersection Delay, s/veh / LOS	25.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.6	B	3.0	C	3.0	C	3.1	C
Bicycle LOS Score / LOS	1.9	A	1.5	A	0.9	A	2.1	B

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

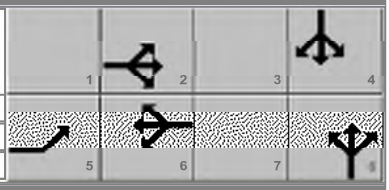
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 2015	Area Type	Other
Jurisdiction	Sioux Falls, SD	Time Period	PM Peak	PHF	0.93
Intersection	10th St & Cambell's / Hy-Ve	Analysis Year	2035	Analysis Period	1> 4:30
File Name	2035_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build 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	1610	140	40	1060	130	40	10	50	120	10	70

Signal Information			
Cycle, s	100.0	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	5.2	62.3	18.2	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	8.2	76.2		67.9		23.8		23.8
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	5.3					8.3		17.9
Green Extension Time (g_e), s	0.0	0.0		0.0		1.0		0.3
Phase Call Probability	0.99					1.00		1.00
Max Out Probability	1.00					0.02		1.00

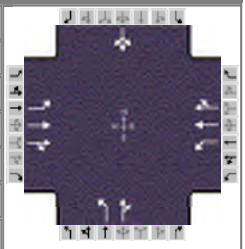
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	161	1271	611	43	651	628		108			215	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1617	1698	1626	232	1698	1633		1437			1331	
Queue Service Time (g_s), s	3.3	15.8	16.2	12.4	25.6	25.9		0.0			9.6	
Cycle Queue Clearance Time (g_c), s	3.3	15.8	16.2	19.6	25.6	25.9		6.3			15.9	
Green Ratio (*g/C*)	0.70	0.71	0.71	0.62	0.62	0.62		0.18			0.18	
Capacity (*c*), veh/h	308	2397	1148	198	1059	1018		312			300	
Volume-to-Capacity Ratio (*X*)	0.523	0.530	0.532	0.217	0.615	0.617		0.344			0.717	
Available Capacity (c_a), veh/h	324	2397	1148	198	1059	1018		343			331	
Back of Queue (*Q*), veh/ln (95th percentile)	2.4	6.6	6.7	1.3	14.7	14.5		4.2			9.5	
Queue Storage Ratio (*RQ*) (95th percentile)	0.42	0.16	0.17	0.23	0.29	0.29		0.21			0.48	
Uniform Delay (d_1), s/veh	12.0	5.8	6.0	15.7	13.7	13.9		35.9			40.2	
Incremental Delay (d_2), s/veh	0.6	0.4	0.8	2.1	2.3	2.4		0.7			6.5	
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	12.6	6.2	6.8	17.9	16.0	16.4		36.6			46.7	
Level of Service (LOS)	B	A	A	B	B	B		D			D	
Approach Delay, s/veh / LOS	6.9	A		16.3	B		36.6	D		46.7	D	
Intersection Delay, s/veh / LOS	13.4						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.0	B	2.1	B	3.2	C	3.0	C
Bicycle LOS Score / LOS	1.6	A	1.6	A	0.7	A	0.8	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build PM				

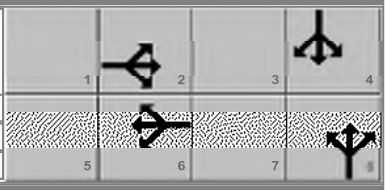


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	30	1600	150	40	1140	30	80	10	60	30	10	10

Signal Information			
Cycle, s	100.0	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	73.7	15.1	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		79.3		79.3		20.7		20.7
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						15.2		8.7
Green Extension Time (g_e), s		0.0		0.0		0.1		0.4
Phase Call Probability						1.00		1.00
Max Out Probability						1.00		0.11

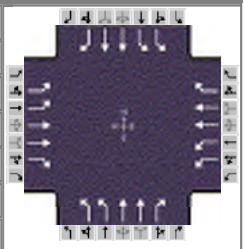
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	32	943	939	43	632	626	86	75			54	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	423	1698	1647	232	1698	1683	1385	1529			1115	
Queue Service Time (g_s), s	1.0	20.4	21.6	2.0	5.8	5.7	6.1	4.4			1.9	
Cycle Queue Clearance Time (g_c), s	6.6	20.4	21.6	28.4	5.8	5.7	13.2	4.4			6.7	
Green Ratio (*g/C*)	0.74	0.74	0.74	0.74	0.74	0.74	0.15	0.15			0.15	
Capacity (*c*), veh/h	362	1255	1217	195	1255	1243	180	228			224	
Volume-to-Capacity Ratio (*X*)	0.089	0.751	0.771	0.220	0.503	0.504	0.478	0.330			0.240	
Available Capacity (c_a), veh/h	362	1255	1217	195	1255	1243	201	251			245	
Back of Queue (*Q*), veh/ln (95th percentile)	0.2	6.7	6.8	0.7	2.4	2.4	3.9	3.1			2.2	
Queue Storage Ratio (*RQ*) (95th percentile)	0.04	0.13	0.13	0.12	0.02	0.02	0.66	0.16			0.11	
Uniform Delay (d_1), s/veh	2.2	2.9	2.9	5.6	1.3	1.3	45.3	38.1			39.1	
Incremental Delay (d_2), s/veh	0.4	3.5	4.0	2.0	1.1	1.1	2.0	0.8			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	
Control Delay (*d*), s/veh	2.6	6.4	6.9	7.5	2.4	2.4	47.3	38.9			39.7	
Level of Service (LOS)	A	A	A	A	A	A	D	D			D	
Approach Delay, s/veh / LOS	6.6	A		2.6	A		43.4	D		39.7	D	
Intersection Delay, s/veh / LOS	7.3						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	2.1	B	1.6	A	0.8	A	0.6	A

Copyright © 2016 University of Florida, All Rights Reserved.

HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	GHM	Analysis Date	Jul 16, 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_Build_10th_St_10th9_PM.xus				
Project Description	2035 Build PM				

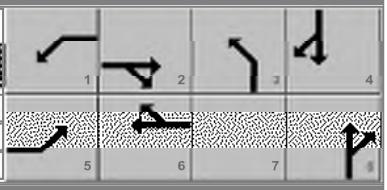


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	340	1010	340	150	560	70	270	390	270	310	440	380

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	56	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.2	22.0	12.4	11.7	0.5	18.2
Yellow	3.6	3.6	3.6	3.6	0.0	3.6
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	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	18.0	45.6	12.8	40.4	17.3	23.8	17.8	24.3
Change Period, (Y+R_c), s	5.6	5.6	5.6	5.6	5.6	5.6	5.6	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	13.5		7.0		10.6	16.7	12.0	15.3
Green Extension Time (g_e), s	0.0	0.0	0.3	0.0	1.1	1.5	0.2	2.2
Phase Call Probability	1.00		0.99		1.00	1.00	1.00	1.00
Max Out Probability	1.00		0.10		0.00	1.00	1.00	0.90

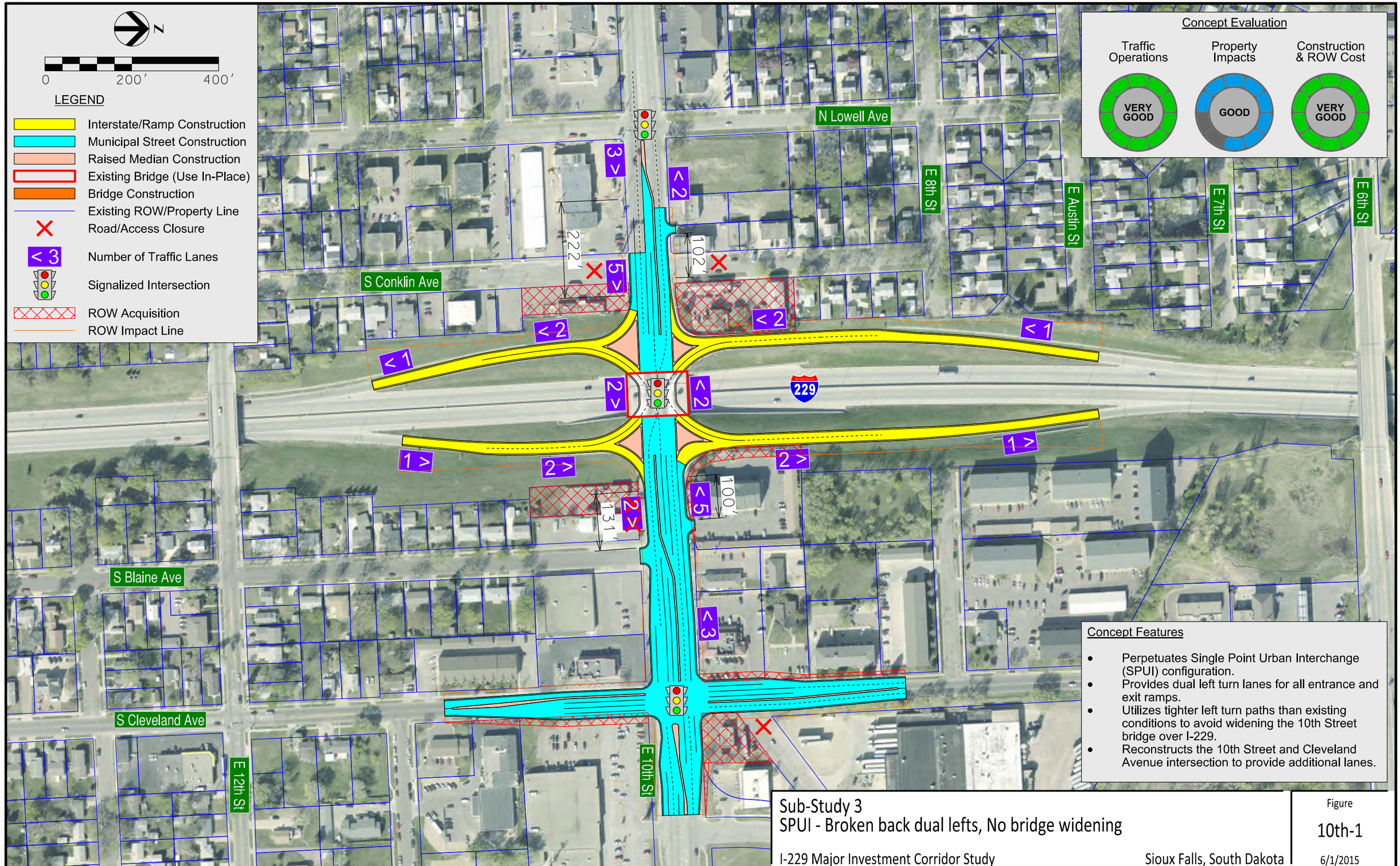
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	366	1086	325	161	602	72	290	419	246	333	473	0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1570	1617	1439	1570	1617	1439	1632	1680	1496	1632	1680	1496
Queue Service Time (g_s), s	11.5	28.8	12.2	5.0	13.3	2.3	8.6	11.7	14.7	10.0	13.3	0.0
Cycle Queue Clearance Time (g_c), s	11.5	28.8	12.2	5.0	13.3	2.3	8.6	11.7	14.7	10.0	13.3	0.0
Green Ratio (*g*/*C*)	0.12	0.40	0.52	0.07	0.35	0.47	0.12	0.18	0.25	0.12	0.19	0.31
Capacity (*c*), veh/h	389	1293	744	226	1125	677	382	611	380	398	628	465
Volume-to-Capacity Ratio (*X*)	0.939	0.840	0.436	0.713	0.535	0.106	0.760	0.686	0.648	0.837	0.754	0.000
Available Capacity (c_a), veh/h	389	1293	744	434	1125	677	894	658	401	437	674	486
Back of Queue (*Q*), veh/ln (95th percentile)	8.4	13.9	5.8	3.6	8.2	0.8	6.5	8.6	9.5	8.2	9.8	0.0
Queue Storage Ratio (*RQ*) (95th percentile)	1.47	0.12	0.87	0.54	0.22	0.20	0.73	0.22	1.61	1.67	0.25	0.00
Uniform Delay (d_1), s/veh	42.6	21.8	11.4	44.2	21.0	1.5	42.8	38.2	33.3	42.9	38.5	0.0
Incremental Delay (d_2), s/veh	21.6	4.1	1.1	4.1	1.8	0.3	3.1	2.7	3.4	12.4	4.5	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	64.1	26.0	12.5	48.3	22.8	1.9	45.9	41.0	36.7	55.4	43.0	0.0
Level of Service (LOS)	E	C	B	D	C	A	D	D	D	E	D	
Approach Delay, s/veh / LOS	31.4	C		26.0	C		41.4	D		48.1	D	
Intersection Delay, s/veh / LOS	35.6						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	2.0	A	1.2	A	1.3	A	1.2	A

Copyright © 2016 University of Florida, All Rights Reserved.

APPENDIX D1 -

PRELIMINARY CONCEPT FIGURES



Concept Features

- Perpetuates Single Point Urban Interchange (SPUI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Utilizes tighter left turn paths than existing conditions to avoid widening the 10th Street bridge over I-229.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

Sub-Study 3
SPUI - Broken back dual lefts, No bridge widening

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-1
6/1/2015

N

0 200′ 400′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
VERY GOOD	GOOD	VERY GOOD

N Lowell Ave
E 8th St
E Austin St
E 7th St
E 6th St
S Conklin Ave
S Blaine Ave
S Cleveland Ave
E 12th St
E 10th St
229
222′
102′
131′
100′

Concept Features

- Perpetuates Single Point Urban Interchange (SPUI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Widens 10th Street bridge over I-229 to the north and south to accommodate added left turn lanes.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

Sub-Study 3
SPUI - Single radius dual lefts, Widen N & S

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 10th-2

6/1/2015

N

0 200′ 400′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 — Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

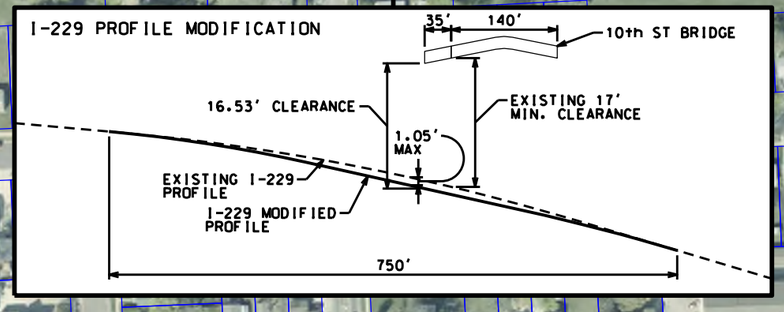
Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
VERY GOOD	GOOD	NEUTRAL

N Lowell Ave
E 8th St
E Austin St
E 7th St
E 6th St
S Conklin Ave
S Cleveland Ave
E 12th St
E 10th St
I-229

3 v
5 v
< 2
204′
750′
144′
< 2
< 2
< 1
< 1
2 v
< 2
1 >
2 >
2 >
1 >
2 v
108′
< 5
147′
< 3

I-229 PROFILE MODIFICATION



Concept Features

- Perpetuates Single Point Urban Interchange (SPUI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Widens 10th Street bridge over I-229 to the south to accommodate added left turn lanes.
- Involves short segment of I-229 reconstruction to maintain required vertical clearance under widened 10th Street bridge.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

Sub-Study 3
SPUI - Single radius dual lefts, Widen S + I-229 profile modification

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 10th-3

6/1/2015

N

0 200′ 400′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

N Lowell Ave
E 8th St
E Austin St
E 7th St
E 6th St
S Conklin Ave
S Blaine Ave
S Cleveland Ave
E 12th St
E 10th St
229

3 v
< 2
5 v
< 2
< 3
< 1
< 1
4 v
< 4
1 >
4 >
2 v
2 >
< 5
1 >
< 3

Sub-Study 3
Tight Diamond

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-4
6/1/2015

N

0 200′ 400′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
VERY GOOD	NEUTRAL	POOR

N Lowell Ave
E 8th St
E Austin St
E 7th St
E 6th St
S Conklin Ave
S Blaine Ave
S Cleveland Ave
E 12th St
E 10th St
I-229
297′
163′
162′
337′

Concept Features

- Replaces Single Point Urban Interchange with Diverging Diamond Interchange (DDI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Eliminates left turn movements on 10th Street by crossing 10th Street traffic to the left side between ramp terminal intersections.
- Provides opportunity to locate pedestrian/bicycle facilities between the 10th Street lanes over I-229 to allow signal control of all pedestrian/ bicycle crossings.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

Sub-Study 3
DDI - 20 mph conventional width

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-5
6/1/2015

N

0 200′ 400′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

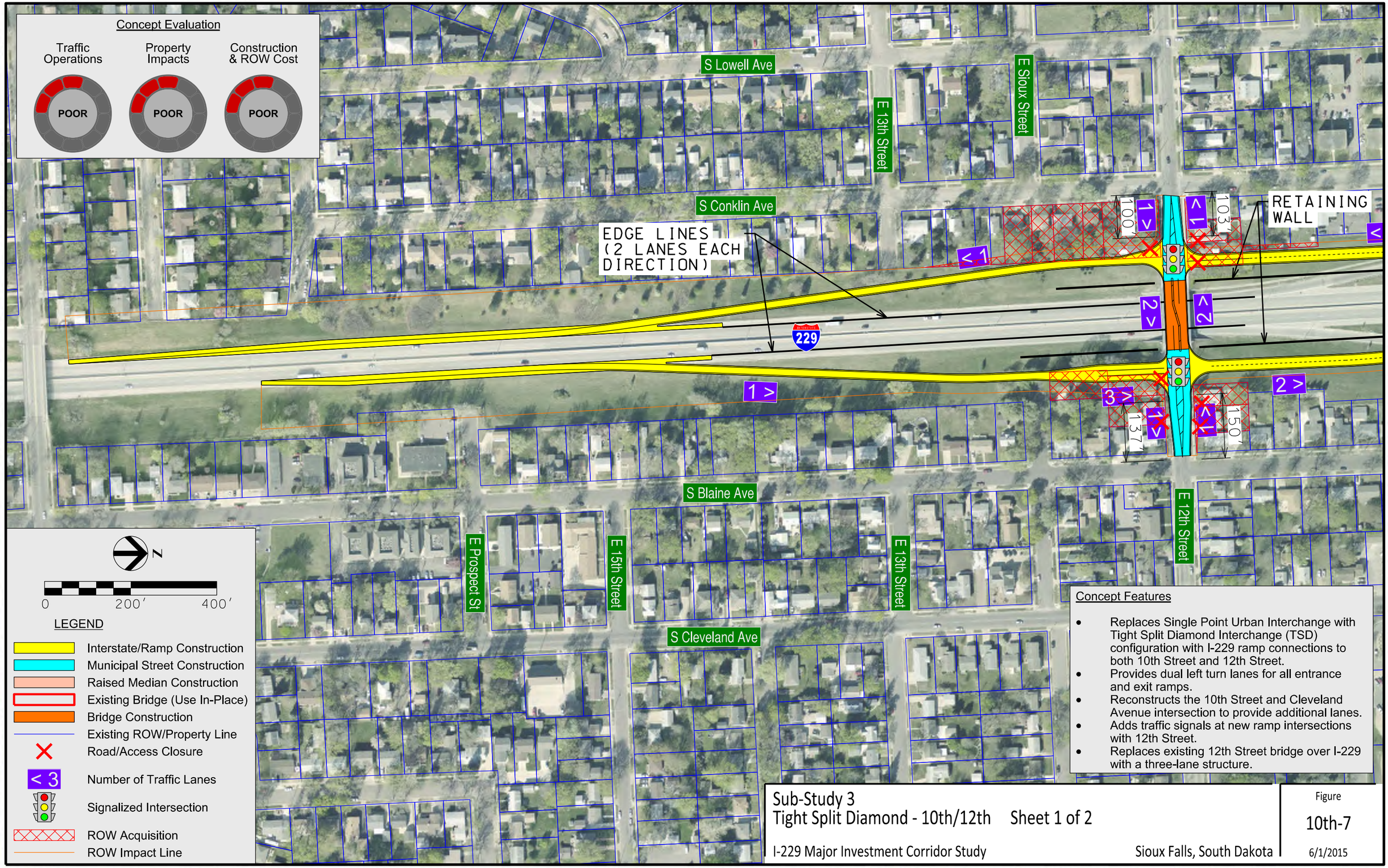
S Conklin Ave
N Lowell Ave
E 8th St
E Austin St
E 7th St
E 6th St
248′R
V=30 mph
229
S Blaine Ave
287′R
V=30 mph
S Cleveland Ave
E 12th St
E 10th St

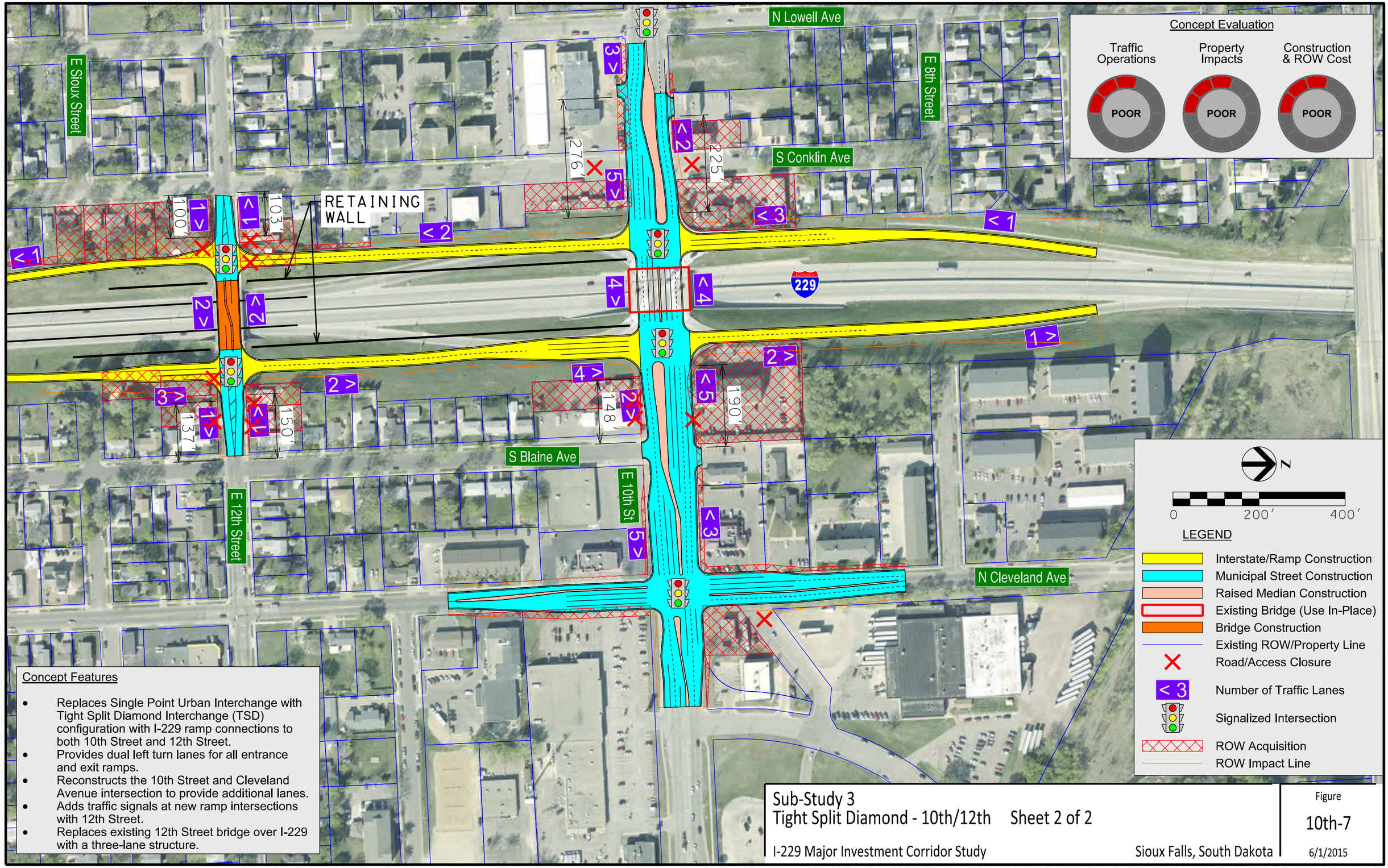
Sub-Study 3
Parclo - Terminals at Lowell & Cleveland, no SW & NE quadrant ramps

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 10th-6

6/1/2015


Concept Evaluation
Traffic Operations
Property Impacts
Construction & ROW Cost
POOR
POOR
POOR
S Lowell Ave
E 13th Street
E Sioux Street
S Conklin Ave
EDGE LINES (2 LANES EACH DIRECTION)
RETAINING WALL
100'
103'
150'
137'
229
1 >
2 >
3 >
< 1
< 2
< 3
1 v
2 v
3 v
S Blaine Ave
S Cleveland Ave
E Prospect St
E 15th Street
E 13th Street
E 12th Street
N
0
200'
400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Existing ROW/Property Line
Road/Access Closure
Number of Traffic Lanes
Signalized Intersection
ROW Acquisition
ROW Impact Line
Concept Features
Replaces Single Point Urban Interchange with Tight Split Diamond Interchange (TSD) configuration with I-229 ramp connections to both 10th Street and 12th Street.
Provides dual left turn lanes for all entrance and exit ramps.
Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
Adds traffic signals at new ramp intersections with 12th Street.
Replaces existing 12th Street bridge over I-229 with a three-lane structure.
Sub-Study 3
Tight Split Diamond - 10th/12th
Sheet 1 of 2
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
10th-7
6/1/2015



Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
POOR	POOR	POOR

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

Concept Features

- Replaces Single Point Urban Interchange with Tight Split Diamond Interchange (TSD) configuration with I-229 ramp connections to both 10th Street and 12th Street.
- Provides dual left turn lanes for all entrance and exit ramps.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
- Adds traffic signals at new ramp intersections with 12th Street.
- Replaces existing 12th Street bridge over I-229 with a three-lane structure.

Sub-Study 3
Tight Split Diamond - 10th/12th Sheet 2 of 2

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

Figure
10th-7
6/1/2015

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
NEUTRAL	POOR	POOR

S Lowell Ave
E 13th Street
E Sioux Street
S Conklin Ave
RETAINING WALL
229
S Blaine Ave
E 10th St
E Prospect St
E 15th Street
E 13th Street
E 12th Street
S Cleveland Ave

N

0 250′ 500′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

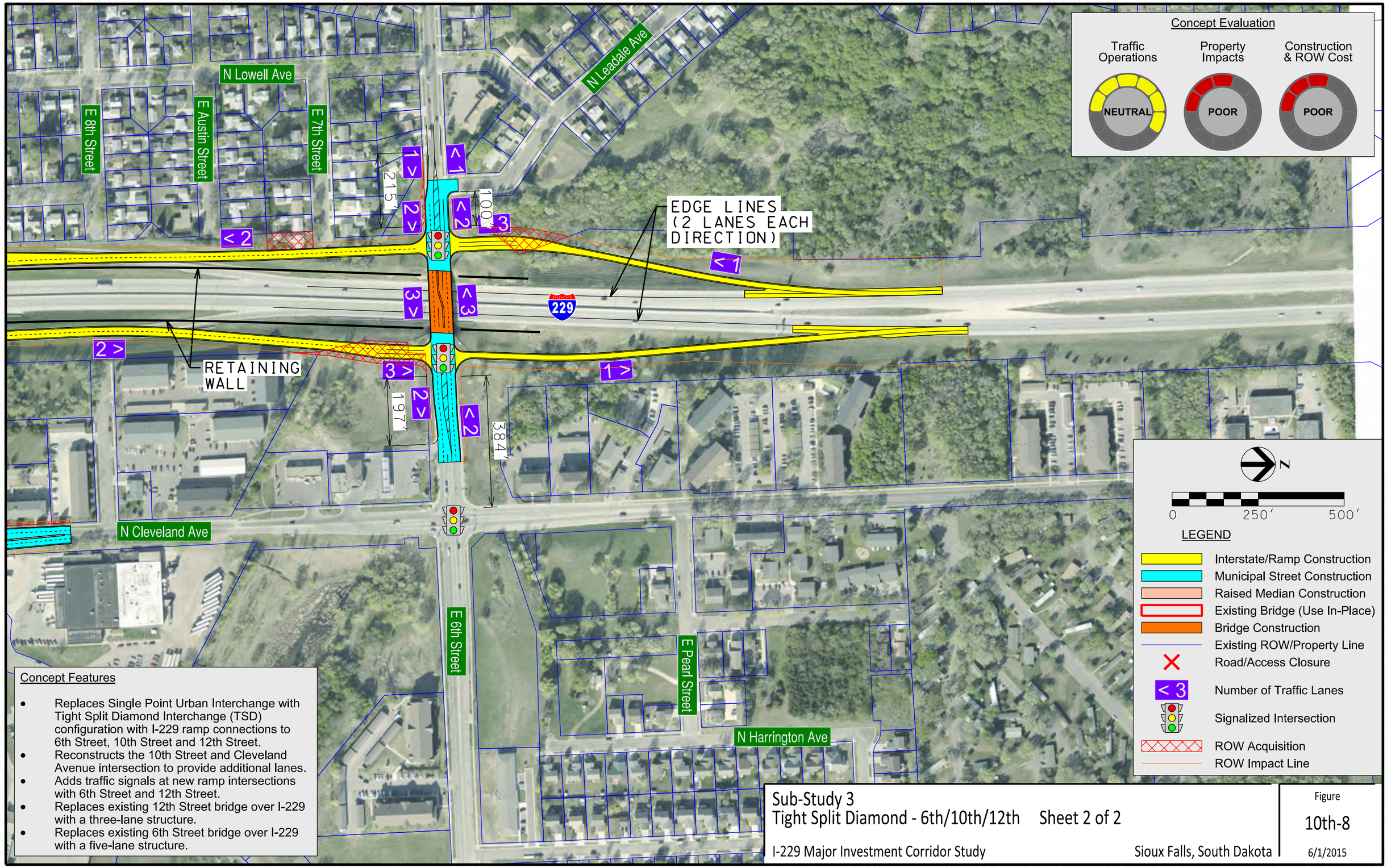
Concept Features

- Replaces Single Point Urban Interchange with Tight Split Diamond Interchange (TSD) configuration with I-229 ramp connections to 6th Street, 10th Street and 12th Street.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
- Adds traffic signals at new ramp intersections with 6th Street and 12th Street.
- Replaces existing 12th Street bridge over I-229 with a three-lane structure.
- Replaces existing 6th Street bridge over I-229 with a five-lane structure.

Sub-Study 3
Tight Split Diamond - 6th/10th/12th Sheet 1 of 2

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

Figure
10th-8
6/1/2015



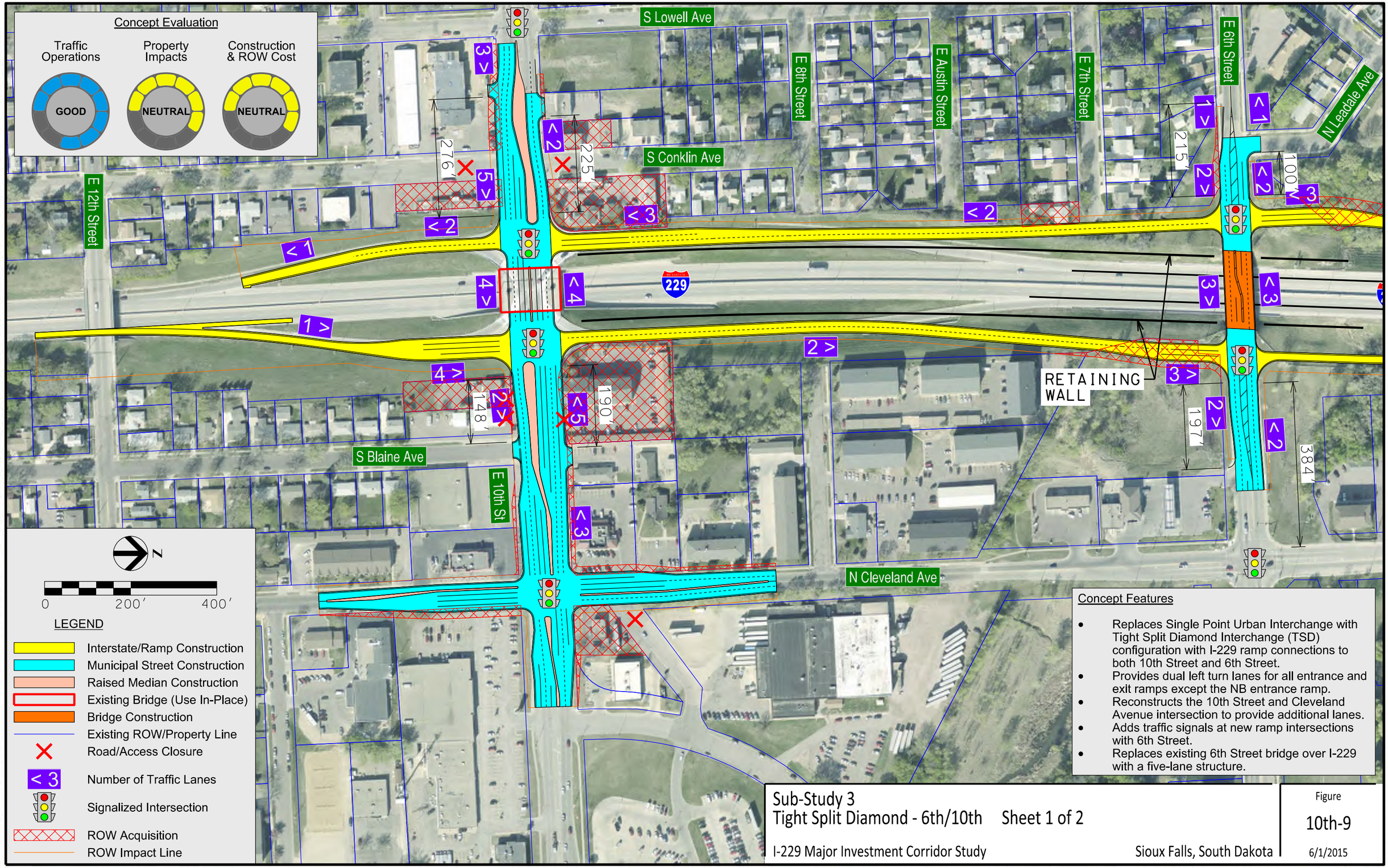
Concept Features

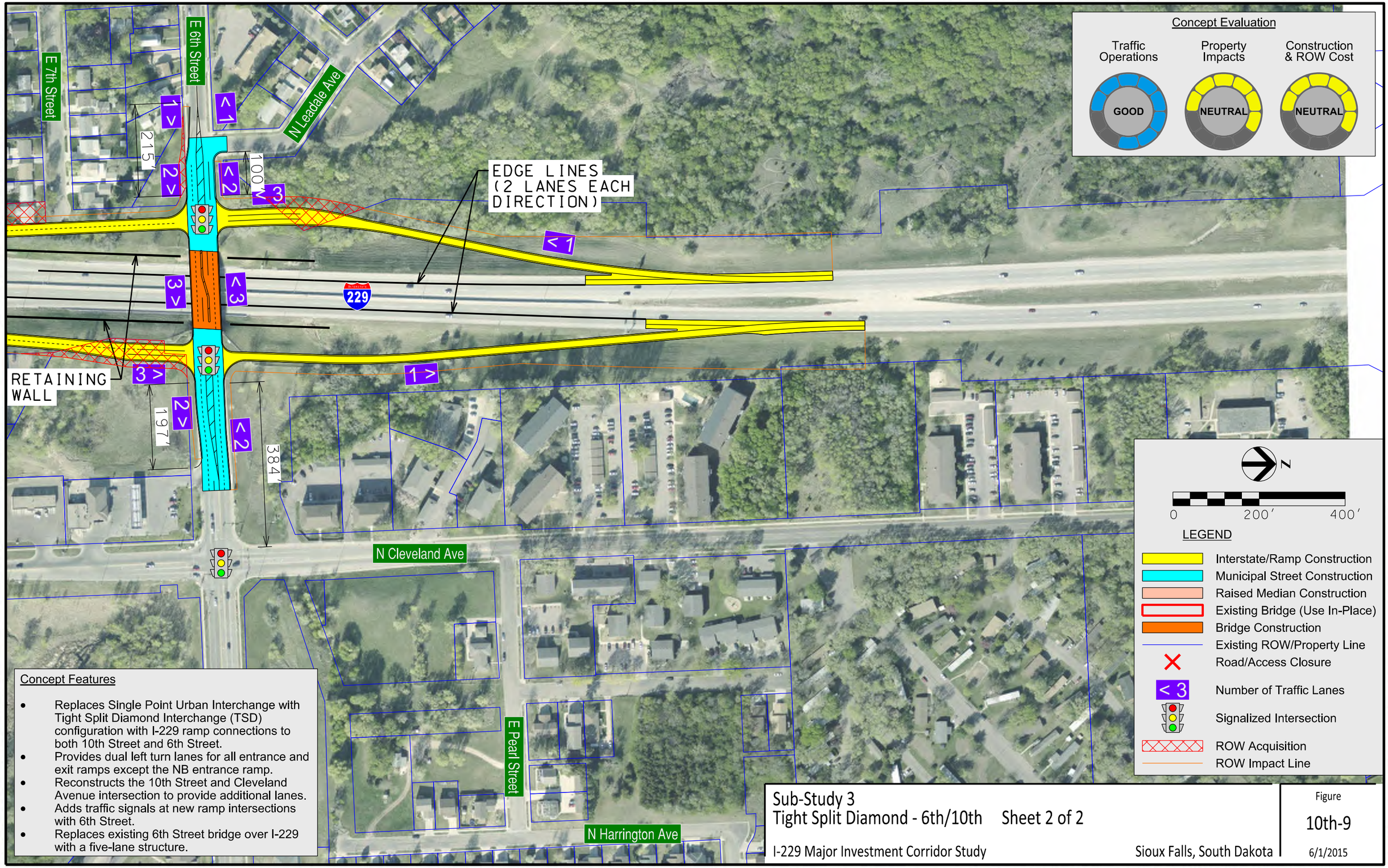
- Replaces Single Point Urban Interchange with Tight Split Diamond Interchange (TSD) configuration with I-229 ramp connections to 6th Street, 10th Street and 12th Street.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
- Adds traffic signals at new ramp intersections with 6th Street and 12th Street.
- Replaces existing 12th Street bridge over I-229 with a three-lane structure.
- Replaces existing 6th Street bridge over I-229 with a five-lane structure.

Sub-Study 3
Tight Split Diamond - 6th/10th/12th Sheet 2 of 2

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

Figure
10th-8
6/1/2015


Concept Evaluation
Traffic Operations
GOOD
Property Impacts
NEUTRAL
Construction & ROW Cost
NEUTRAL
S Lowell Ave
E 8th Street
E Austin Street
E 7th Street
E 6th Street
N Leadale Ave
S Conklin Ave
E 12th Street
229
RETAINING WALL
S Blaine Ave
E 10th St
N Cleveland Ave
276'
225'
215'
100'
148'
190'
197'
384'
N
0
200'
400'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Existing ROW/Property Line
Road/Access Closure
Number of Traffic Lanes
Signalized Intersection
ROW Acquisition
ROW Impact Line
Concept Features
Replaces Single Point Urban Interchange 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.
Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
Adds traffic signals at new ramp intersections with 6th Street.
Replaces existing 6th Street bridge over I-229 with a five-lane structure.
Sub-Study 3
Tight Split Diamond - 6th/10th
Sheet 1 of 2
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
10th-9
6/1/2015



Concept Features

- Replaces Single Point Urban Interchange 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.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
- Adds traffic signals at new ramp intersections with 6th Street.
- Replaces existing 6th Street bridge over I-229 with a five-lane structure.

Sub-Study 3
Tight Split Diamond - 6th/10th Sheet 2 of 2

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

Figure
10th-9
6/1/2015

N

0 200′ 400′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

N Lowell Ave
E 8th St
E Austin St
E 7th St
E 6th St
S Conklin Ave
229
S Blaine Ave
S Cleveland Ave
E 12th St
E 10th St

Sub-Study 3
Cleveland Ave CFI

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-10
6/1/2015

N

0 200′ 400′

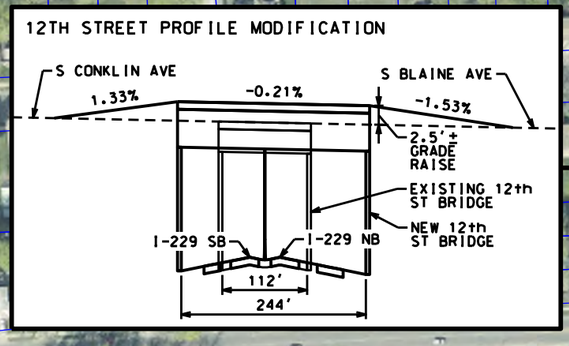
LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 — Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

Concept Features

- Reconstructs the I-229 NB exit ramp and SB entrance ramp to provide extended dual lanes for added capacity.
- Replaces existing 12th Street bridge over I-229 to eliminate constraint to widening the 10th Street ramps.
- Concept variation can be integrated with other concepts

12TH STREET PROFILE MODIFICATION



N Lowell Ave
E 8th St
S Conklin Ave
S Blaine Ave
S Cleveland Ave
E 10th St
E 12th St
RETAINING WALL
RETAINING WALL
222'
102'
131'
96'
229

Sub-Study 3
Unconstrained SB Entrance & NB Exit Ramps

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 10th-Var

6/1/2015

N

0 200′ 400′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

S Conklin Ave

S Blaine Ave

S Cleveland Ave

E 12th St

E 11th St

E 10th St

E 8th St

N Chapel Hill Rd

EB 10th STREET TO NB CLEVELAND AVE PATH

WB 10th STREET TO SB CLEVELAND AVE PATH

< 2 < 1 < 1 < 2 < 4 < 2 < 2 < 2

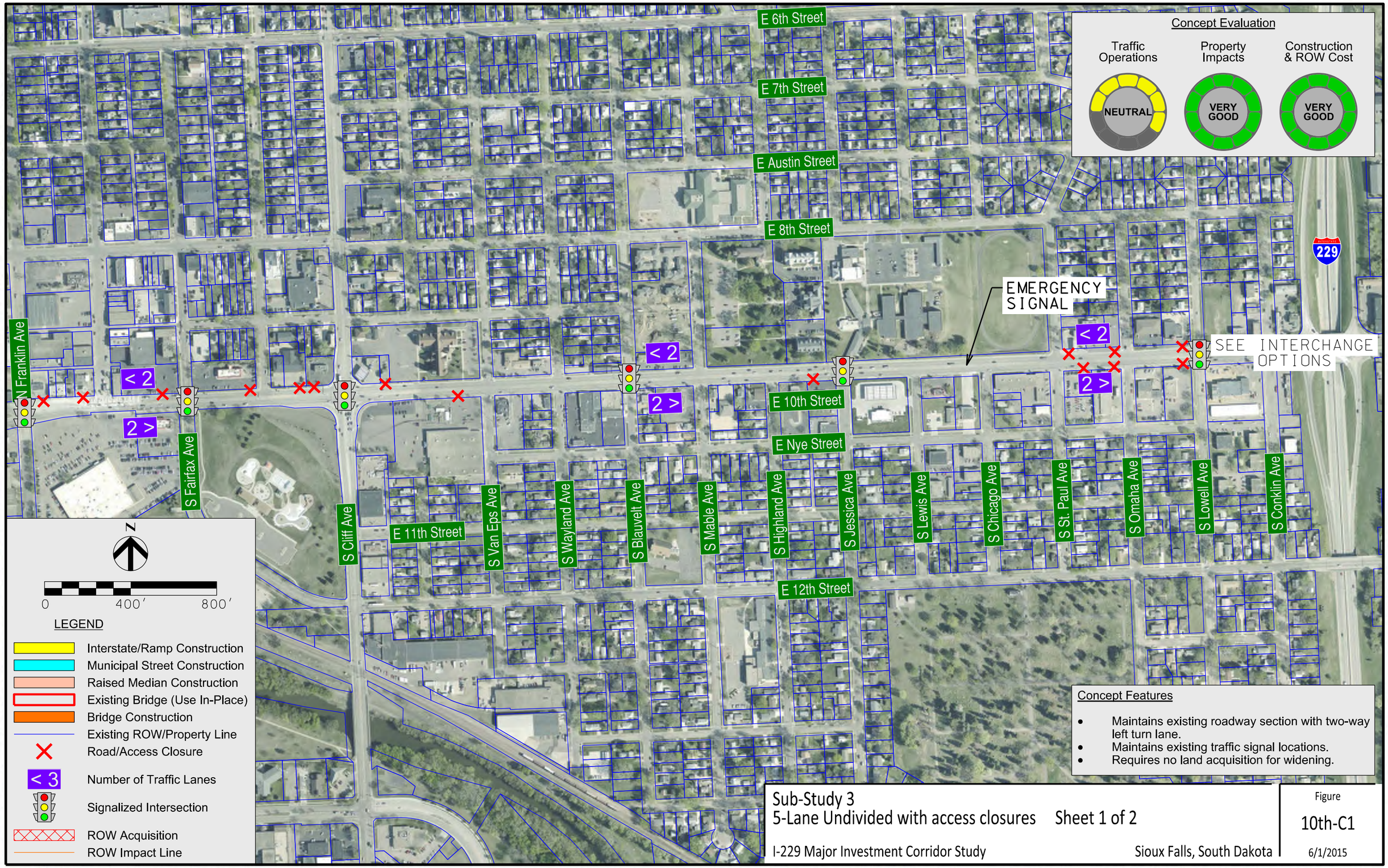
< 1 2 > 2 > 4 > 2 > 1 > 2 > 2 >

Sub-Study 3
Cleveland Ave restricted left turns

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
Cleve-2
6/1/2015



Sub-Study 3
5-Lane Undivided with access closures Sheet 1 of 2

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

Figure
10th-C1
6/1/2015

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
NEUTRAL	VERY GOOD	VERY GOOD

N

0 400′ 800′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

229

N Chapel Hill Road

< 2

2 >

E 10th Street

SEE INTERCHANGE OPTIONS

S Blaine Ave

S Cleveland Ave

S Thompson Ave

S Sneve Ave

S Bahnson Ave

N Sycamore Ave

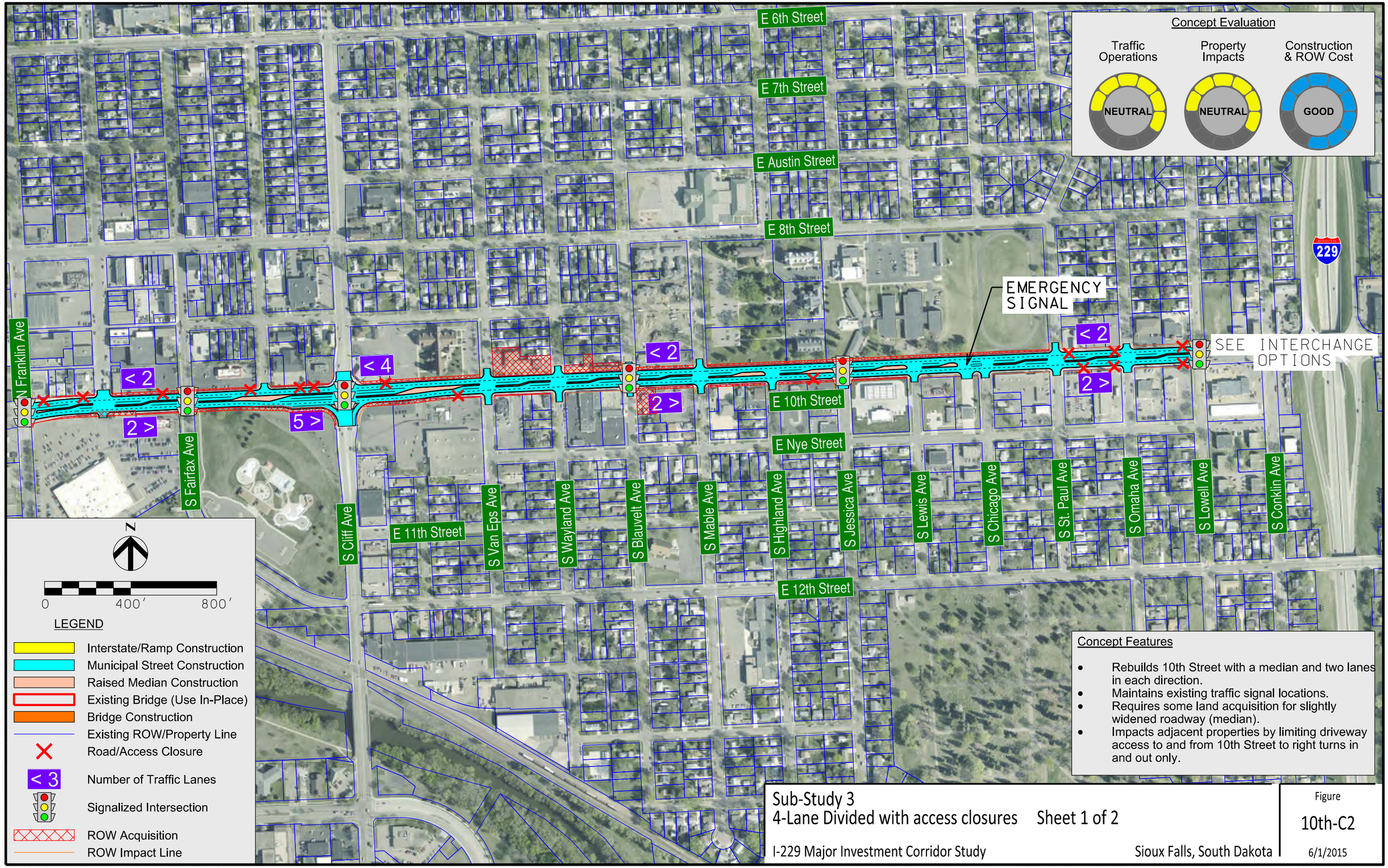
Concept Features

- Maintains existing roadway section with two-way left turn lane.
- Maintains existing traffic signal locations.
- Requires no land acquisition for widening.

Sub-Study 3
5-Lane Undivided with access closures Sheet 2 of 2

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

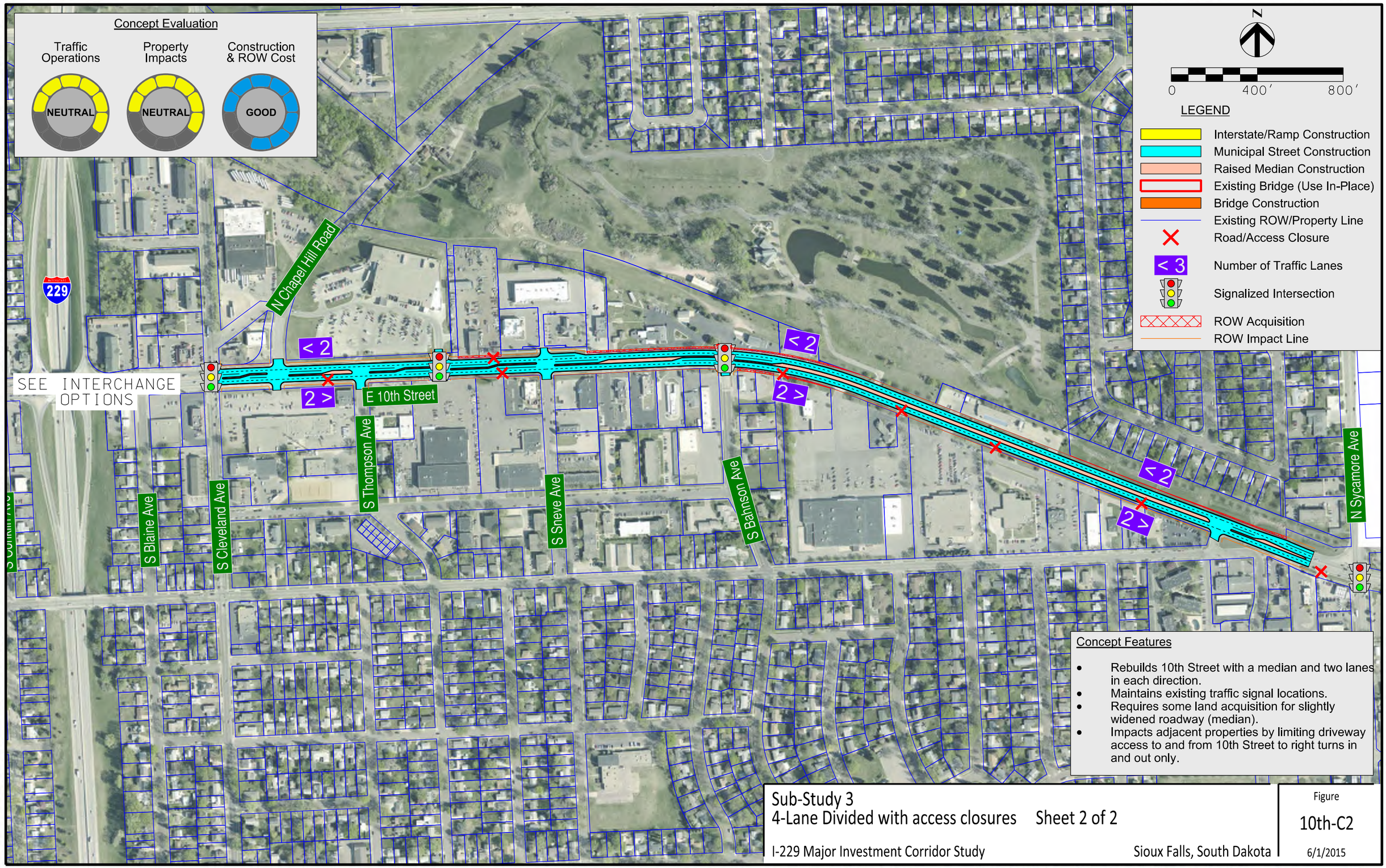
Figure
10th-C1
6/1/2015



Sub-Study 3
4-Lane Divided with access closures Sheet 1 of 2

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

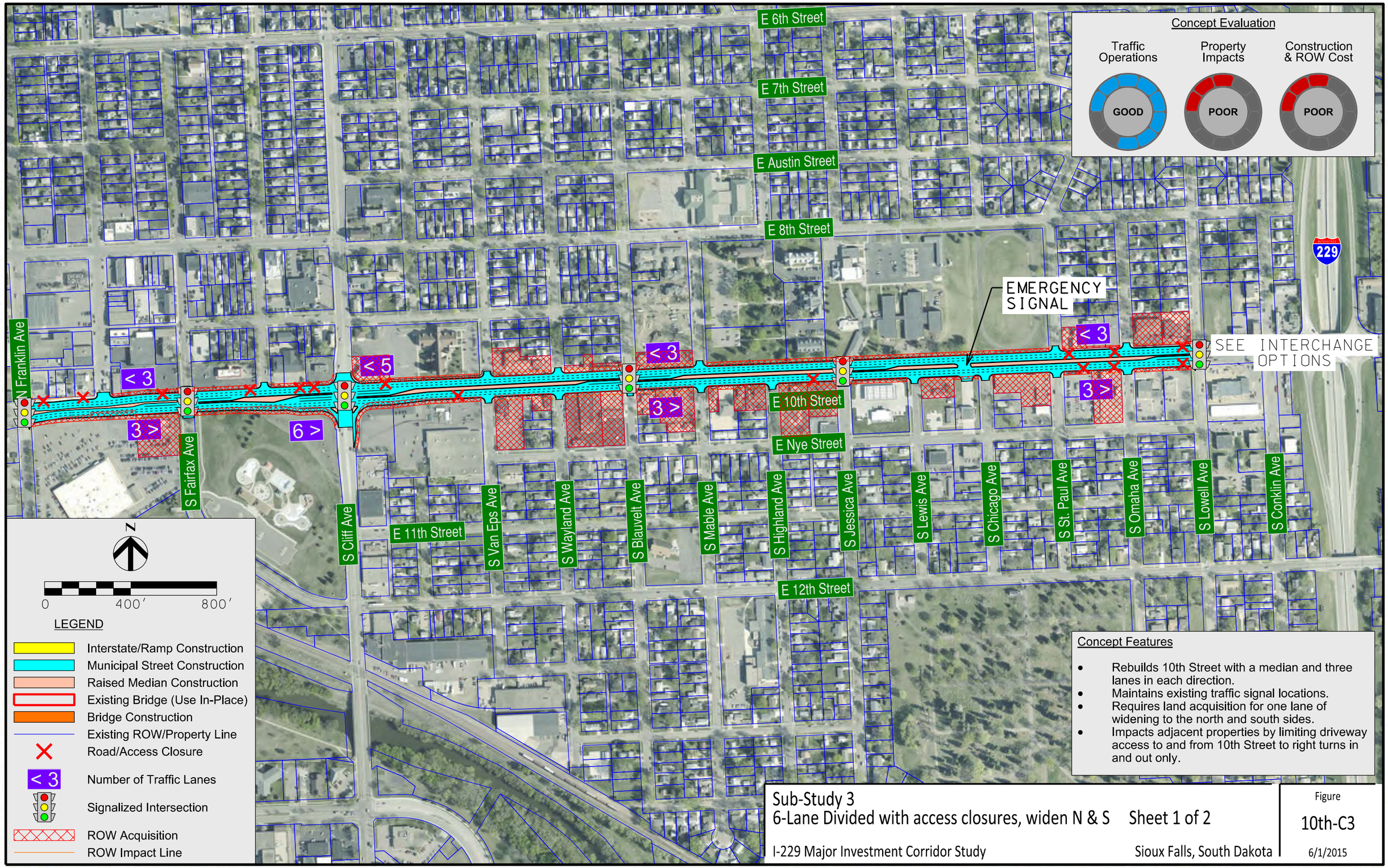
Figure
10th-C2
6/1/2015



Sub-Study 3
4-Lane Divided with access closures Sheet 2 of 2

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

Figure
10th-C2
6/1/2015


Concept Evaluation
Traffic Operations
GOOD
Property Impacts
POOR
Construction & ROW Cost
POOR
E 6th Street
E 7th Street
E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
E 12th Street
EMERGENCY SIGNAL
SEE INTERCHANGE OPTIONS
229
N Franklin Ave
S Fairfax Ave
S Cliff Ave
S Van Eps Ave
S Wayland Ave
S Blauvelt Ave
S Mable Ave
S Highland Ave
S Jessica Ave
S Lewis Ave
S Chicago Ave
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
< 3
< 5
6 >
3 >
N
0
400'
800'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Existing ROW/Property Line
Road/Access Closure
Number of Traffic Lanes
Signalized Intersection
ROW Acquisition
ROW Impact Line
Concept Features
Rebuilds 10th Street with a median and three lanes in each direction.
Maintains existing traffic signal locations.
Requires land acquisition for one lane of widening to the north and south sides.
Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.
Sub-Study 3
6-Lane Divided with access closures, widen N & S
Sheet 1 of 2
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
10th-C3
6/1/2015

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
GOOD	POOR	POOR

N

0 400′ 800′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

229

N Chapel Hill Road

< 3 < 2 < 2

3 > 2 >

E 10th Street

SEE INTERCHANGE OPTIONS

S Blaine Ave

S Cleveland Ave

S Thompson Ave

S Sneve Ave

S Bahnson Ave

N Sycamore Ave

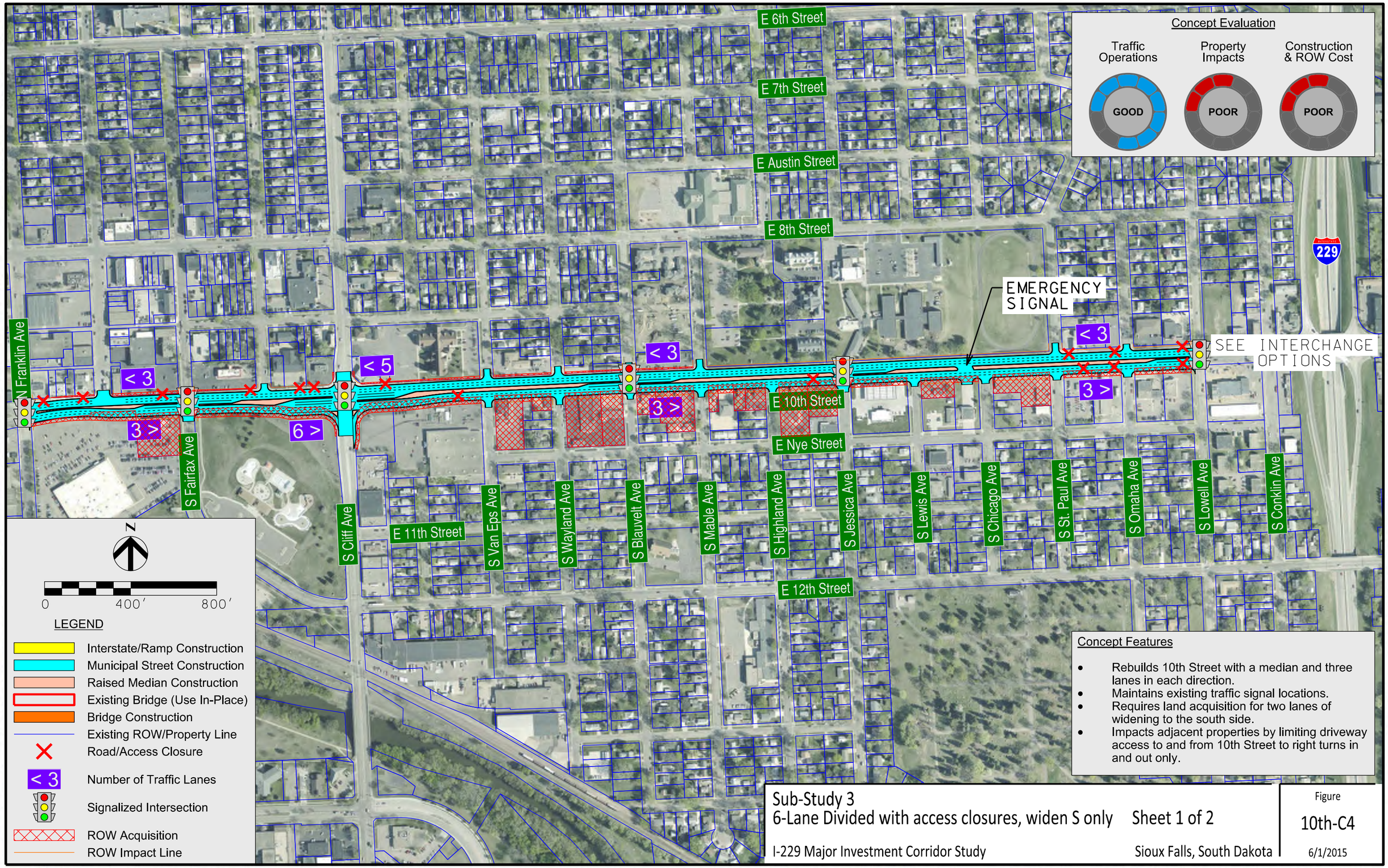
Concept Features

- Rebuilds 10th Street with a median and three lanes in each direction.
- Maintains existing traffic signal locations.
- Requires land acquisition for one lane of widening to the north and south sides.
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

Sub-Study 3
6-Lane Divided with access closures, widen N & S Sheet 2 of 2

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

Figure
10th-C3
6/1/2015


Concept Evaluation
Traffic Operations
GOOD
Property Impacts
POOR
Construction & ROW Cost
POOR
E 6th Street
E 7th Street
E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
E 12th Street
EMERGENCY SIGNAL
SEE INTERCHANGE OPTIONS
229
N Franklin Ave
S Fairfax Ave
S Cliff Ave
S Van Eps Ave
S Wayland Ave
S Blauvelt Ave
S Mable Ave
S Highland Ave
S Jessica Ave
S Lewis Ave
S Chicago Ave
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
< 3
< 5
3 >
6 >
N
0
400'
800'
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
Existing Bridge (Use In-Place)
Bridge Construction
Existing ROW/Property Line
Road/Access Closure
Number of Traffic Lanes
Signalized Intersection
ROW Acquisition
ROW Impact Line
Concept Features
Rebuilds 10th Street with a median and three lanes in each direction.
Maintains existing traffic signal locations.
Requires land acquisition for two lanes of widening to the south side.
Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.
Sub-Study 3
6-Lane Divided with access closures, widen S only
Sheet 1 of 2
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
10th-C4
6/1/2015

Concept Evaluation

Traffic Operations	Property Impacts	Construction & ROW Cost
GOOD	POOR	POOR

N

0 400′ 800′

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Existing ROW/Property Line
- Road/Access Closure
- < 3 Number of Traffic Lanes
- Signalized Intersection
- ROW Acquisition
- ROW Impact Line

229

N Chapel Hill Road

< 3 < 2 < 2

3 > 2 >

E 10th Street

SEE INTERCHANGE OPTIONS

S Thompson Ave

S Sneve Ave

S Bahnson Ave

N Sycamore Ave

S Blaine Ave

S Cleveland Ave

Concept Features

- Rebuilds 10th Street with a median and three lanes in each direction.
- Maintains existing traffic signal locations.
- Requires land acquisition for two lanes of widening to the south side.
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

Sub-Study 3
6-Lane Divided with access closures, widen S only Sheet 2 of 2

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

Figure
10th-C4
6/1/2015

APPENDIX D2. PRELIMINARY CONCEPTS TECH MEMO

Preliminary Concepts – 10th Street Corridor and Interchanges

The 10th Street 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 D1- 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.

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.

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		Comments
			Traffic Assessment	ROW/Environ/ Cost	
10th Street Interchange					
10th-1	SPUI - Broken back lefts, No bridge widening	Develop	X	X	- Added Cleveland Ave Dual left configuration
10th-2	SPUI - Single radius lefts, Widen N & S	Develop		X	- Added Cleveland Ave Dual left configuration
10th-3	SPUI - Single radius lefts, Widen S + I229 profile modification	Develop		X	- New Concept - Bridge widening to the south - Developed limits of I-229 profile reconstruction for Bridge clearance
10th-4	Tight Diamond	Show			- Added Cleveland Ave Dual left configuration
	DDI - 20 mph tightest footprint	Eliminate			
10th-5	DDI - 20 mph conventional width	Develop	X	X	- Added Cleveland Ave Dual left configuration
	Par - 160' radius	Eliminate			
10th-6	Par - Terminals at Lowell & Cleveland, no SW & NE quadrant ramps	Show			- Eliminated SW & NE Diagonal Ramps - Full intersection with Lowell/SB I-229 and Cleveland and NB I-229
10th-7	TSD - 10th / 12th	Develop	X	X	- Added Cleveland Ave Dual left configuration - Added approximate retaining wall locations
10th-8	TSD - 6th / 10th / 12th	Develop	X	X	- Added Cleveland Ave Dual left configuration - Added approximate retaining wall locations
10th-9	TSD - 6th / 10th	Develop	X	X	- Added Cleveland Ave Dual left configuration - Added approximate retaining wall locations
	TSD - 6th / 10th / 12th with embedded ramps for 10th	Eliminate			
10th-10	Cleveland Ave CFI	Show (1)			- No changes from workshop
10th-Var	Unconstrained SB Entrance & NB Exit Ramps (2)	Develop (3)		X	- New Concept - NB I-229 exit ramp Lengthened with two-lane off ramp - SB I-229 entrance ramp lengthened
Cleve-1	Cleveland Ave Dual Left Turns	Develop (4)	X (5)	X	- Merged with all 10th layouts
Cleve-2	Cleveland Ave restricted left turns	Show			- No changes from workshop
10th Street Corridor					
10th-C1	5-Lane Undivided with drive closures	Develop		X	- No changes from workshop
10th-C2	4-Lane Divided with drive closures	Develop		X	- No changes from workshop
10th-C3	6-Lane Divided with drive closures, widen N & S	Develop	X	X	- No changes from workshop
10th-C4	6-Lane Divided with drive closures, widen S only	Develop		X	- New Concept - Widening to the south only

Footnotes
(1) Concept will not be developed further based on linked movement traffic count.
(2) Eliminate existing 12th St Bridge as a constraint for ramps.
(3) Consider as variation for all 10th St interchange concepts except 10th-7 and 10th-8.
(4) Combine with all 10th St interchange concepts
(5) Analyzed in conjunction with interchange improvements

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)

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 D3- DTA MODEL INTERCHANGE AND MODEL SUBAREAS***.

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

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 D3- DTA MODEL INTERCHANGE AND MODEL SUBAREAS***. 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
10th-1	SPUI, No Bridge Widening, Cleveland Dual Lefts	-72%	-25%	Very Good
10th-5	DDI, Cleveland Dual Lefts	-71%	-79%	Very Good
10th-7	TSD- 10th/ 12th, Cleveland Dual Lefts	-1%	-22%	Good
10th-8	TSD- 6th/ 10th/ 12th, Cleveland Dual Lefts	3%	-53%	Good
10th-9	TSD- 6th/ 10th, Cleveland Dual Lefts	-33%	-71%	Very Good
10th-C3	6 lane divided, Cleveland Dual Lefts	53% [2]	4%	Poor

Delay

Interchange Area Delay (veh-min)		Delay, veh-min		Subjective
Concept ID	Description	AM	PM	Classification
10th-1	SPUI, No Bridge Widening, Cleveland Dual Lefts	-67%	-17%	Good
10th-5	DDI, Cleveland Dual Lefts	-68%	-71%	Very Good
10th-7	TSD- 10th/ 12th, Cleveland Dual Lefts	142%	199%	Poor
10th-8	TSD- 6th/ 10th/ 12th, Cleveland Dual Lefts	38% [1]	-34%	Neutral
10th-9	TSD- 6th/ 10th, Cleveland Dual Lefts	-28%	-60%	Very Good
10th-C3	6 lane divided, Cleveland Dual Lefts	35% [2]	-3%	Poor
Overall Subarea Delay (min)		**Delay, min**		**Subjective**
Concept ID	Description	AM	PM	Classification
10th-1	SPUI, No Bridge Widening, Cleveland Dual Lefts	0%	3%	Neutral
10th-5	DDI, Cleveland Dual Lefts	-2%	-2%	Neutral
10th-7	TSD- 10th/ 12th, Cleveland Dual Lefts	8%	-2%	Neutral
10th-8	TSD- 6th/ 10th/ 12th, Cleveland Dual Lefts	1%	-10%	Neutral
10th-9	TSD- 6th/ 10th, Cleveland Dual Lefts	4%	-5%	Neutral
10th-C3	6 lane divided, Cleveland Dual Lefts	2%	-6%	Neutral

Table 2. Preliminary Concept 2035 Conditions DTA Traffic Assessment Comparative Data (Continued)

Travel Time

Interstate Through Trips		Travel Time		Subjective
Concept ID	Description	AM	PM	Classification
10th-1	SPUI, No Bridge Widening, Cleveland Dual Lefts	**2%**	**1%**	**Neutral**
10th-5	DDI, Cleveland Dual Lefts	**0%**	**0%**	**Neutral**
10th-7	TSD- 10th/ 12th, Cleveland Dual Lefts	**1%**	**1%**	**Neutral**
10th-8	TSD- 6th/ 10th/ 12th, Cleveland Dual Lefts	**0%**	**0%**	**Neutral**
10th-9	TSD- 6th/ 10th, Cleveland Dual Lefts	**0%**	**1%**	**Neutral**
10th-C3	6 lane divided, Cleveland Dual Lefts	**1%**	**3%**	**Neutral**
10th Street Corridor		**Travel Time**		**Subjective**
Concept ID	Description	AM	PM	Classification
10th-1	SPUI, No Bridge Widening, Cleveland Dual Lefts	**-19%**	**0%**	**Good**
10th-5	DDI, Cleveland Dual Lefts	**-30%**	**-28%**	**Very Good**
10th-7	TSD- 10th/ 12th, Cleveland Dual Lefts	**-3%**	**-21%**	**Good**
10th-8	TSD- 6th/ 10th/ 12th, Cleveland Dual Lefts	**-35%**	**-34%**	**Very Good**
10th-9	TSD- 6th/ 10th, Cleveland Dual Lefts	**-31%**	**-37%**	**Very Good**
10th-C3	6 lane divided, Cleveland Dual Lefts	**9%** [2]	**-24%**	**Good**
69th/Louise to/from Cleveland N. of 10th		**Travel Time**		**Subjective**
Concept ID	Description	AM	PM	Classification
10th-1	SPUI, No Bridge Widening, Cleveland Dual Lefts	**12%** [1]	**10%** [1]	**Poor**
10th-5	DDI, Cleveland Dual Lefts	**-4%**	**-10%**	**Good**
10th-7	TSD- 10th/ 12th, Cleveland Dual Lefts	**136%**	**142%**	**Poor**
10th-8	TSD- 6th/ 10th/ 12th, Cleveland Dual Lefts	**45%** [1]	**8%** [1]	**Poor**
10th-9	TSD- 6th/ 10th, Cleveland Dual Lefts	**1%**	**-18%**	**Good**
10th-C3	6 lane divided, Cleveland Dual Lefts	**15%** [2]	**-4%**	**Poor**

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. The known sites are not located within the area potentially affected by Sub-Study 3.

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 was 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).

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 is found within 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. 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 D4- ENVIRONMENTAL CONSTRAINTS MAPS***.

Note, a noise assessment will be included at a 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
10th-1	SPUI - Broken back dual lefts, No bridge widening	Likely no wetland impacts, but should be confirmed at time of proposal		If any structures are eligible for NRHP, they would be protected under Section 4(f). Could have 4(f) impacts	Structures should be reviewed for historic eligibility	4 structures Potential impact to motel; Autozone	Medium/ potential 4(f)	10th-1 and 2 have similar impacts. Structure removal involved. Structures should be evaluated for eligibility.
10th-2	SPUI - Single radius dual lefts, Widen N & S	Likely no wetland impacts, but should be confirmed at time of		If any structures are eligible, could have 4(f) impacts	Structures should be reviewed for historic eligibility	4 structures Potential impact to motel; AutoZone	Medium/ potential 4(f)	
10th-3	SPUI - Single radius dual lefts, Widen S + I-229 profile modification	Likely no wetland impacts, but should be confirmed at time of proposal		If any structures are eligible, could have 4(f) impacts	Structures should be reviewed for historic eligibility	Potential impact to motel; AutoZone; slightly more ROW	Medium/ potential 4(f)	Slightly more ROW impacts than 10th-1-2 options. Structure removal involved. Structures should be evaluated for eligibility.
10th-5	DDI - 20 mph conventional width	Likely no wetland impacts, but should be confirmed at time of proposal	Potential impacts to northern long-eared bat if trees are removed during summer maternity season.	If any structures are eligible, could have 4(f) impacts	Structures should be reviewed for historic eligibility	9 structures to be removed	Medium/ potential 4(f)	More business impact than 10th 1-3. Structure removal involved. Structures should be evaluated for eligibility.
10th-7	Tight Split Diamond - 10th/12th	No wetland impacts anticipated, but should be confirmed at time of proposal	Potential impacts to northern long-eared bat if trees are removed during summer maternity season.	If any structures are eligible, could have 4(f) impacts	Structures should be reviewed for historic eligibility	15 structures to be removed	Medium/ potential 4(f)	Highest level of business impacts; other impacts minimal. Structure removal involved. Structures should be evaluated for eligibility.
10th-8	Tight Split Diamond - 6th/10th/12th	Potential wetlands present	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.	Leaders Park - direct impacts. Possible 6(f) impacts and 4(f) if FHWA funds are used.	Structures should be reviewed for historic eligibility	13 structures to be removed	High/ likely 4(f)/6(f)	High level of potential impacts. Potential 4(f)/6(f) impacts. Potential wetlands.
10th-9	Tight Split Diamond - 6th/10th	Potential wetlands present	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.	Leaders Park - direct impacts. Possible 6(f) impacts and 4(f) if FHWA funds are used.	Structures should be reviewed for historic eligibility	5 structures to be removed	High/ likely 4(f)/6(f)	Less impacts than 10th 8. Potential 4(f)/6(f) impacts. Potential wetlands.
10th-Var	Unconstrained SB Entrance & NB Exit Ramps		Potential impacts to northern long-eared bat if trees are removed during summer maternity season.	If any structures are eligible, could have 4(f) impacts	Structures should be reviewed for historic eligibility	4 structures to be removed	Low	Minimal impacts if tree removal timing is outside summer maternity season for the bat.
Cleve-1	Cleveland Ave Dual Left Turns				Structure assumed modern	1 structure to be removed (Pizza Hut)	Low	Least business impacts
10th-C1	5-Lane Undivided with access closures					Change in access along corridor	Low	Minimal impacts
10th-C2	4-Lane Divided with access closures			Acquisition along Nelson Park & SD School for the Deaf	Structures should be reviewed for historic eligibility	3 structures to be removed; change in access along corridor	High/ likely 4(f)/6(f)	Potential 4(f). Structural removal.
10th-C3	6-Lane Divided with access closures, widen N & S			Acquisition along Nelson Park & SD School for the Deaf	Structures should be reviewed for historic eligibility	24 structures to be removed	High/ likely 4(f)/6(f)	Most impacts between 10th C1-C4. Potential 4(f).Highest level of structural removal.
10th-C4	6-Lane Divided with access closures, widen S only			Acquisition along Nelson Park & SD School for the Deaf	Structures should be reviewed for historic eligibility	13th structures to be removed	High/ likely 4(f)/6(f)	Medium level of impacts. Potential 4(f).

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.

SDDOT advised on 7/9/15 that widening of the existing 10th St bridge over I-229 would require replacement of existing retaining walls at the bridge abutments. Estimated construction costs for this concept do not include an allowance for retaining wall replacement and is noted in ***TABLE 4*** for concepts 10th-2, 10th- 3 and 10th-VAR.

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	Property Impacts		Total Cost
		Area (acre)	Cost	
10th-1	SPUI - Broken back dual lefts, No bridge widening	2.3	$2,600,000	$9,200,000
10th-2 *	SPUI - Single radius dual lefts, Widen N & S	2.3	$2,600,000	$9,800,000
10th-3 *	SPUI - Single radius dual lefts, Widen S + I-229 profile modification	3.7	$6,000,000	$15,220,000
10th-4	Tight Diamond	3.0	$5,300,000	$12,620,000
10th-5	DDI - 20 mph conventional width	5.8	$8,900,000	$15,620,000
10th-6	Parclo - Terminals at Lowell & Cleveland, no SW & NE quadrant ramps	16.1	$21,600,000	$33,540,000
10th-7	Tight Split Diamond - 10th/12th	6.4	$9,500,000	$23,360,000
10th-8	Tight Split Diamond - 6th/10th/12th	7.1	$10,100,000	$32,860,000
10th-9	Tight Split Diamond - 6th/10th	4.7	$7,100,000	$23,320,000
10th-10	Cleveland Ave CFI	5.8	$9,600,000	$16,560,000
10th-Var *	Unconstrained SB Entrance & NB Exit Ramps	3.3	$3,900,000	$18,560,000
Cleve-1	Cleveland Ave Dual Left Turns	0.7	$800,000	$3,920,000
Cleve-2	Cleveland Ave restricted left turns	10.1	$11,200,000	$15,400,000
10th-C1	5-Lane Undivided with access closures	0.0	$0	$600,000
10th-C2	4-Lane Divided with access closures	3.0	$3,000,000	$24,120,000
10th-C3	6-Lane Divided with access closures, widen N & S	14.3	$20,100,000	$34,620,000
10th-C4	6-Lane Divided with access closures, widen S only	10.1	$12,400,000	$27,880,000

* *Estimated construction costs for this concept do not include an allowance for retaining wall replacement*

Table 5. Preliminary Concepts Composite Comparative Assessment

Preliminary Concept		Traffic Assessment			Environmental Impacts	Cost	ROW (acre)
		Queues	Delay	Travel Time			
10th-1	SPUI - Broken back dual lefts, No bridge widening	Very Good	Good	Neutral	Medium/ potential 4(f)	$9,200,000	2.3
10th-2 *	SPUI - Single radius dual lefts, Widen N & S	Very Good	Good	Neutral	Medium/ potential 4(f)	$9,800,000	2.3
10th-3 *	SPUI - Single radius dual lefts, Widen S + I-229 profile modification	Very Good	Good	Neutral	Medium/ potential 4(f)	$15,220,000	3.7
10th-4	Tight Diamond	*n/a*	*n/a*	*n/a*	n/a	$12,620,000	3
10th-5	DDI - 20 mph conventional width	Very Good	Very Good	Good	Medium/ potential 4(f)	$15,620,000	5.8
10th-6	Parclo - Terminals at Lowell & Cleveland, no SW & NE quadrant ramps	*n/a*	*n/a*	*n/a*	n/a	$33,540,000	16.1
10th-7	Tight Split Diamond - 10th/12th	Good	Poor	Poor	Medium/ potential 4(f)	$23,360,000	6.4
10th-8	Tight Split Diamond - 6th/10th/12th	Good	Neutral	Neutral	High/ likely 4(f)/6(f)	$32,860,000	7.1
10th-9	Tight Split Diamond - 6th/10th	Very Good	Good	Good	High/ likely 4(f)/6(f)	$23,320,000	4.7
10th-10	Cleveland Ave CFI	*n/a*	*n/a*	*n/a*	n/a	$16,560,000	5.8
10th-Var *	Unconstrained SB Entrance & NB Exit Ramps	*n/a*	*n/a*	*n/a*	Low	$18,560,000	2.5
Cleve-1	Cleveland Ave Dual Left Turns	*n/a*	*n/a*	*n/a*	Low	$3,920,000	0.7
Cleve-2	Cleveland Ave restricted left turns	*n/a*	*n/a*	*n/a*	n/a	$15,400,000	5.7
10th-C1	5-Lane Undivided with access closures	Neutral	Neutral	Neutral	Low	$600,000	0
10th-C2	4-Lane Divided with access closures	Neutral	Neutral	Neutral	High/ likely 4(f)/6(f)	$24,120,000	3
10th-C3	6-Lane Divided with access closures, widen N & S	Poor	Poor	Neutral	High/ likely 4(f)/6(f)	$34,620,000	14.3
10th-C4	6-Lane Divided with access closures, widen S only	Poor	Poor	Neutral	High/ likely 4(f)/6(f)	$27,880,000	10.1

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.

TYPE OF INTERCHANGE:

- SPUI = Single Point
- TD = Tight Diamond
- DDI = Diverging Diamond
- Par = Parclo
- TSD = Tight Split Diamond
- CFI = Continuous Flow Intersection

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- 10th Street Corridor

Concept ID	Type / Details Description	Workshop Decision	Action Items	Comments
10th Street Interchange				
10th-1	SPUI - Broken back lefts, No bridge widening	Carry Ahead		- May be eliminated later if HSM analysis shows increased crash rates due to broken back configuration compared to 10th-2.
10th-2	SPUI - Single radius lefts, Widen N & S	Carry Ahead	- Update cost estimate for retaining walls replacement	- MSE walls at existing bridge abutments would have to be replaced - not included in cost est. - May be eliminated later if HSM 5-yr analysis does not indicate crash reduction compared to 10th-1.
10th-3	SPUI - Single radius lefts, Widen S + I229 profile	Eliminate		- Impacts to I-229 mainline do not add value to offset cost and inconvenience.
10th-5	DDI - 20 mph conventional width	Carry Ahead		
10th-7	TSD - 10th / 12th	Eliminate		- Eliminated because capacity constraints at 12th St limit traffic operations effectiveness and create impacts & costs
10th-8	TSD - 6th / 10th / 12th	Eliminate		- Eliminated for same reasons as 10th-8
10th-9	TSD - 6th / 10th	Carry Ahead	- Identify area traffic pattern impact. Develop figure showing pattern changes expected from DTA model. - Possible need to develop concept variant with 3-lane 6th St.. City to obtain traffic counts for HCS analysis to determine if 3-lane section needed.	- City: Community will not object to minor impact to Leaders park as shown. - May need improvements on 6th (3-lane continuous section, no parking) if HCS shows need.
10th-Var	Unconstrained SB Entrance & NB Exit Ramps	Carry Ahead		- Profile development to refine cost & impacts footprint only. Concept would be pursued if traffic analysis shows potential for ramp queues.
10th Street Corridor				
10th-C1	5-Lane Undivided with drive	Carry Ahead		
10th-C2	4-Lane Divided with drive closures	Carry Ahead	- Close median at unsignalized intersections & add widening for U-turns at signals	- SAT prefers to close median across all unsignalized intersections for safety & minor capacity increase. - Revise geometrics to allow U-turns at signalized intersections
10th-C3	6-Lane Divided with drive closures, widen N & S	Carry Ahead	- Extend concept limits to Sycamore	- Extend East limits to Sycamore
10th-C4	6-Lane Divided with drive closures, widen S only	Defer		- Further consideration of widening to the S only will be deferred until the NEPA phase for the 10th St corridor.

10th Street Corridor Build Scenarios

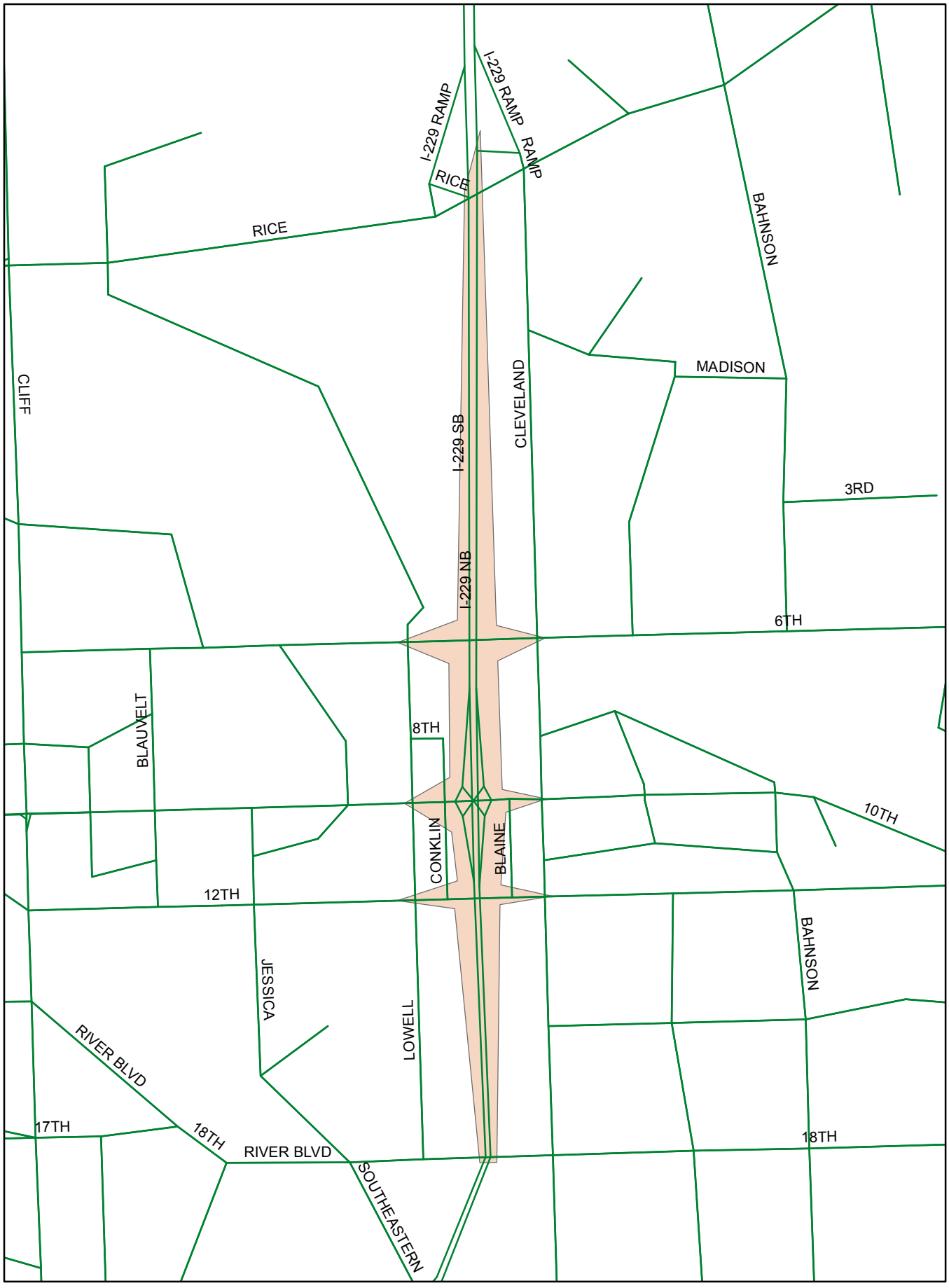
NINE build scenarios have been defined for the 10th Street corridor, which include a combination of interchange concepts and corridor concepts:

- 10th 1/ 2 + 10th-C1
- 10th 5 + 10th-C1
- 10th 9 + 10th-C1
- 10th 1/ 2 + 10th-C2
- 10th 5 + 10th-C2
- 10th 9 + 10th-C2
- 10th 1/ 2 + 10th-C3
- 10th 5 + 10th-C3
- 10th 9 + 10th-C3

APPENDIX D3 -

DTA MODEL INTERCHANGE AND MODEL SUBAREAS

Sub-Study 3 - 10th Corridor - Interchange Area



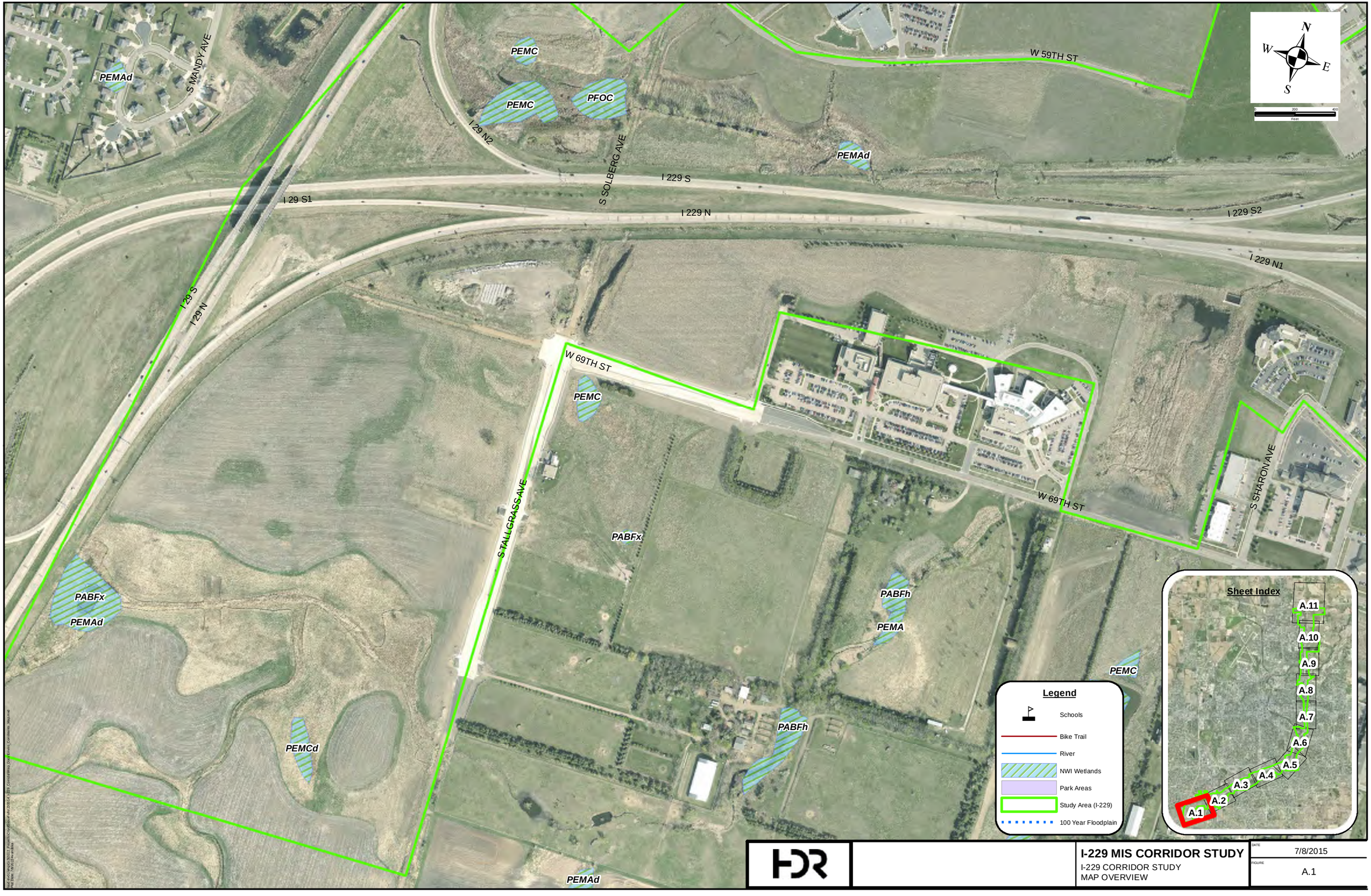
Attachment C-

DTA Model Subarea



APPENDIX D4 -

ENVIRONMENTAL CONSTRAINTS MAPS



I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.1

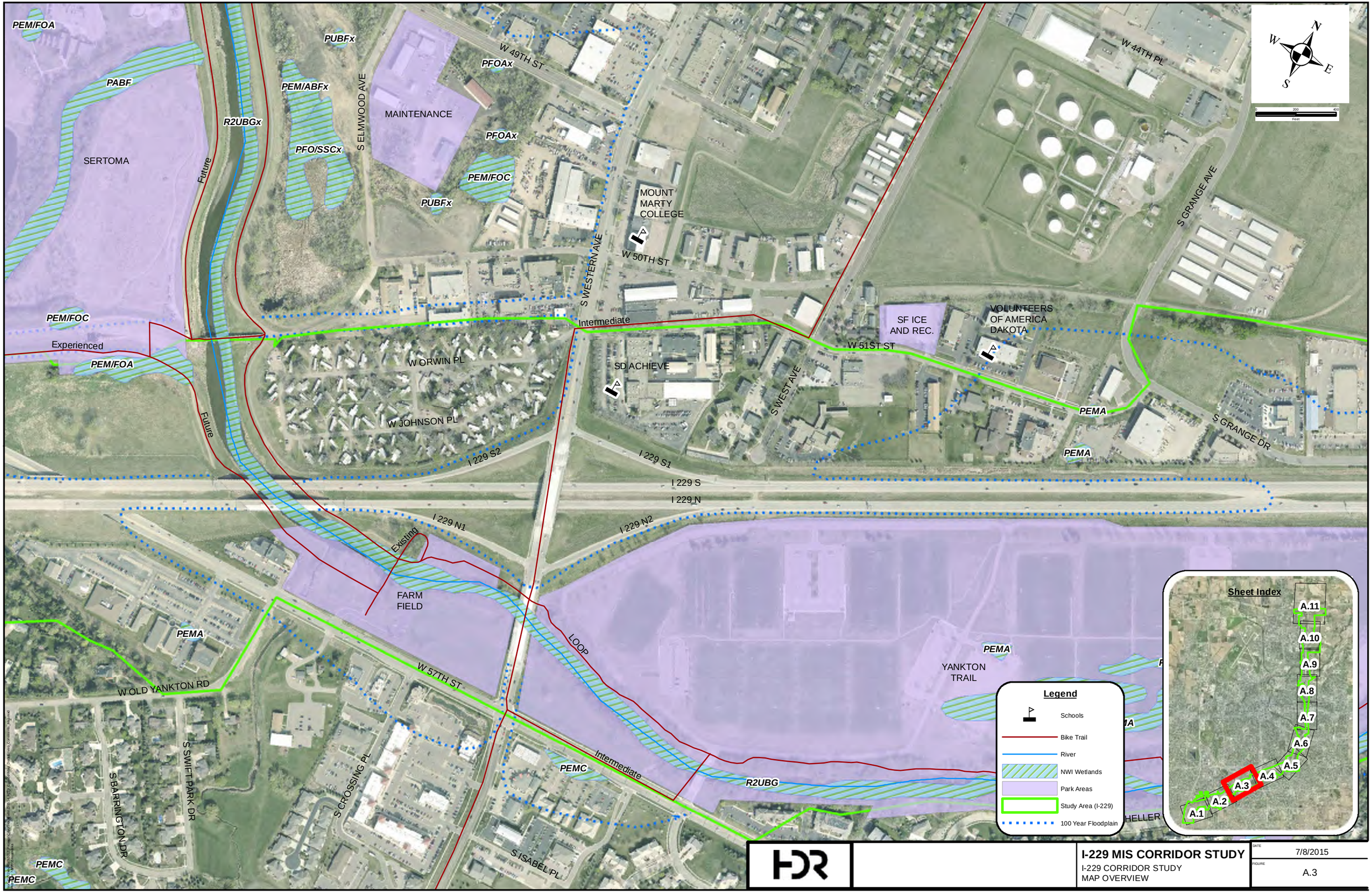


I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.2



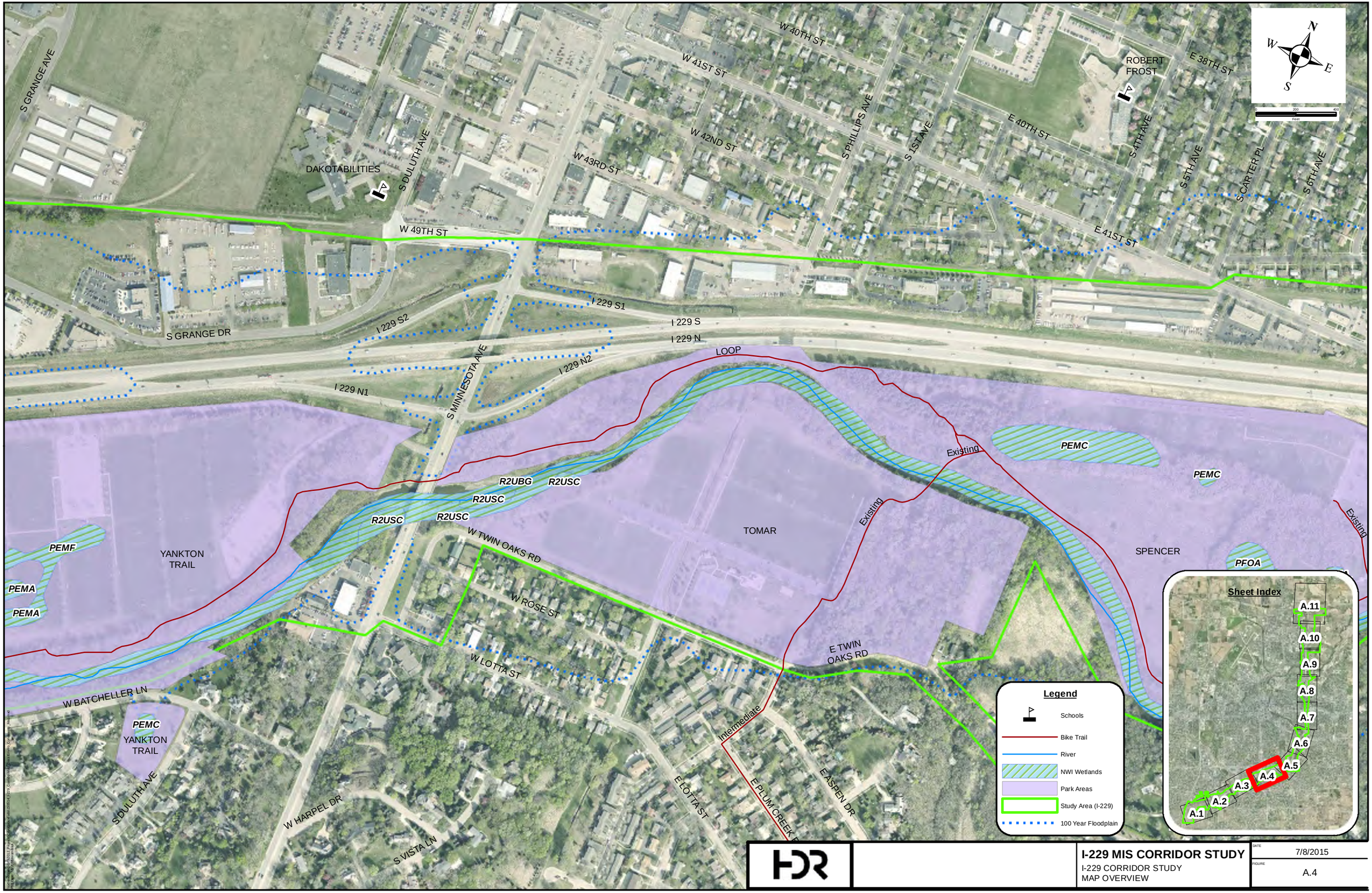
HDR

I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.3

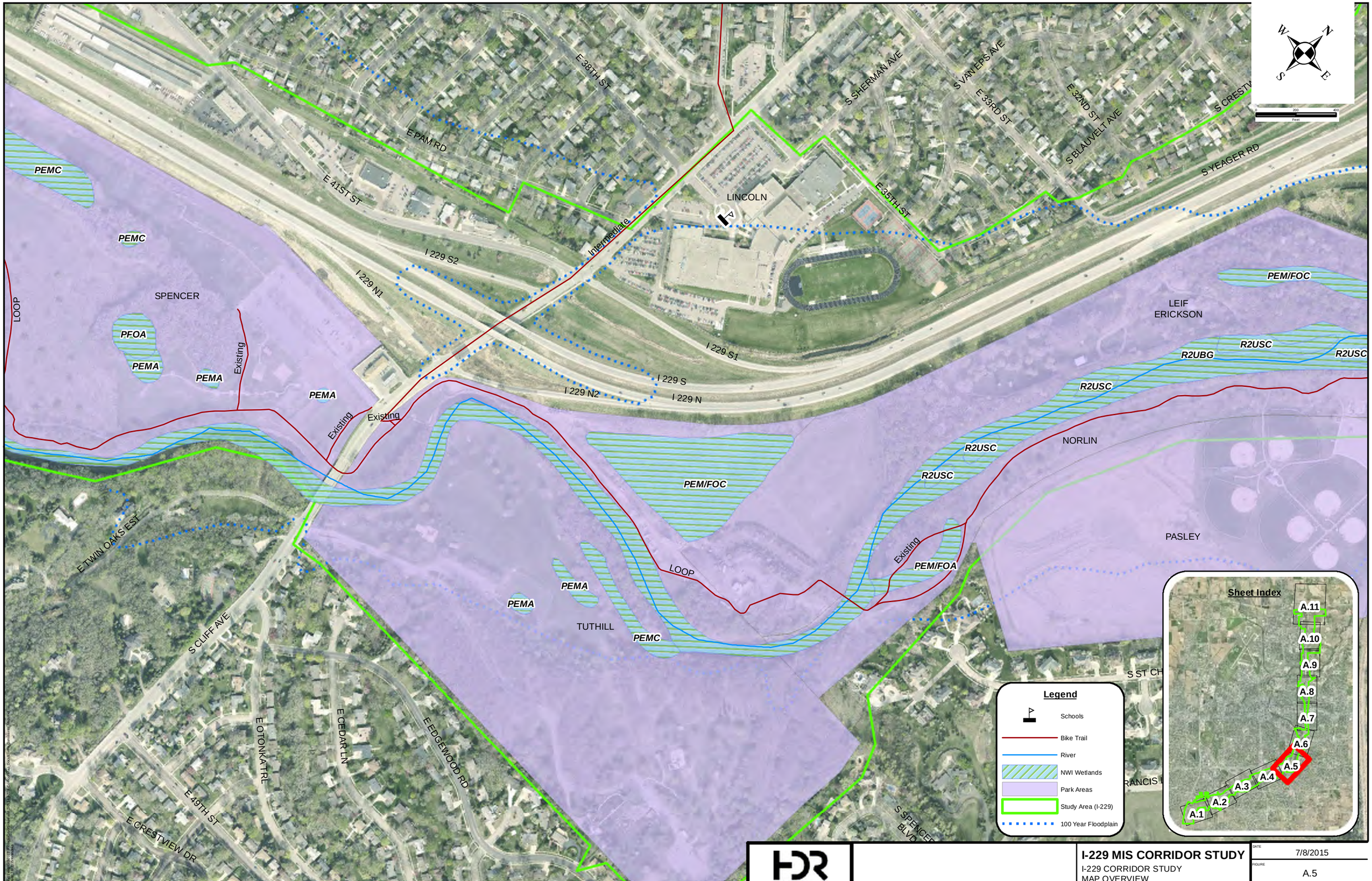


I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.4



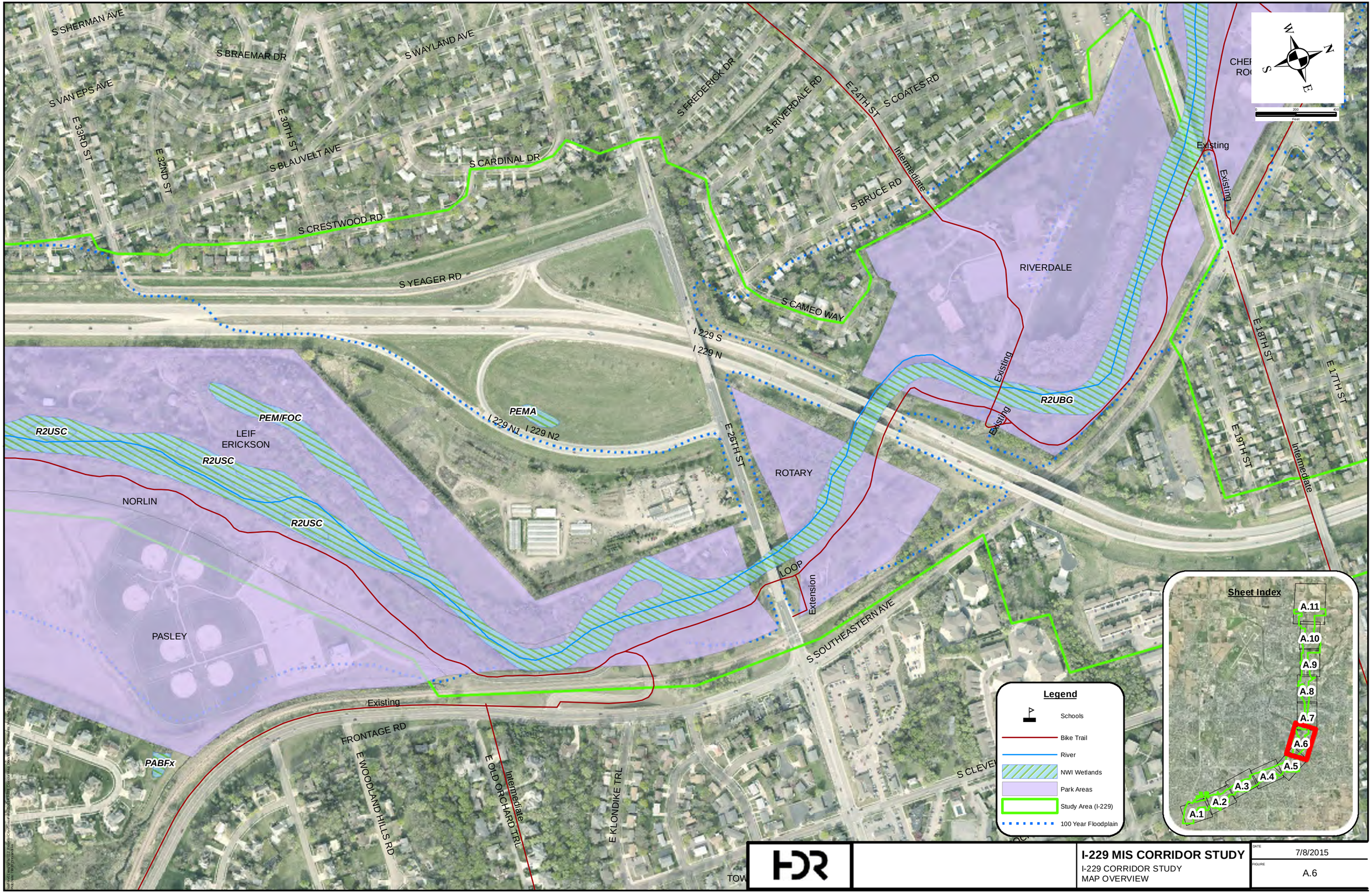
HDR

I-229 MIS CORRIDOR STUDY

I-229 CORRIDOR STUDY
MAP OVERVIEW

DATE 7/8/2015

FIGURE A.5



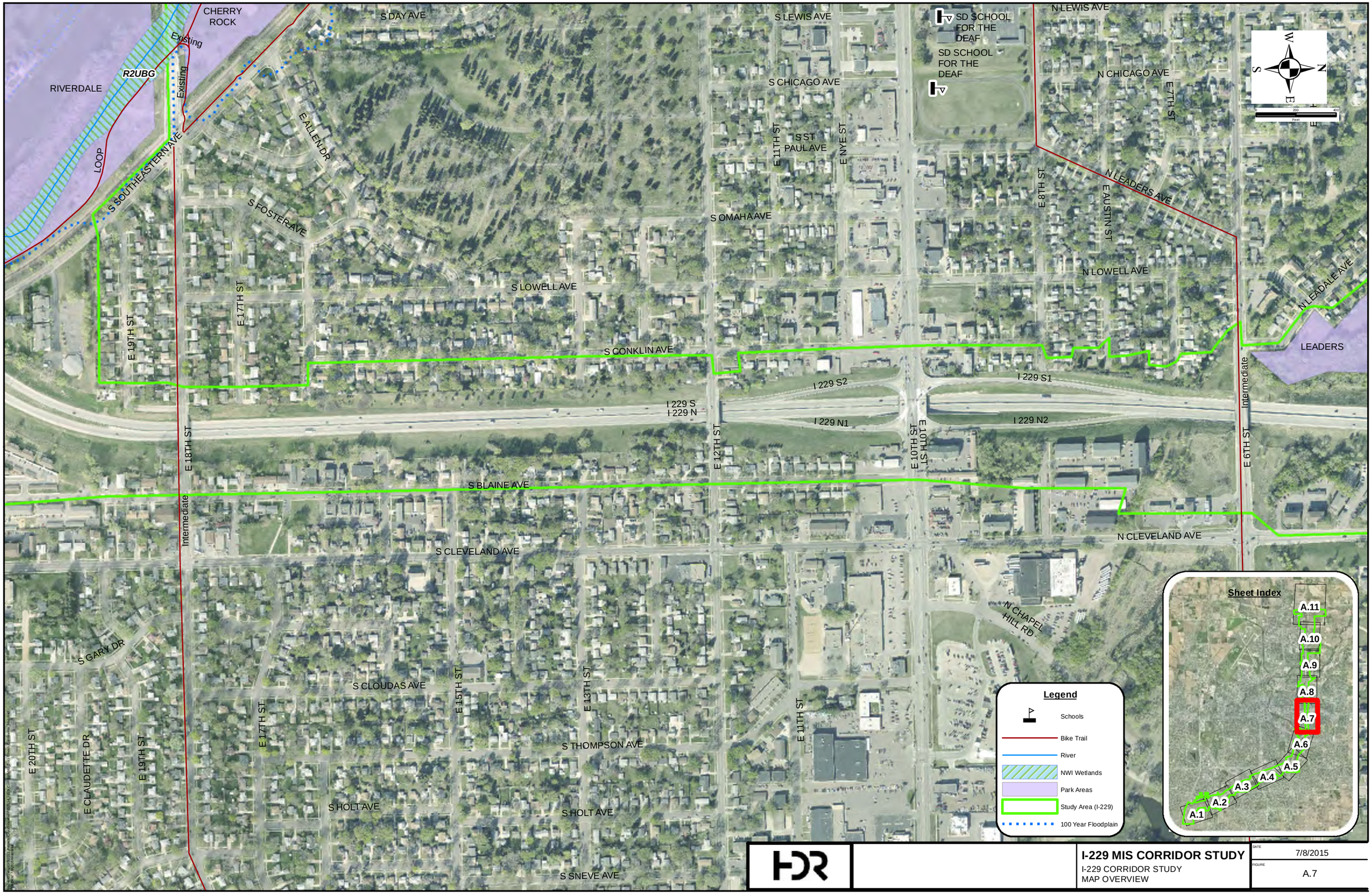
HDR

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

E 7TH ST
E 5TH ST
N LEADALE AVE
E 1ST ST
E MADISON ST
E TRICIA LN
E TRACY LN
E MULBERRY ST
N OMAHA AVE
RONNING
N LOWELL AVE
LEADERS
N LOWELL AVE
N HOMESTEAD CIR
I 229 S1
I 229 S2
I 229 S
I 229 N
E RICE ST
I 229 N1
I 229 N2
PEMCx
PEMCx
PEMA
PEMA
PEMCd
E 6TH ST
Intermediate
N CLEVELAND AVE
N SHERWOOD AVE
N SHEPHERD AVE
N SHAWNEE AVE
E LACEY PL
N CARBINE PL
N BULLET PL
N BUNKER PL
E MADISON ST
N ARCHER DR
N MOSSY OAK AVE
N BROKEN BOW AVE
PABFh
N ARCHER DR
W
S
N
E
0 200 400
Feet

Legend

- Schools
- Bike Trail
- River
- NWI Wetlands
- Park Areas
- Study Area (I-229)
- 100 Year Floodplain

Sheet Index

A.11
A.10
A.9
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.8

PEMCx
PEMCx
PEMA
PEMA
PEMA
PFOA
R2UBG
PEMCd
PFOA
PEMAd
PUBFx
PUBFx
PUBFx
PUBFx
PABFh
PUBFx
PUBGx
N FIERO PL
N PONTIAC PL
N POTSDAM AVE
I 229 S
I 229 N
I 229 N2
N GLENWOOD CIR
E RICE ST
N BAHNSON AVE
Future

W
S
N
E
0 200 400
Feet

Legend

- Schools
- Bike Trail
- River
- NWI Wetlands
- Park Areas
- Study Area (I-229)
- 100 Year Floodplain

Sheet Index

A.11
A.10
A.9
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.9



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 D5 -

ALTERNATIVE SCENARIO FIGURES

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Perpetuates Single Point Urban Interchange (SPUI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Widens 10th Street bridge over I-229 to the north and south to accommodate added left turn lanes.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
I-229
N Chapel Hill Road
Hyvee
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
S Blaine Ave
S Cleveland Ave
S Thompson Ave

Matchline - See Figure 10th-C3 (Sheet 2 of 4)

Matchline - See Figure 10th-C3 (Sheet 3 of 4)

Sub-Study 3
6-Lane Corridor with 6-Lane SPUI Single Radius Lefts

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure
10th-2A
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Perpetuates Single Point Urban Interchange (SPUI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Widens 10th Street bridge over I-229 to the north and south to accommodate added left turn lanes.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
I-229
N Chapel Hill Road
Hyvee
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
S Blaine Ave
S Cleveland Ave
S Thompson Ave

Matchline - See Figure 10th-C2 (Sheet 2 of 4)

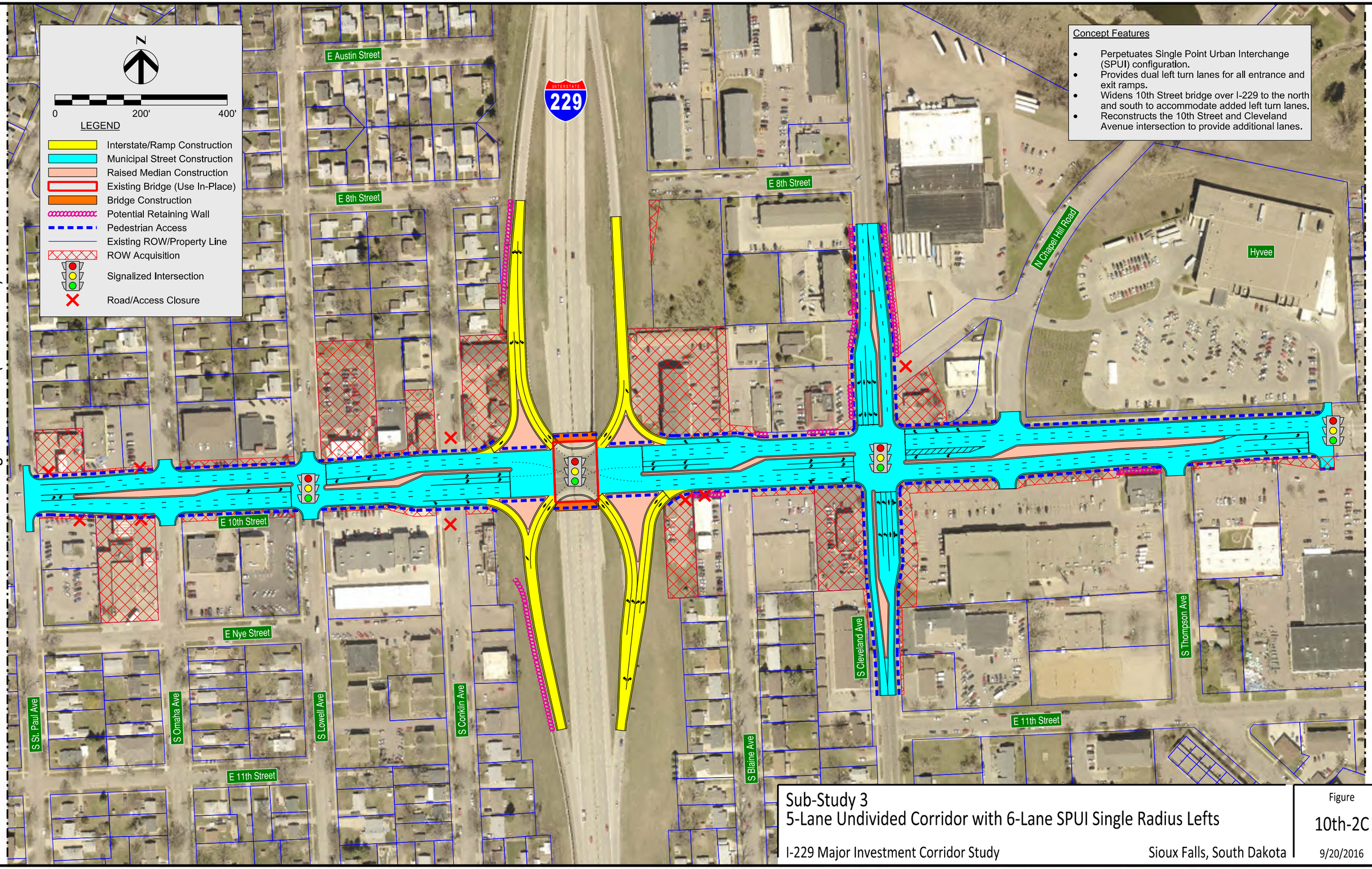
Matchline - See Figure 10th-C2 (Sheet 3 of 4)

Sub-Study 3
4-Lane Corridor with 6-Lane SPUI Single Radius Lefts

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

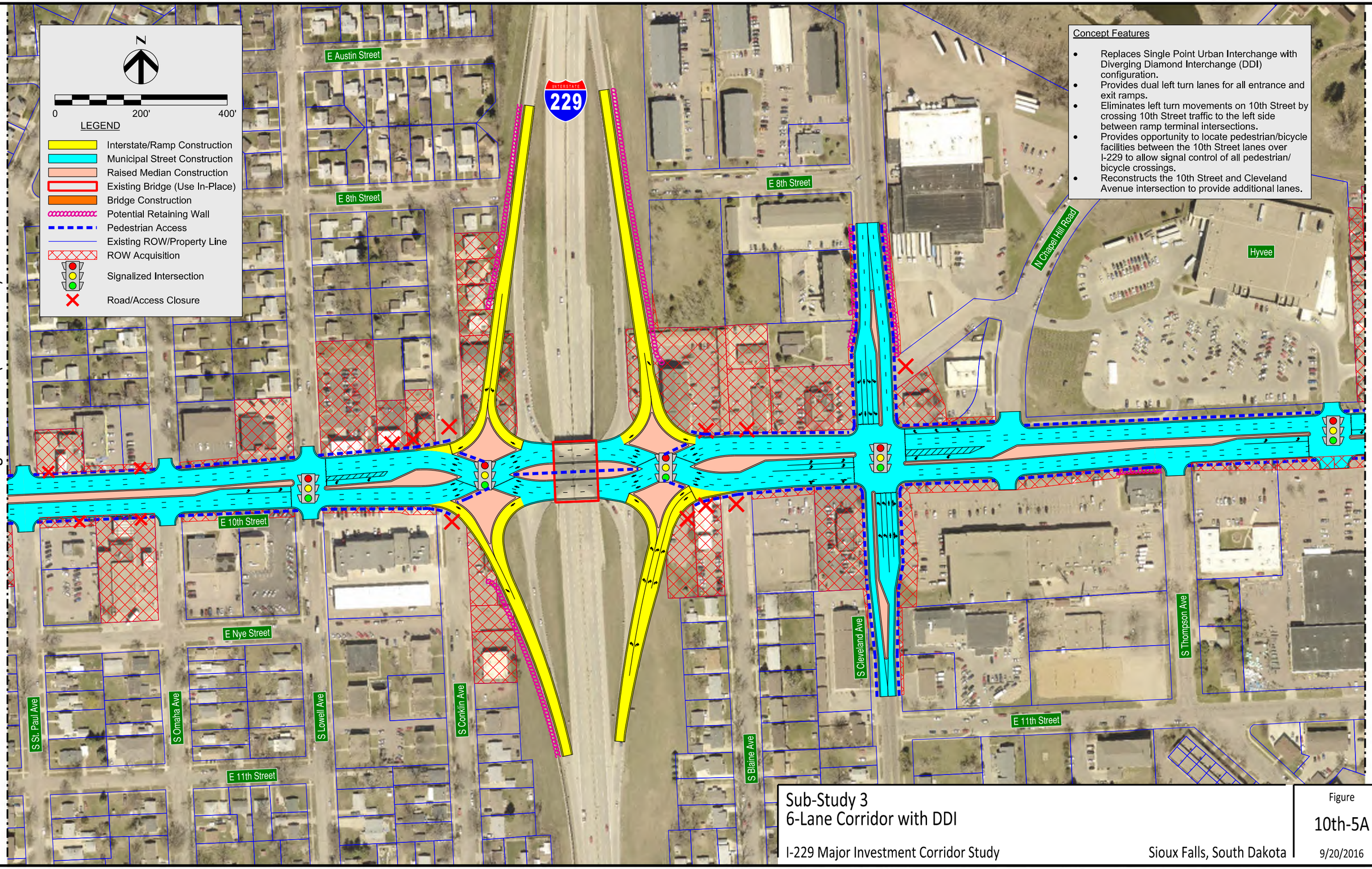
Figure
10th-2B
9/20/2016



Sub-Study 3
5-Lane Undivided Corridor with 6-Lane SPUI Single Radius Lefts

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure
10th-2C
9/20/2016

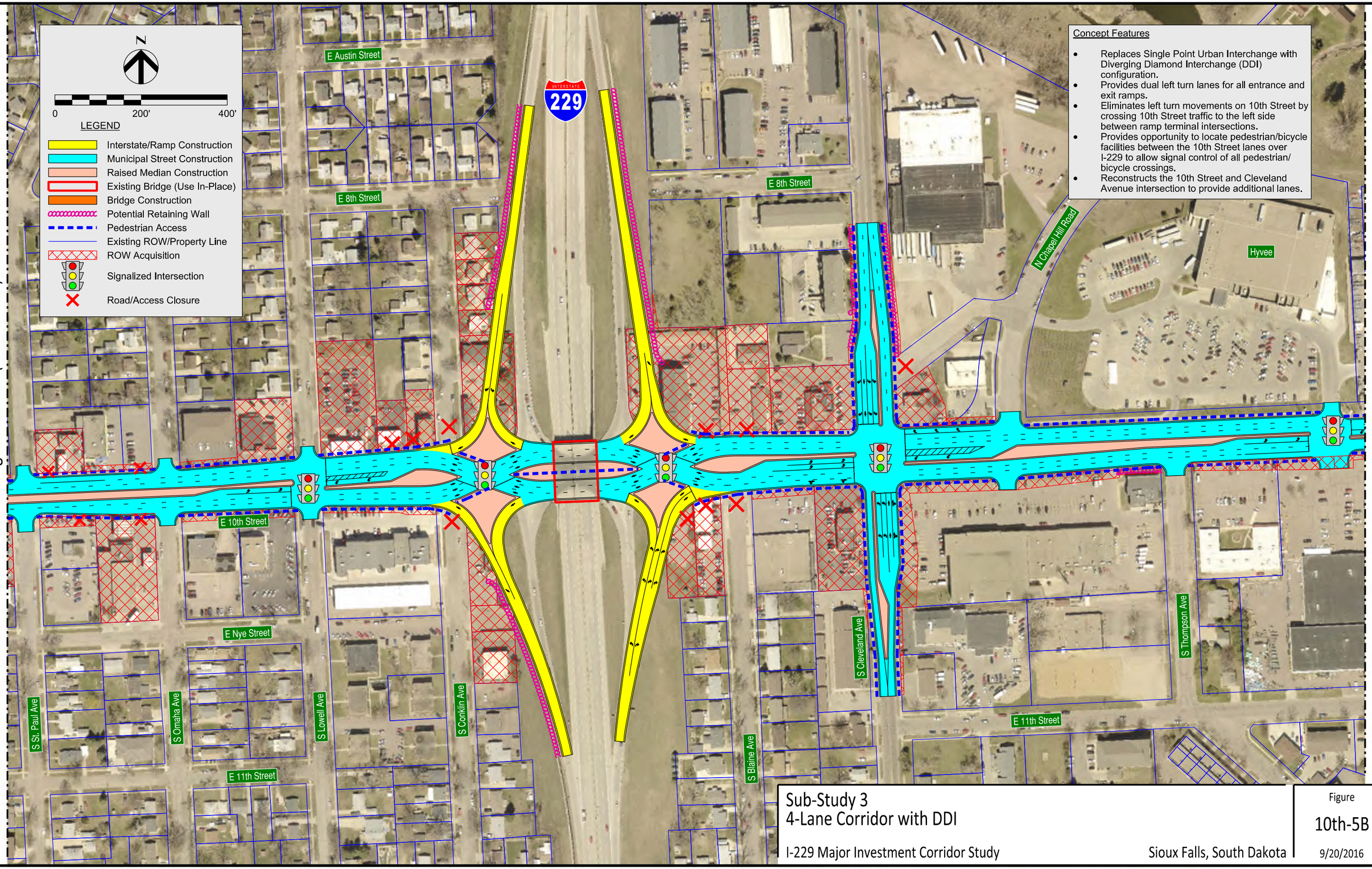


Sub-Study 3
6-Lane Corridor with DDI

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-5A
9/20/2016



Sub-Study 3
4-Lane Corridor with DDI

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-5B
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Replaces Single Point Urban Interchange with Diverging Diamond Interchange (DDI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Eliminates left turn movements on 10th Street by crossing 10th Street traffic to the left side between ramp terminal intersections.
- Provides opportunity to locate pedestrian/bicycle facilities between the 10th Street lanes over I-229 to allow signal control of all pedestrian/ bicycle crossings.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

E Austin Street
E 8th Street
INTERSTATE 229
E 8th Street
N Chapel Hill Road
Hyvee
E 10th Street
E Nye Street
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
E 11th Street
S Blaine Ave
S Cleveland Ave
S Thompson Ave
E 11th Street

Matchline - See Figure 10th-C1 (Sheet 2 of 4)

Matchline - See Figure 10th-C1 (Sheet 3 of 4)

Sub-Study 3
5-Lane Undivided Corridor with DDI

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-5C
9/20/2016

Matchline - See Figure 10th-9A (Sheet 2 of 2)

Matchline - See Figure 10th-C2 (Sheet 2 of 4)

Matchline - See Figure 10th-C2 (Sheet 3 of 4)

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Replaces Single Point Urban Interchange 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.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
- Adds traffic signals at new ramp intersections with 6th Street.
- Replaces existing 6th Street bridge over I-229 with a five-lane structure.

E Austin Street
E 8th Street
E 10th Street
E Nye Street
E 11th Street
S St. Paul Ave
S Omaha Ave
S Lowell Ave
S Conklin Ave
S Blaine Ave
S Cleveland Ave
S Thompson Ave
N Chapel Hill Road
Hyvee
I-229

Sub-Study 3
Tight Split Diamond - 6th/10th with 4-Lane Corridor (Sheet 1 of 2)

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure
10th-9A
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Replaces Single Point Urban Interchange 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.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
- Adds traffic signals at new ramp intersections with 6th Street.
- Replaces existing 6th Street bridge over I-229 with a five-lane structure.

Leaders Park

N Cleveland Ave

N Harrington Ave

N Sherwood Ave

N Shepherd Ave

E Pearl Street

INTERSTATE 229

N Leadale Ave

N Omaha Ave

N Leaders Ave

N Lowell Ave

E 7th Street

E 6th Street

Matchline - See Figure 10th-9A (Sheet 1 of 2)

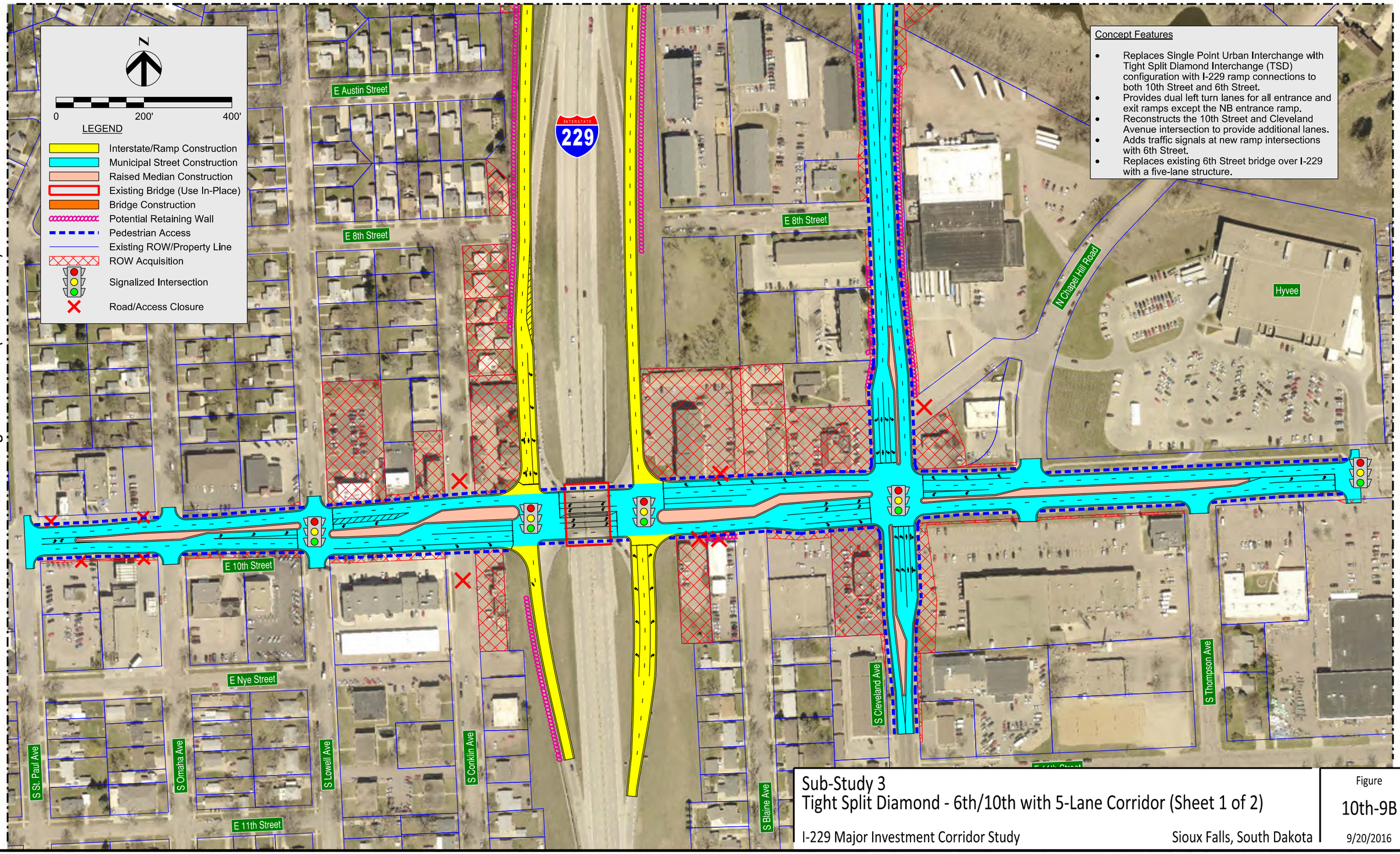
Sub-Study 3
Tight Split Diamond - 6th/10th with 4-Lane Corridor (Sheet 2 of 2)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-9A
9/20/2016

Matchline - See Figure 10th-9B (Sheet 2 of 4)



Matchline - See Figure 10th-C1 (Sheet 2 of 4)

Matchline - See Figure 10th-C1 (Sheet 3 of 4)

Sub-Study 3
Tight Split Diamond - 6th/10th with 5-Lane Corridor (Sheet 1 of 2)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-9B
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Replaces Single Point Urban Interchange 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.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.
- Adds traffic signals at new ramp intersections with 6th Street.
- Replaces existing 6th Street bridge over I-229 with a five-lane structure.

Leaders Park

N Cleveland Ave

N Harrington Ave

N Sherwood Ave

N Shepherd Ave

E Pearl Street

INTERSTATE 229

N Leadale Ave

N Omaha Ave

N Leaders Ave

N Lowell Ave

E 7th Street

E 6th Street

Matchline - See Figure 10th-9B (Sheet 1 of 2)

Sub-Study 3
Tight Split Diamond - 6th/10th with 5-Lane Corridor (Sheet 2 of 2)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-9B
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Maintains existing roadway section with two-way left turn lane.
- Maintains existing traffic signal locations.
- Requires no land acquisition for widening.

E 8th Street

E 9th Street

E 10th Street

E 11th Street

N Franklin Ave

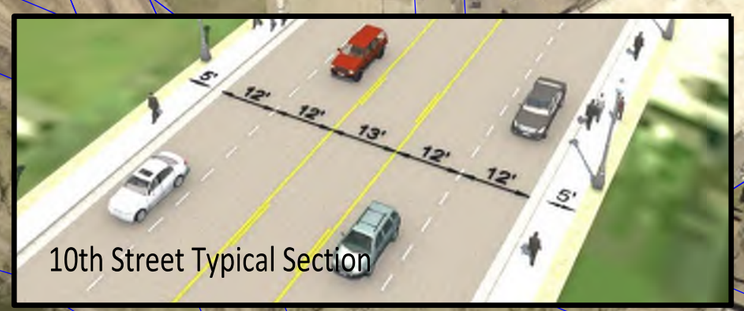
N Indiana Ave

N Fairfax Ave

N French Ave

East Side Lutheran Church

Nelson Park



10th Street Typical Section

Matchline - See Figure 10th-C3 (Sheet 2 of 4)

Sub-Study 3
5-Lane Undivided with access closures (Sheet 1 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

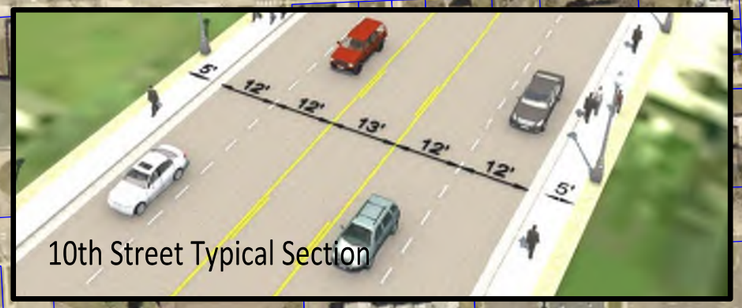
Figure
10th-C1
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Maintains existing roadway section with two-way left turn lane.
- Maintains existing traffic signal locations.
- Requires no land acquisition for widening.

E Austin Street
E 8th Street
E 9th Street
South Dakota School for the Deaf
E 10th Street
E Nye Street
E 11th Street
S Van Eps Ave
S Wayland Ave
S Blauvelt Ave
S Maple Ave
S Highland Ave
S Jessica Ave
S Lewis Ave
S Chicago Ave

Matchline - See Figure 10th-C1 (Sheet 1 of 4)

Matchline - See Interchange Concepts

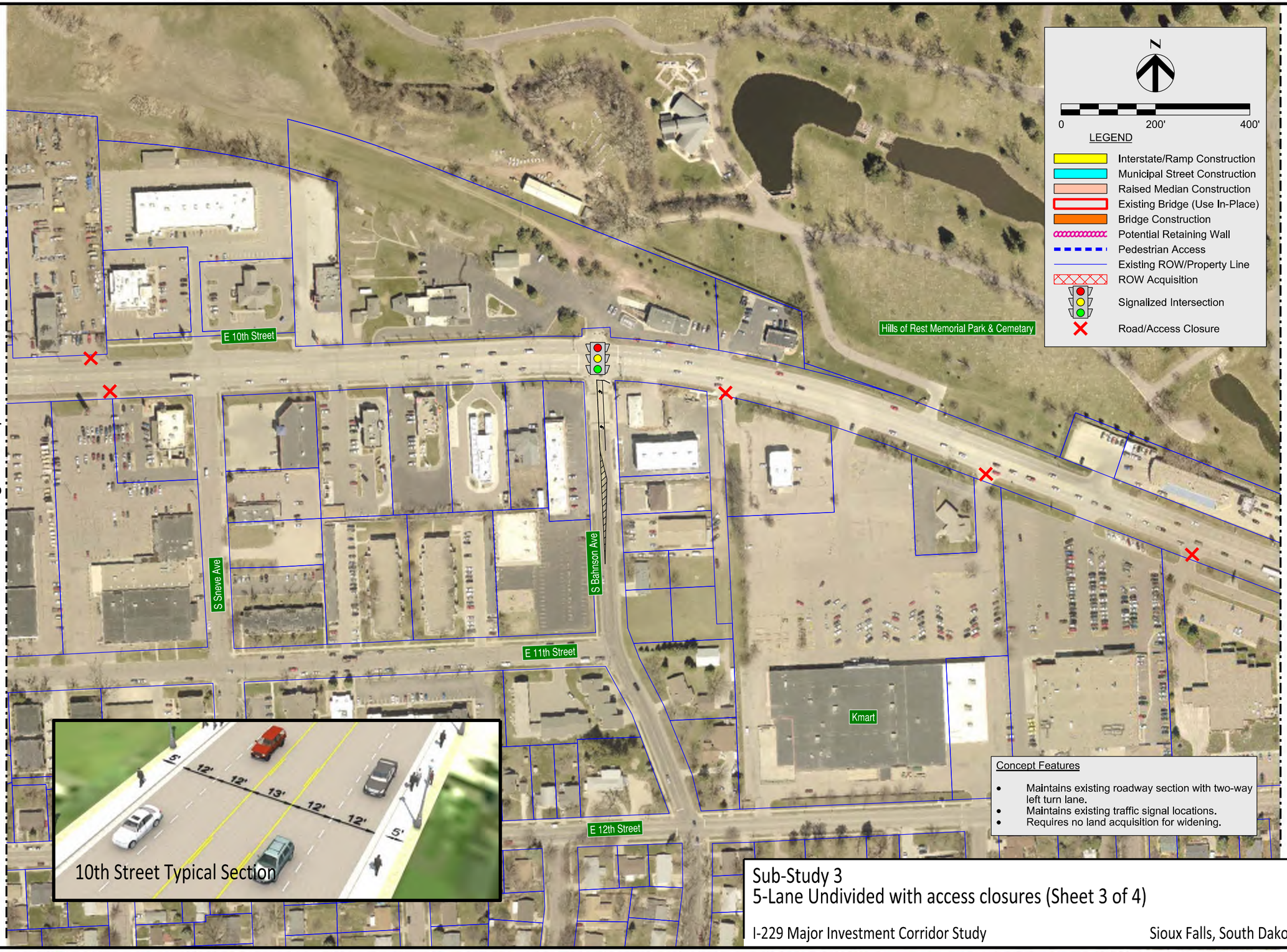
Sub-Study 3
5-Lane Undivided with access closures (Sheet 2 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-C1
9/20/2016

Matchline - See Interchange Concepts



Matchline - See Figure 10th-C3 (Sheet 4 of 4)

Sub-Study 3
5-Lane Undivided with access closures (Sheet 3 of 4)

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

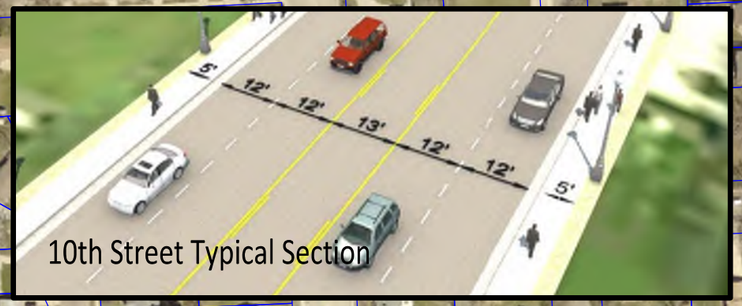
Figure
10th-C1
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Maintains existing roadway section with two-way left turn lane.
- Maintains existing traffic signal locations.
- Requires no land acquisition for widening.

E 10th Street

E 12th Street

N Sycamore Ave

S Kennedy Ave

S Charlotte Ave

Arrowhead Pkwy

Matchline - See Interchange Concepts

Matchline - See Figure 10th-C3 (Sheet 4 of 4)

Sub-Study 3
5-Lane Undivided with access closures (Sheet 4 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-C1
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Rebuilds 10th Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires some land acquisition for slightly widened roadway (median).
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

E 8th Street

E 9th Street

E 10th Street

E 11th Street

N Franklin Ave

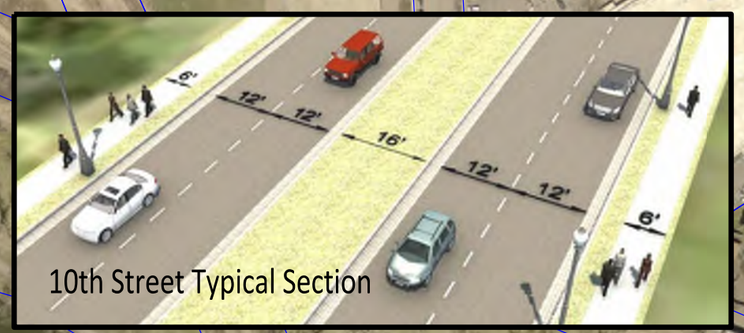
N Indiana Ave

N Fairfax Ave

N French Ave

East Side Lutheran Church

Nelson Park



10th Street Typical Section

Matchline - See Figure 10th-C3 (Sheet 2 of 4)

Sub-Study 3
4-Lane Divided with access closures (Sheet 1 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

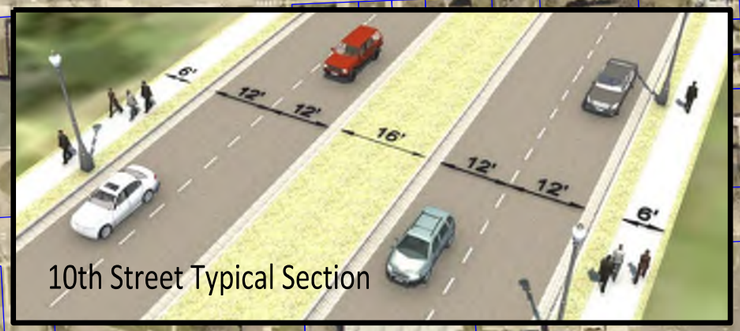
Figure
10th-C2
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires some land acquisition for slightly widened roadway (median).
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

E Austin Street
E 8th Street
E 9th Street
South Dakota School for the Deaf
E 10th Street
E Nye Street
E 11th Street
S Van Eps Ave
S Wayland Ave
S Blauvelt Ave
S Mable Ave
S Highland Ave
S Jessica Ave
S Lewis Ave
S Chicago Ave

Matchline - See Figure 10th-C2 (Sheet 1 of 4)

Matchline - See Interchange Concepts

Sub-Study 3
4-Lane Divided with access closures (Sheet 2 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-C2
9/20/2016

Matchline - See Interchange Concepts

Matchline - See Figure 10th-C3 (Sheet 4 of 4)

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

E 10th Street

Hills of Rest Memorial Park & Cemetary

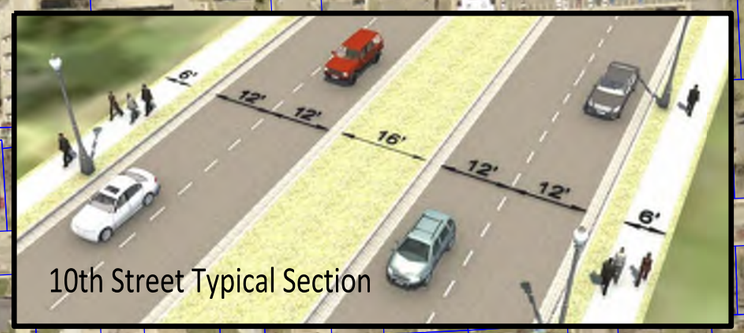
S Sneve Ave

S Bahnson Ave

E 11th Street

E 12th Street

Kmart



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires some land acquisition for slightly widened roadway (median).
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

Sub-Study 3
4-Lane Divided with access closures (Sheet 3 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

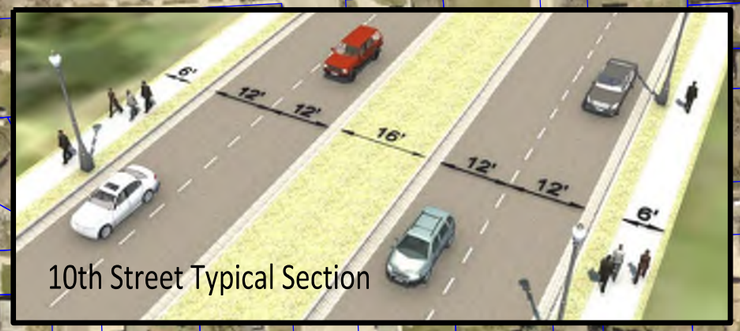
Figure
10th-C2
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and two lanes in each direction.
- Maintains existing traffic signal locations.
- Requires some land acquisition for slightly widened roadway (median).
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

Matchline - See Interchange Concepts

Matchline - See Figure 10th-C3 (Sheet 4 of 4)

E 10th Street

E 12th Street

S Kennedy Ave

S Charlotte Ave

N Sycamore Ave

Arrowhead Pkwy

Sub-Study 3
4-Lane Divided with access closures (Sheet 4 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-C2
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Rebuilds 10th Street with a median and three lanes in each direction.
- Maintains existing traffic signal locations.
- Requires land acquisition for one lane of widening to the north and south sides.
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

E 8th Street

E 9th Street

E 10th Street

E 11th Street

N Franklin Ave

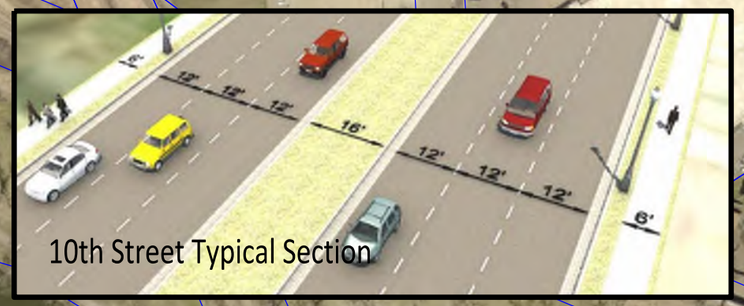
N Indiana Ave

N Fairfax Ave

N French Ave

East Side Lutheran Church

Nelson Park



10th Street Typical Section

Matchline - See Figure 10th-C3 (Sheet 2 of 4)

Sub-Study 3
6-Lane Divided with access closures, widen N & S (Sheet 1 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

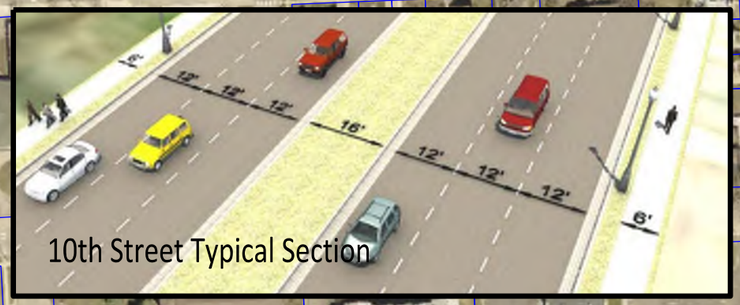
Figure
10th-C3
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and three lanes in each direction.
- Maintains existing traffic signal locations.
- Requires land acquisition for one lane of widening to the north and south sides.
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

E Austin Street

E 8th Street

E 9th Street

South Dakota School for the Deaf

E 10th Street

E Nye Street

E 11th Street

S Van Eps Ave

S Wayland Ave

S Blauvelt Ave

S Mable Ave

S Highland Ave

S Jessica Ave

S Lewis Ave

S Chicago Ave

Matchline - See Figure 10th-C3 (Sheet 1 of 4)

Matchline - See Interchange Concepts

Sub-Study 3
6-Lane Divided with access closures, widen N & S (Sheet 2 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-C3
9/20/2016

Matchline - See Interchange Concepts

Matchline - See Figure 10th-C3 (Sheet 4 of 4)

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

E 10th Street

Hills of Rest Memorial Park & Cemetary

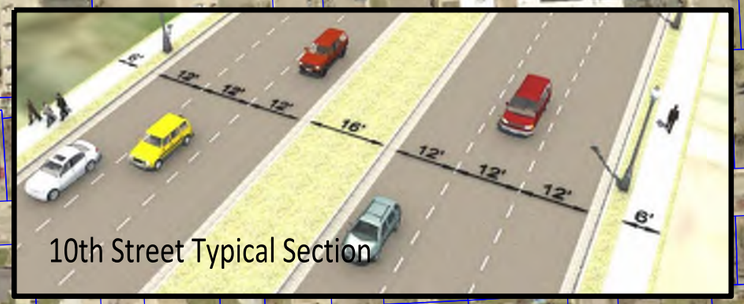
S Sneve Ave

S Bahnson Ave

E 11th Street

E 12th Street

Kmart



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and three lanes in each direction.
- Maintains existing traffic signal locations.
- Requires land acquisition for one lane of widening to the north and south sides.
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

Sub-Study 3
6-Lane Divided with access closures, widen N & S (Sheet 3 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

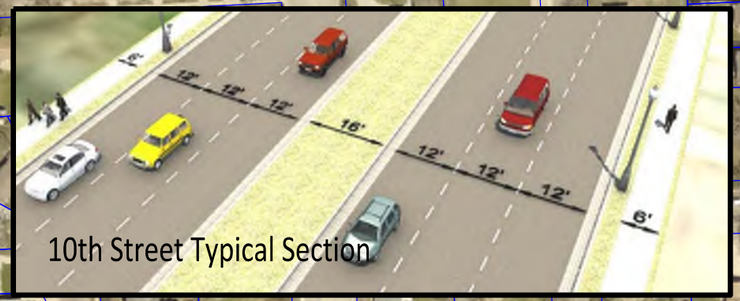
Figure
10th-C3
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure



10th Street Typical Section

Concept Features

- Rebuilds 10th Street with a median and three lanes in each direction.
- Maintains existing traffic signal locations.
- Requires land acquisition for one lane of widening to the north and south sides.
- Impacts adjacent properties by limiting driveway access to and from 10th Street to right turns in and out only.

Matchline - See Interchange Concepts

Matchline - See Figure 10th-C3 (Sheet 4 of 4)

E 10th Street

E 12th Street

N Sycamore Ave

S Kennedy Ave

S Charlotte Ave

Arrowhead Pkwy

Sub-Study 3
6-Lane Divided with access closures, widen N & S (Sheet 4 of 4)

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-C3
9/20/2016

N

0 200' 400'

LEGEND

- Interstate/Ramp Construction
- Municipal Street Construction
- Raised Median Construction
- Existing Bridge (Use In-Place)
- Bridge Construction
- Potential Retaining Wall
- Pedestrian Access
- Existing ROW/Property Line
- ROW Acquisition
- Signalized Intersection
- Road/Access Closure

Concept Features

- Perpetuates Single Point Urban Interchange (SPUI) configuration.
- Provides dual left turn lanes for all entrance and exit ramps.
- Widens 10th Street bridge over I-229 to the north and south to accommodate added left turn lanes.
- Reconstructs the 10th Street and Cleveland Avenue intersection to provide additional lanes.

E 11th Street
E Nye Street
E 10th Street
S Lowell Ave
E 8th Street
S Conklin Ave
INTERSTATE 229
S Blaine Ave
E 8th Street
S Cleveland Ave
E 11th Street

Sub-Study 3
Unconstrained SB Entrance & NB Exit Ramps

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure
10th-Var
9/20/2016

Appendix E. 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.

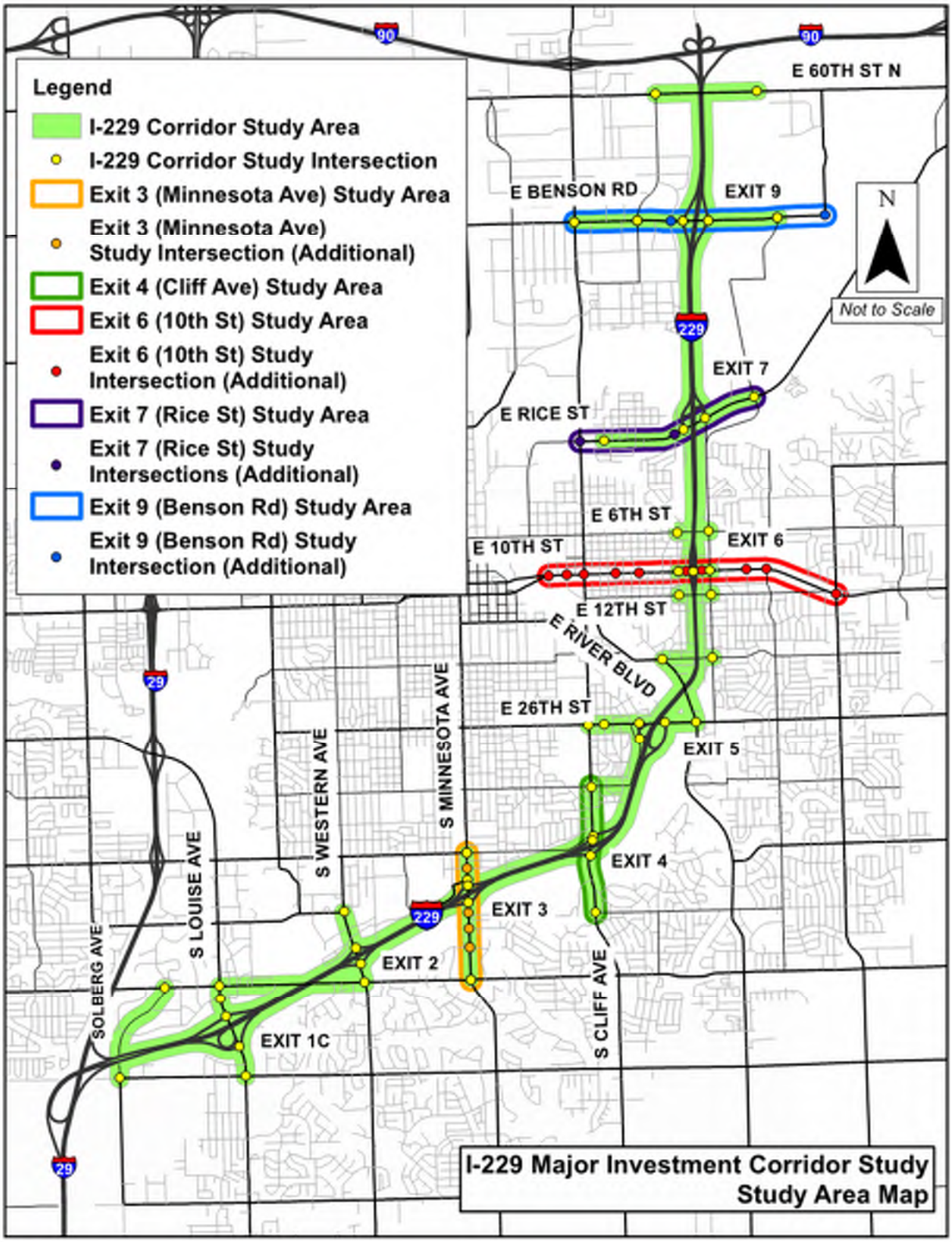
The I-229 MIS has been separated into individual sub-studies. The sub-studies include:

- 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

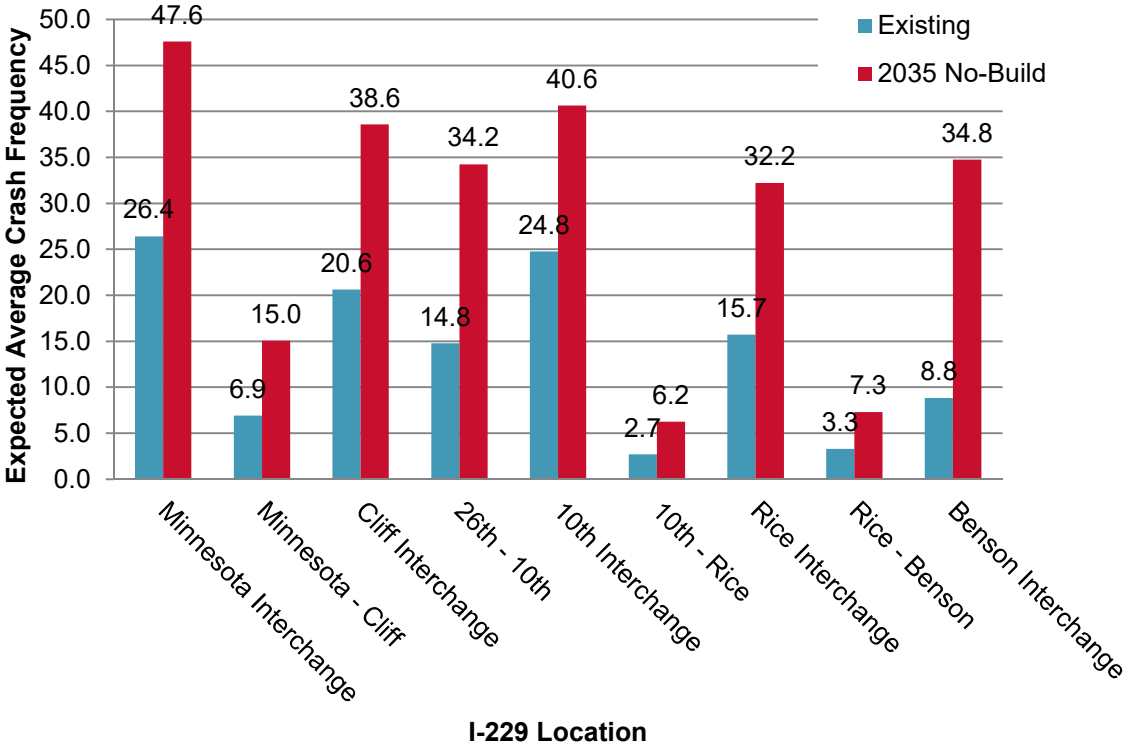
crash predictions were then compared to the No-Build crash prediction for subject interchange. Hence, the results of the crash predictions for Build alternatives are presented by sub-study.

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

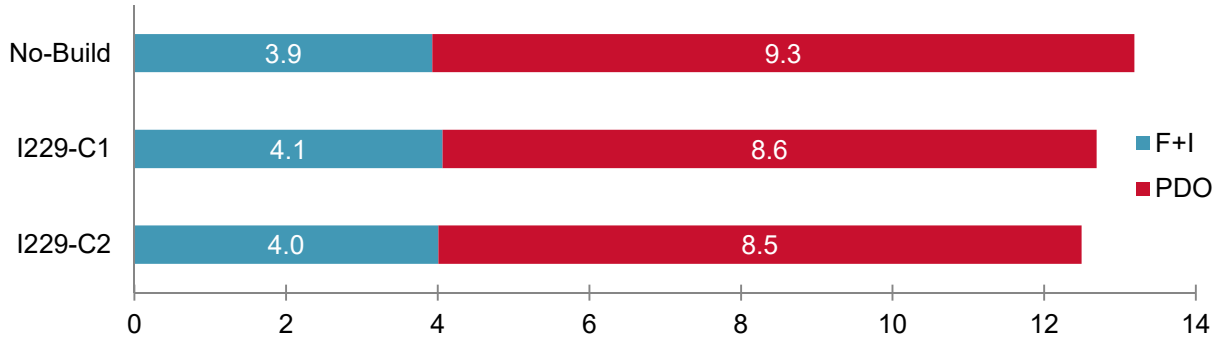
The alternatives to be analyzed for the I-229 Corridor Study are:

- 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)

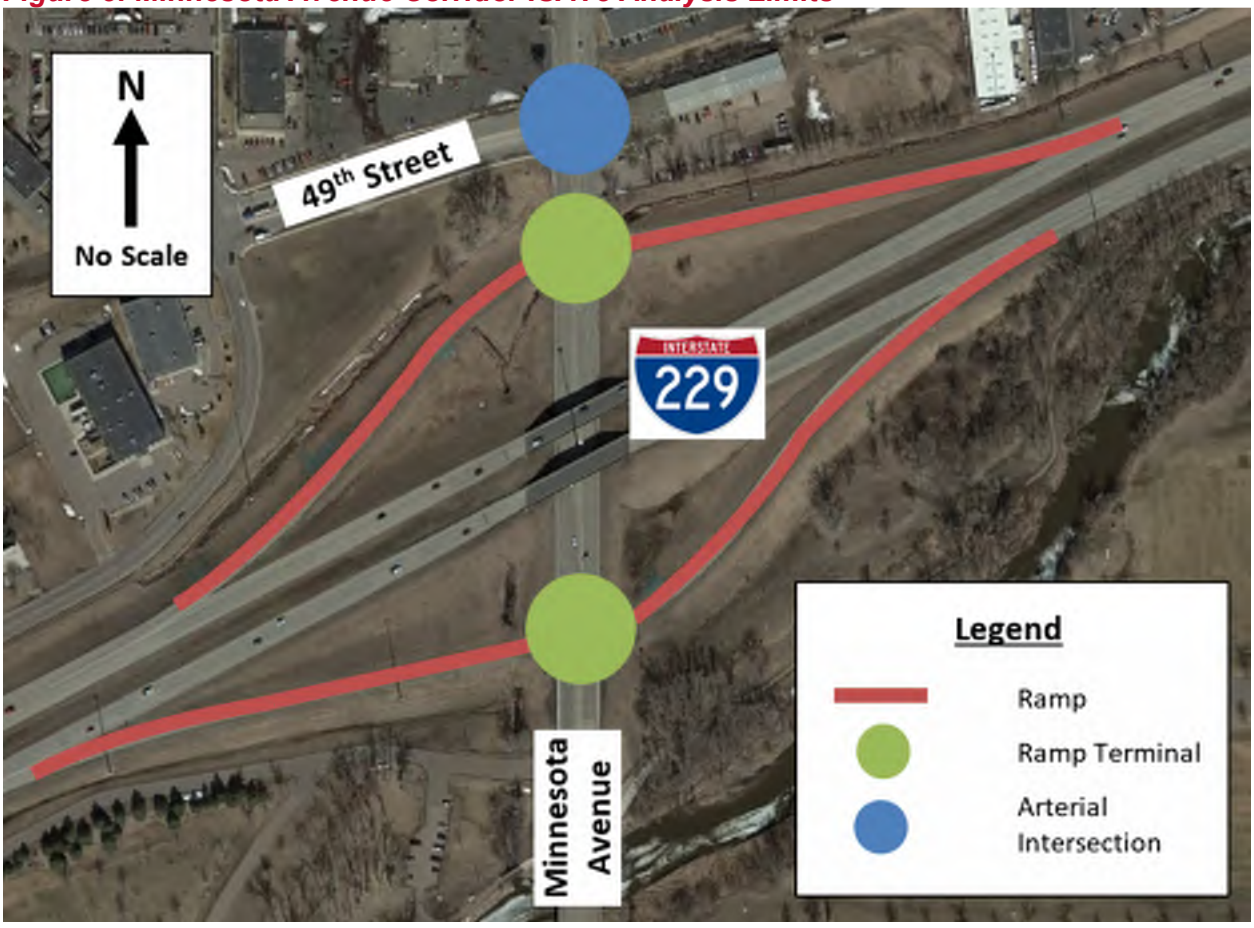
[1]Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all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

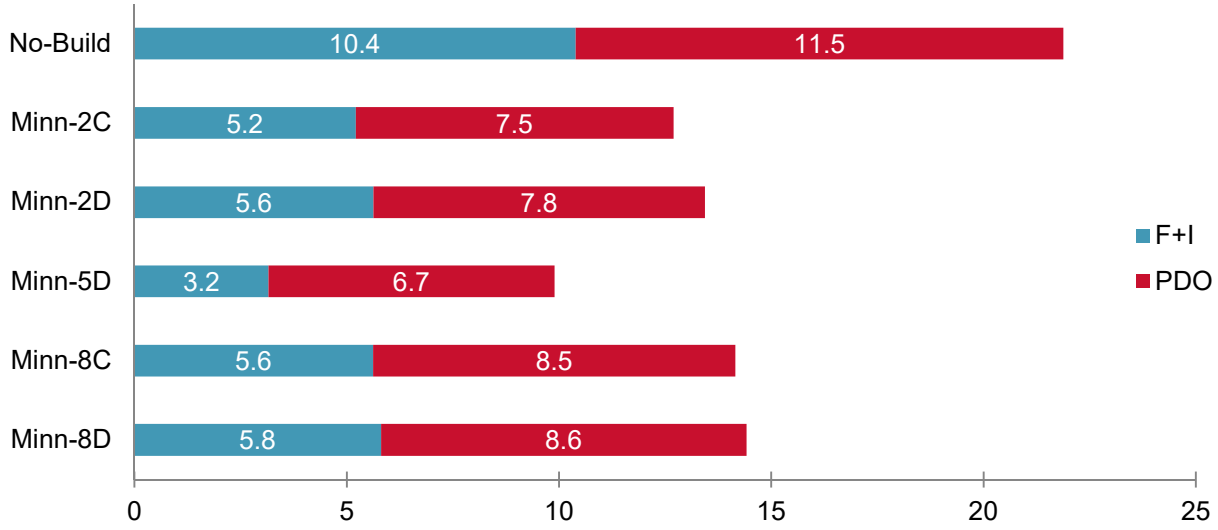
- Minn-2D
  - Same as Minn-2C except rebuilds Minnesota Avenue with a median and three lanes in each direction.
- Minn-5D
  - Replaces Diamond Interchange with Diverging Diamond Interchange (DDI) configuration.
- Minn-8C
  - Replaces Diamond Interchange with Single Point Urban Interchange (SPUI) centered 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

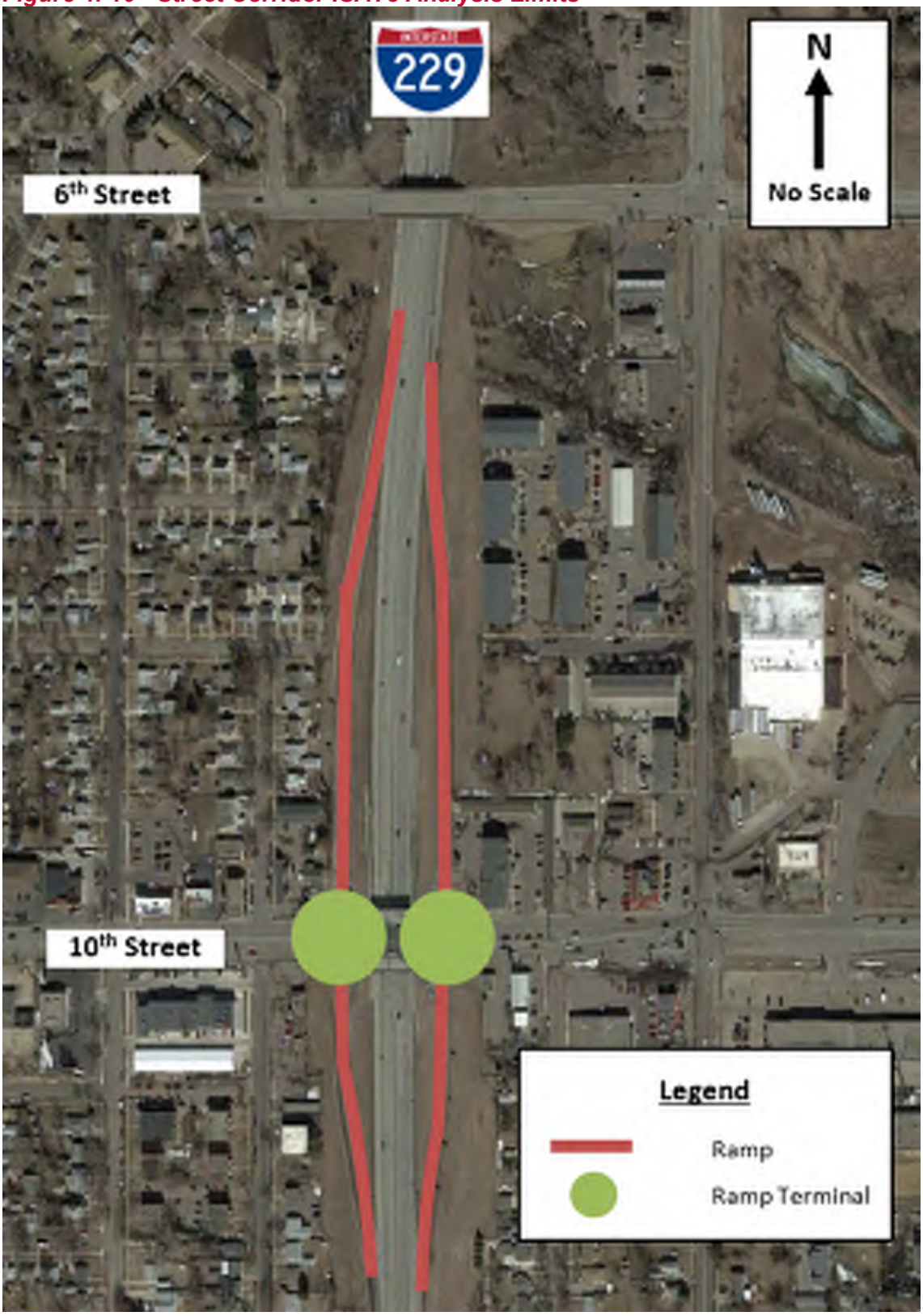
The ISATe analysis limits for the 10th Street Corridor Study focus on the I-229 ramps and the ramp terminals. For the Tight Split Diamond alternative, the proposed 6th Street ramp terminals were also included in the analysis. Because they are new intersections, no arterial intersection was included for 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



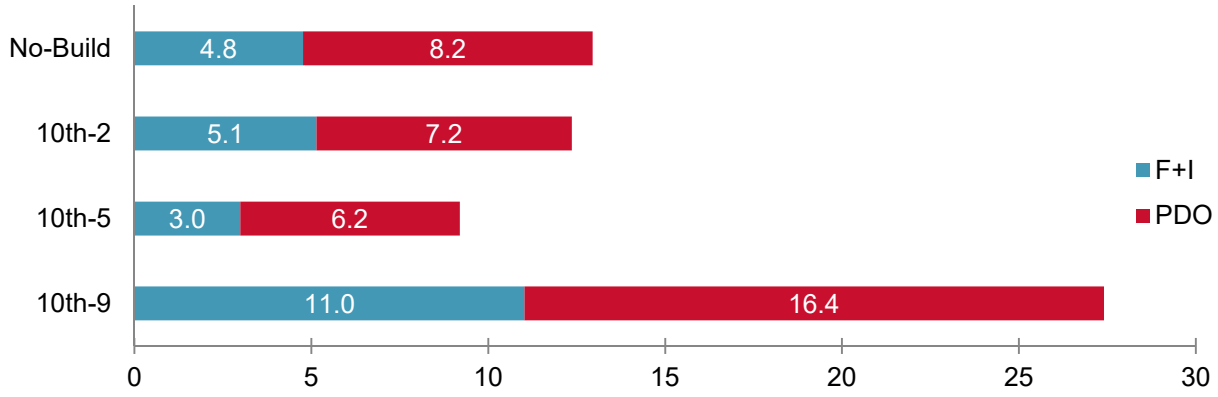
Source: Google Earth, December 2016

- 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



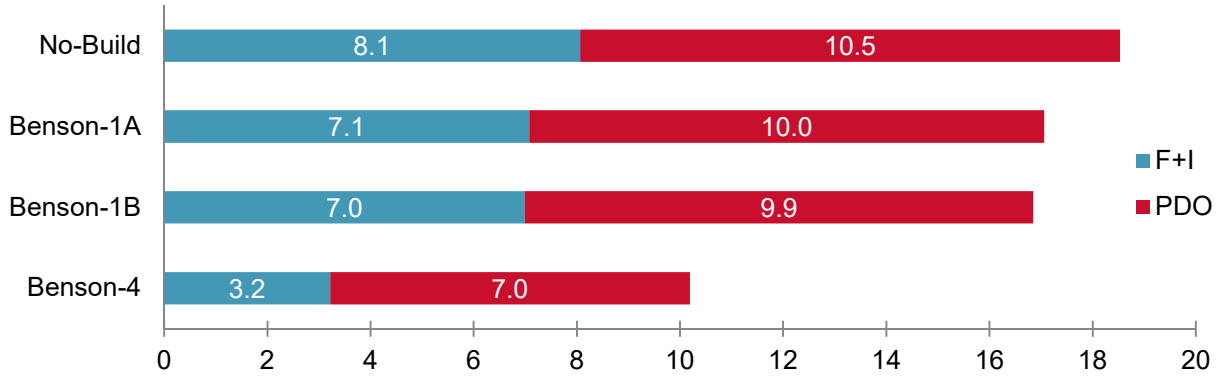
Source: Google Earth, December 2016

- 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

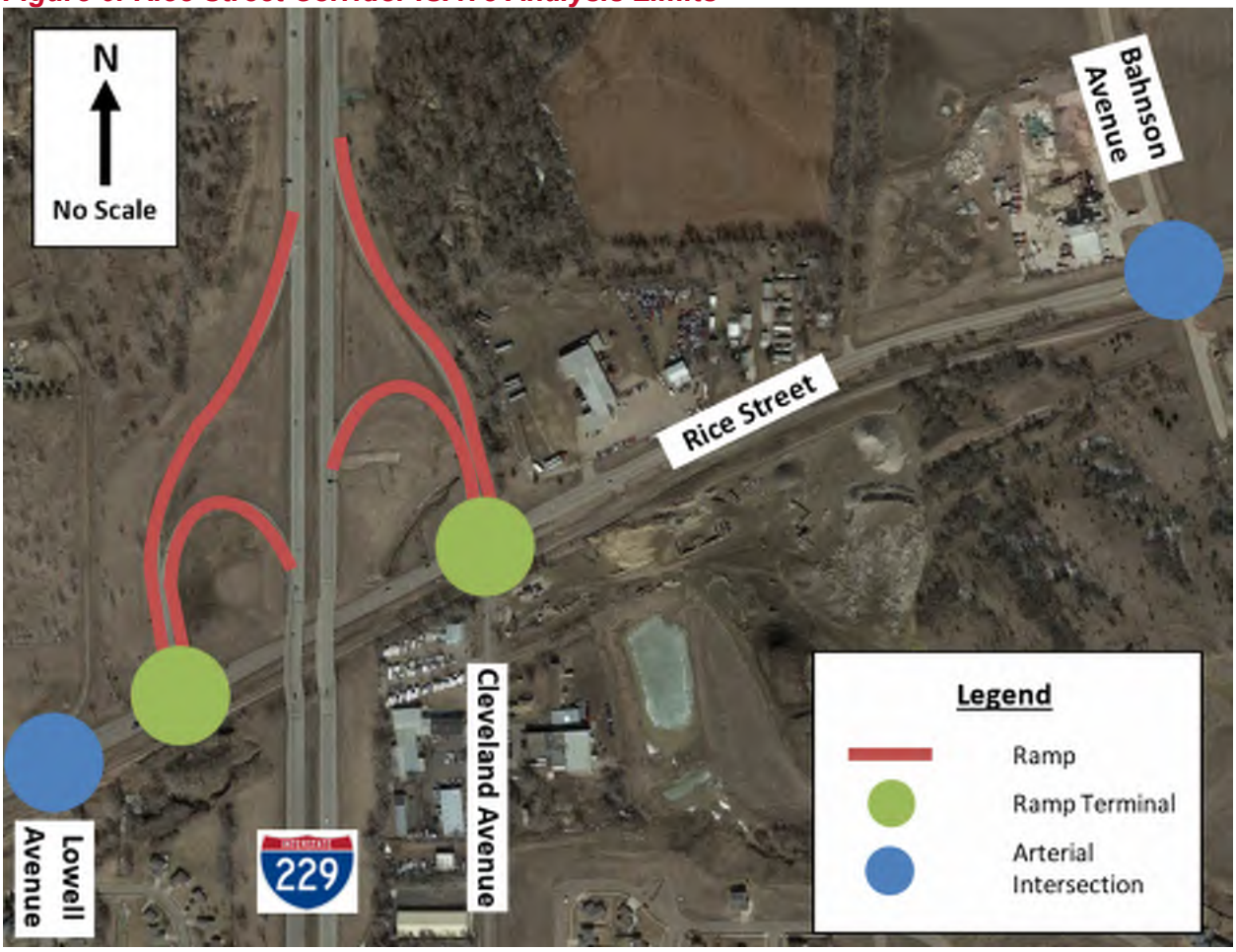
[1]Total User Cost – The discounted, monetized safety benefit from the crashes totaled for all years in the period 2012-2035 (rounded to $100,000).
[2]User Cost Savings - The discounted, monetized safety benefit from the crashes reduced by a scenario (compared to a baseline of No-Build) totaled for all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

- 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.

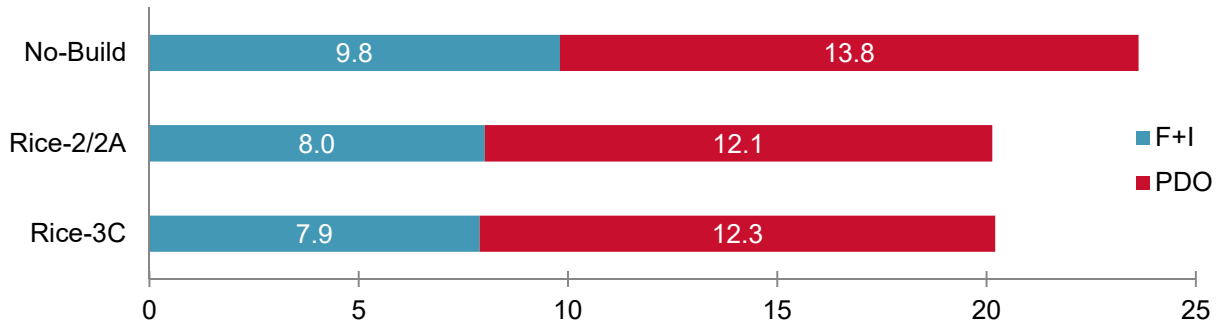
- Rice-2A
  - Same as Rice-2 except shifts and rebuilds Rice Street north of its current alignment to avoid impacts to BNSF Railroad Right-of-Way.
- Rice-3C
  - Replaces Folded Diamond Interchange with an improved geometrics Folded Diamond Interchange configuration.
  - Aligns SB I-229 ramps with Lowell 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.

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

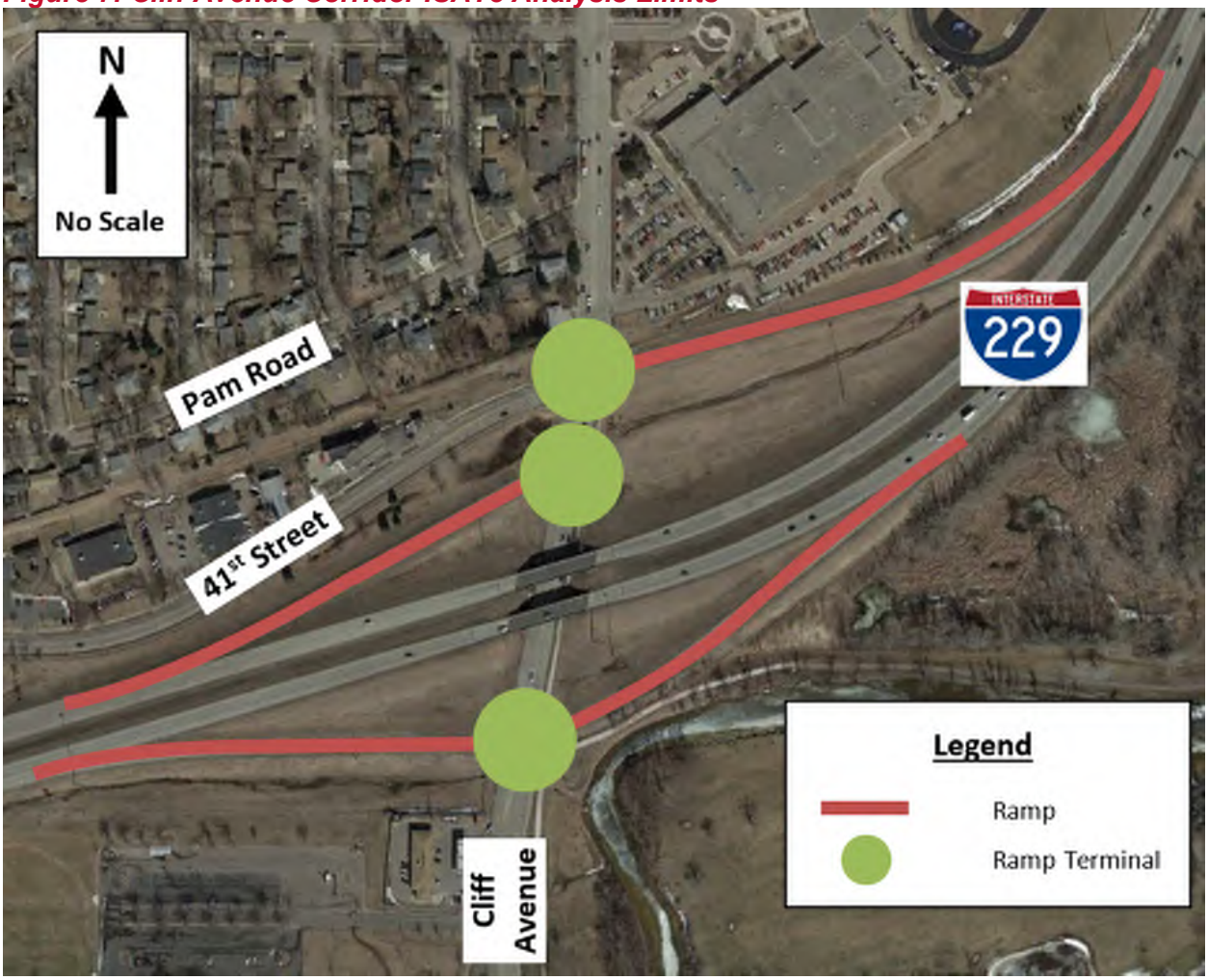
The ISATe analysis limits for the Cliff Avenue Corridor Study focus on the I-229 ramps, the ramp terminals, and the arterial intersection of Cliff Avenue and 41st Street. 41st Street is aligned with the I-229 southbound off-ramp for all the alternatives except Cliff-6. 41st Street is realigned to Pam 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



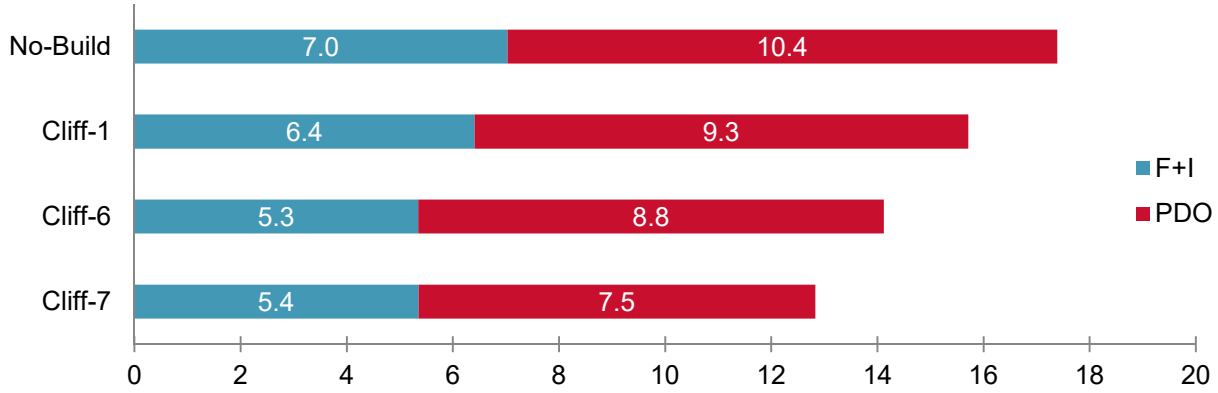
Source: Google Earth, December 2016

- 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 F. 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 B1. 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

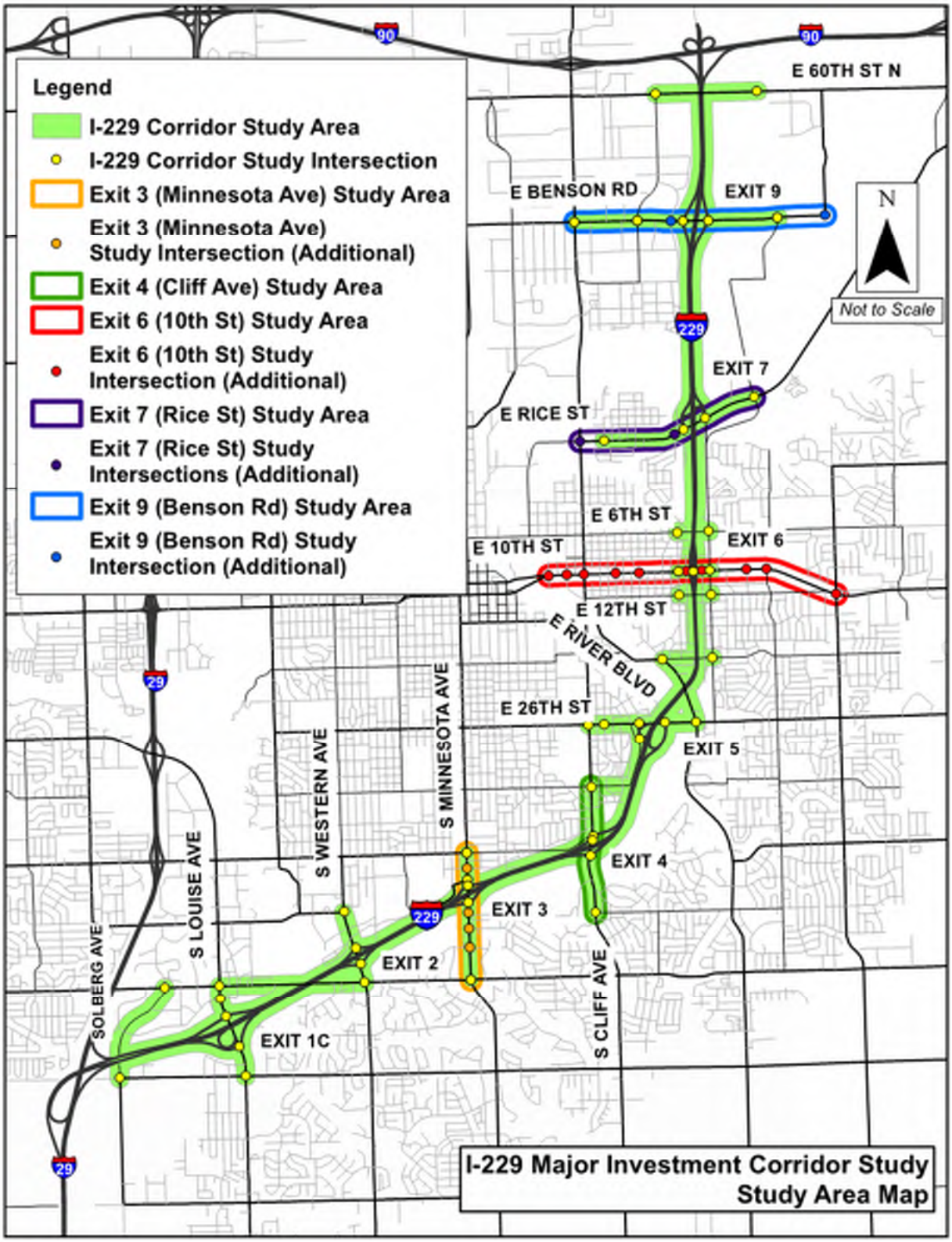
Volume Development

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 (Qualitative Analysis Only)
    - 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***. Minn-9D is an alternative that was originally screened out prior to the concept refinement stage. As the concept refinement progressed, Minn-9D was reconsidered and reinstated as a Build alternative. The project team's qualitative assessment of Minn-9D is that the concept would likely result in a year of failure beyond the year of failure for 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 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	Beyond 2060 (Estimation)

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.
- 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.

Year of Failure Results

The resulting year of failure for the No-Build and Build alternatives is shown in ***Table 3***.

Table 3 – 10th Street Corridor Year of Failure

Alternative	Year of Failure
10th-NB	Earlier than 2035
10th-2	Beyond 2065
10th-5	Beyond 2065
10th-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 G -

SUB-STUDY 3 NOISE STUDY TECHNICAL REPORT

Noise Study Technical Report

I-229 Major Investment Corridor Study

Sub-Study #3

Sioux Falls, South Dakota

HDR Project Number: 207030

May 2016

I-229 Major Investment Corridor Study (Sub-Study #3)
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. Sub-Study #3 assesses existing and future conditions along the 10th Street Corridor, which includes a combination of interchange concepts and corridor concepts (the Project). Eleven (11) Build Alternatives were evaluated as part of Sub-Study #3.

On behalf of SDDOT, and as part of the environmental documentation, HDR Engineering, Inc. (HDR) performed a traffic noise analysis along the 10th Street 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 is discussed.

Traffic noise levels were evaluated for the existing conditions and future Build Alternatives 2A, 2B, 2C, 2D, 2E, 5A, 5B, 5C, 9A, 9B, and Var at 576 receptors in the Project area. There are 98 traffic noise impacts predicted under the Existing Alternative, 165 impacts predicted under Future Build Alternative 2A, 163 impacts predicted under Future Build Alternatives 2B, 2C, 2D, 165 impacts predicted under Future Build Alternative 2E, 146 impacts predicted under Future Build Alternative 5A, 136 impacts predicted under Future Build Alternative 5B, 141 impacts predicted under Future Build Alternative 5C, 148 impacts predicted under Future Build Alternative 9A, 141 impacts predicted under Future Build Alternative 9B, and 168 impacts predicted under Future Build Alternative Var.

Table of Contents

EXECUTIVE SUMMARY **2**
1. Introduction **4**
2. Nature of Noise **5**
3. SDDOT Noise Analysis and Abatement Guidance **7**
4. Noise Prediction Method **8**
5. Adjacent Land Use **9**
6. Model Validation **9**
6.1. Field Testing Procedure 9
6.2. Instrumentation 9
6.3. Field Measurement Methods 10
6.4. Field Measurement Locations 10
6.5. Model Validation Results 10
7. Traffic Noise Prediction **10**
8. Noise Impact Analysis **24**
8.1. Impacts 24
8.1.1. Alternative 2A 24
8.1.2. Alternative 2B 24
8.1.3. Alternative 2C 25
8.1.4. Alternative 2D 25
8.1.5. Alternative 2E 25
8.1.6. Alternative 5A 25
8.1.7. Alternative 5B 25
8.1.8. Alternative 5C 25
8.1.9. Alternative 9A 25
8.1.10. Alternative 9B 26
8.1.11. Alternative Var 26
9. Noise Abatement Measures **26**
9.1. Discussion of Feasibility of Noise Barriers (based on SDDOT Guidance) 26
10. Construction Noise and Vibration **28**
11. Information for Local Officials **29**
12. Conclusion **29**
13. References **29**

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. Sub-Study #3 assesses existing and future conditions along the 10th Street Corridor, which includes a combination of interchange concepts and corridor concepts (the Project). Eleven (11) Build Alternatives were evaluated as part of Sub-Study #3. 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) 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.

Eleven (11) Build Alternatives were evaluated as part of Sub-Study #3.

1. **2A:** 6-Lane Corridor with SPUI Single Radius Lefts
2. **2B:** 4-Lane Corridor with 6-Lane SPUI Single Radius Lefts
3. **2C:** 5-Lane Undivided Corridor with 6-lane SPUI Single Radius Lefts
4. **2D:** 4-Lane Corridor with 4-Lane SPUI Broken Back Lefts with Triple NB Rights
5. **2E:** 6-Lane Corridor with SPUI Broken Back Lefts
6. **5A:** 6-Lane Corridor with DDI
7. **5B:** 4-Lane Corridor with 6-Lane DDI
8. **5C:** 5-Lane Undivided Corridor with 6-Lane DDI
9. **9A:** Tight Split Diamond – 6th and 10th with 4-Lane Corridor
10. **9B:** Tight Split Diamond – 6th and 10th with 5-Lane Undivided Corridor
11. **Var:** Unconstrained SB Entrance and NB Exit Ramps

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.

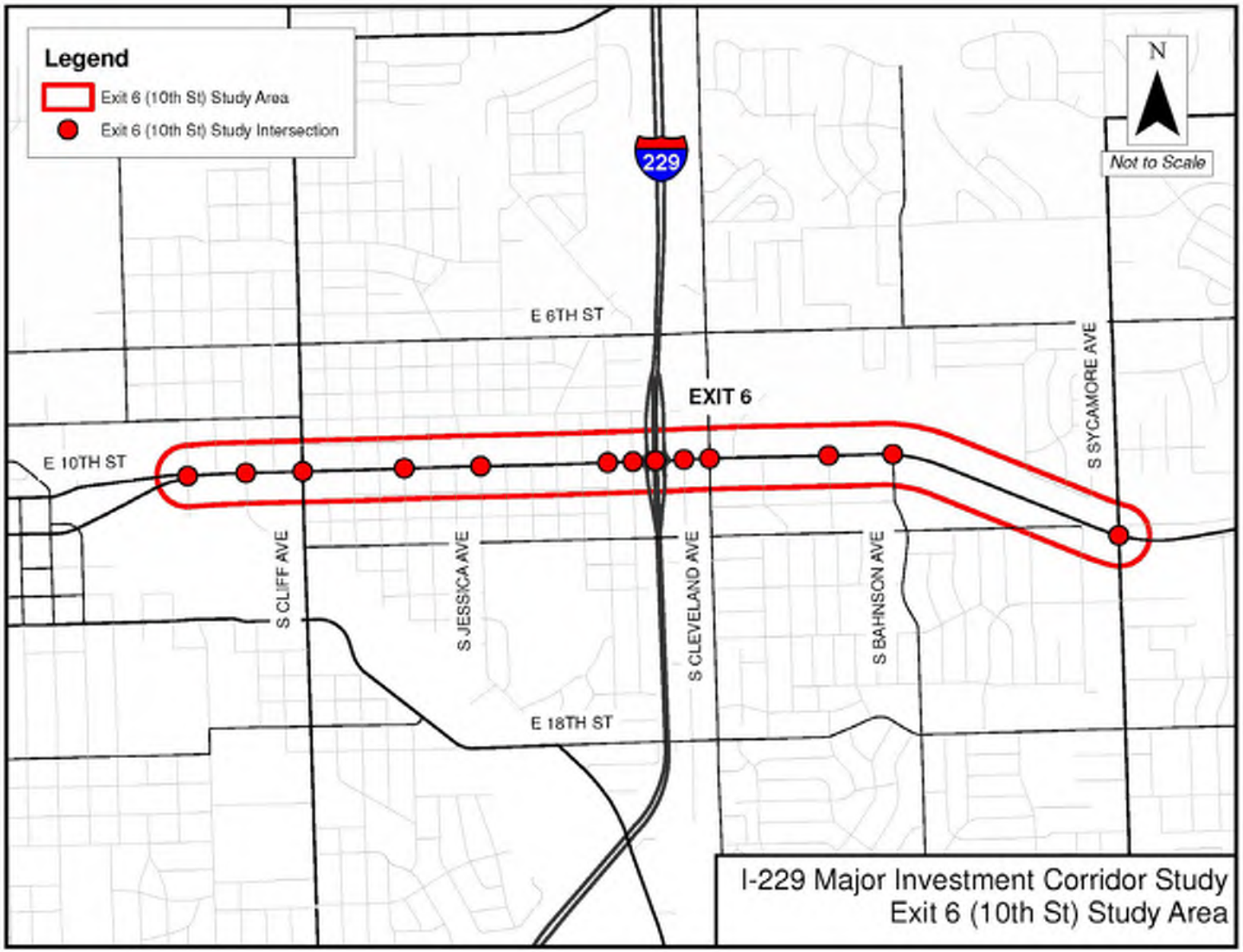
Noise is measured in decibels (dB) – a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, certain frequencies are given more "weight." The A-weighted scale corresponds to the sensitivity range for human hearing. Therefore, noise levels are measured in dBA, 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 equal/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 (Appendix 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

Five-hundred seventy-six (576) receptors were identified in the project area. The I-229 10th Street corridor is located east of I-29 in the Sioux Falls metropolitan area. The 10th Street Corridor study limits include an approximately 2.3 mile section of 10th Street from Franklin Avenue to South Sycamore Avenue and an approximately 1 mile section of I-229 from north of East 6th Street to south of East 12th Street.

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. Figures located in 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	≅ 66 °F
Humidity	≅ 54%
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). 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 location of the validation site in the project corridor.

Table 5: Noise Validation Location Summary

Measurement Location	Description
G	≈ 315' north of E 10th Street

The validation location is shown in Appendix B, and is within 315 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
G	56.2	53.4	-2.8

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 TNM model accounts for 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) modeled 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												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1157	B	66	66.4	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.4	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.0
1158	B	66	66.1	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0
1159	B	66	66.6	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.6	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.0
1160	B	66	66.1	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.3	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.2
1161	B	66	66.6	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.3
1162	B	66	66.3	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.5
1163	B	66	66.1	67.9	67.9	67.9	67.9	67.9	67.9	67.9	67.9	67.9	67.9	68.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.6
1164	B	66	66.2	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.5
1165	B	66	66.4	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	68.2	69.1	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.7
1166	B	66	67.0	68.9	68.9	68.9	68.9	68.9	68.9	68.9	68.9	68.9	68.9	70.2	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	3.2
1179	B	66	62.3	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.0
1180	B	66	62.2	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.9	64.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.1
1181	B	66	62.2	63.9	63.9	63.8	63.9	63.9	63.9	63.8	63.8	63.8	63.8	64.3	1.7	1.7	1.6	1.7	1.7	1.7	1.6	1.6	1.6	1.6	2.1
1182	B	66	62.1	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	63.7	64.1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.0
1183	B	66	62.3	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.9	64.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.2
1184	B	66	62.3	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.5
1185	B	66	62.7	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.3	65.0	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.6	2.3
1186	B	66	62.5	64.1	64.1	64.1	64.1	64.1	64.1	64.1	64.1	64.1	64.1	65.2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.7
1188	B	66	66.7	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	69.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	3.1
1189	B	66	66.3	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	69.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	3.0
1190	B	66	66.9	68.5	68.5	68.6	68.5	68.5	68.5	68.5	68.6	68.5	68.5	70.0	1.6	1.6	1.7	1.6	1.6	1.6	1.6	1.7	1.6	1.6	3.1
1191	B	66	66.7	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	69.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.0
1192	B	66	67.1	68.7	68.7	68.7	68.7	68.7	68.7	68.7	68.7	68.7	68.7	70.2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.1
1193	B	66	66.9	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	69.9	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.0
1194	B	66	67.1	68.7	68.7	68.7	68.7	68.7	68.7	68.7	68.7	68.7	68.7	70.3	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.2
1195	B	66	67.0	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	70.2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.2
1196	B	66	66.8	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	68.4	69.9	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.1
1197	B	66	67.5	69.1	69.1	69.1	69.1	69.1	69.0	69.0	69.0	69.1	69.1	70.6	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.6	1.6	3.1
1198	B	66	61.7	63.3	63.4	63.3	63.3	63.3	63.4	63.3	63.3	63.3	63.3	64.4	1.6	1.7	1.6	1.6	1.6	1.7	1.6	1.6	1.6	1.6	2.7
1199	B	66	62.7	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	65.4	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.7
1200	B	66	62.9	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	64.4	65.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.6
1201	B	66	62.7	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	65.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.7
1202	B	66	59.6	61.1	61.1	61.1	61.1	61.1	61.2	61.1	61.1	61.1	61.1	62.1	1.5	1.5	1.5	1.5	1.5	1.6	1.5	1.5	1.5	1.5	2.5
1203	B	66	59.2	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	61.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5
1204	B	66	58.4	59.9	59.9	59.9	59.9	59.9	59.9	59.9	59.9	59.9	59.9	60.9	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5
1205	B	66	58.5	60.0	60.0	60.0	60.0	60.0	60.0	59.9	60.0	60.0	59.9	61.2	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.5	1.5	1.4	2.7
1206	B	66	63.3	64.8	64.8	64.8	64.8	64.8	64.8	64.7	64.8	64.8	64.7	65.9	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.5	1.5	1.4	2.6
1207	B	66	61.0	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	63.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.6
1208	B	66	63.2	64.9	64.9	64.9	64.9	64.9	64.8	64.7	64.8	64.9	64.8	65.8	1.7	1.7	1.7	1.7	1.7	1.6	1.5	1.6	1.7	1.6	2.6
1209	B	66	63.1	64.8	64.8	64.8	64.9	64.8	64.7	64.6	64.7	64.8	64.7	65.7	1.7	1.7	1.7	1.8	1.7	1.6	1.5	1.6	1.7	1.6	2.6
1210	B	66	63.6	65.5	65.5	65.5	65.5	65.5	65.4	65.3	65.4	65.5	65.4	66.2	1.9	1.9	1.9	1.9	1.9	1.8	1.7	1.8	1.9	1.8	2.6
1211	B	66	59.8	61.4	61.4	61.4	61.4	61.4	61.3	61.3	61.3	61.4	61.3	62.4	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.6	1.5	2.6
1212	B	66	58.2	59.7	59.8	59.7	59.8	59.7	59.7	59.7	59.7	59.7	59.7	60.8	1.5	1.6	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.5	2.6
1213	B	66	58.4	60.0	60.0	60.0	60.0	60.0	60.0	59.9	60.0	60.0	59.9	61.0	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.6	1.6	1.5	2.6
1214	B	66	58.3	60.0	60.0	60.0	60.0	60.0	60.0	59.9	60.0	59.9	59.9	61.0	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.7	1.6	1.6	2.7

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1215	B	66	61.2	63.1	63.1	63.1	63.2	63.1	62.9	62.8	62.9	63.1	63.0	63.7	1.9	1.9	1.9	2.0	1.9	1.7	1.6	1.7	1.9	1.8	2.5
1245	B	66	66.2	67.9	67.9	67.9	67.9	67.9	67.9	67.9	67.9	67.9	67.9	68.0	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8
1246	B	66	66.4	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.9
1247	B	66	65.9	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.9	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.0
1248	B	66	66.2	67.9	67.9	67.9	67.9	67.9	67.9	67.8	67.9	67.9	67.8	68.2	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.7	1.7	1.6	2.0
1249	B	66	65.7	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.4	67.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.9
1250	B	66	66.0	67.7	67.7	67.7	67.7	67.7	67.7	67.7	67.7	67.7	67.7	68.1	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.1
1251	B	66	66.0	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	67.6	68.1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.1
1252	B	66	65.4	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	67.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.1
1253	B	66	65.4	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	67.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.0
1254	B	66	66.9	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.6	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.7
1255	B	66	65.8	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	66.9	67.4	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.6
1256	B	66	66.0	67.1	67.1	67.1	67.1	67.1	67.1	67.0	67.1	67.1	67.1	67.6	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.1	1.1	1.1	1.6
1257	B	66	66.6	67.5	67.6	67.6	67.6	67.5	67.6	67.5	67.6	67.6	67.6	68.2	0.9	1.0	1.0	1.0	0.9	1.0	0.9	1.0	1.0	1.0	1.6
1263	B	66	61.9	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.9	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	2.0
1264	B	66	62.0	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6	63.6	64.0	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.0
1265	B	66	61.9	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.9	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.0
1266	B	66	61.9	63.5	63.5	63.5	63.5	63.4	63.5	63.4	63.5	63.5	63.4	64.0	1.6	1.6	1.6	1.6	1.5	1.6	1.5	1.6	1.6	1.5	2.1
1267	B	66	61.8	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.9	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.1
1268	B	66	61.8	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.9	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.1
1269	B	66	61.7	63.2	63.2	63.2	63.2	63.2	63.2	63.1	63.2	63.2	63.1	63.8	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.5	1.5	1.4	2.1
1270	B	66	61.8	63.2	63.2	63.2	63.2	63.2	63.2	63.1	63.2	63.2	63.1	63.9	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.4	1.4	1.3	2.1
1271	B	66	62.1	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.2	63.8	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.7
1272	B	66	62.1	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3	64.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.9
1273	B	66	62.3	63.5	63.5	63.5	63.5	63.5	63.5	63.4	63.5	63.5	63.5	64.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.2	1.2	1.2	1.9
1274	B	66	62.5	63.6	63.5	63.6	63.6	63.6	63.6	63.5	63.5	63.6	63.5	64.3	1.1	1.0	1.1	1.1	1.1	1.1	1.0	1.0	1.1	1.0	1.8
1276	B	66	72.1	72.3	72.3	72.3	72.3	72.3	72.3	72.3	72.3	72.3	72.3	73.9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.8
1277	B	66	66.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.8
1278	B	66	66.4	67.5	67.5	67.5	67.5	67.5	67.5	67.4	67.5	67.5	67.5	68.3	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.1	1.1	1.1	1.9
1279	B	66	71.0	71.4	71.4	71.4	71.4	71.4	71.3	71.3	71.3	71.4	71.4	73.1	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.4	2.1
1280	B	66	68.8	70.0	70.0	70.0	70.0	70.0	70.0	69.9	70.0	70.0	70.0	70.8	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.2	1.2	1.2	2.0
1281	B	66	67.0	68.8	68.8	68.8	68.8	68.8	68.8	68.7	68.8	68.8	68.8	69.1	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.8	2.1
1282	B	66	64.6	66.6	66.6	66.6	66.6	66.6	66.5	66.5	66.5	66.6	66.6	66.9	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	2.0	2.0	2.3
1283	B	66	64.8	67.0	67.0	67.1	67.0	67.0	67.0	66.9	67.0	67.0	67.0	67.2	2.2	2.2	2.3	2.2	2.2	2.2	2.1	2.2	2.2	2.2	2.4
1286	B	66	61.1	62.9	62.9	62.9	62.9	62.9	62.9	62.8	62.9	62.8	62.8	63.2	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.8	1.7	1.7	2.1
1287	B	66	62.4	63.8	63.8	63.8	63.8	63.8	63.8	63.7	63.7	63.8	63.7	64.4	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.4	1.3	2.0
1288	B	66	62.3	63.6	63.6	63.6	63.6	63.6	63.6	63.5	63.6	63.6	63.6	64.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.3	1.3	2.0
1289	B	66	62.0	63.1	63.1	63.1	63.2	63.1	63.1	63.0	63.1	63.1	63.1	63.8	1.1	1.1	1.1	1.2	1.1	1.1	1.0	1.1	1.1	1.1	1.8
1290	B	66	60.3	61.6	61.6	61.6	61.6	61.6	61.5	61.3	61.4	61.6	61.5	62.3	1.3	1.3	1.3	1.3	1.3	1.2	1.0	1.1	1.3	1.2	2.0
1293	B	66	73.5	74.7	74.7	74.7	74.8	74.7	74.7	74.6	74.7	74.7	74.7	76.4	1.2	1.2	1.2	1.3	1.2	1.2	1.1	1.2	1.2	1.2	2.9
1294	B	66	69.3	70.6	70.6	70.6	70.6	70.6	70.4	70.3	70.4	70.6	70.6	71.8	1.3	1.3	1.3	1.3	1.3	1.1	1.0	1.1	1.3	1.3	2.5
1295	B	66	68.2	69.6	69.6	69.6	69.5	69.6	69.3	69.2	69.2	69.6	69.6	70.5	1.4	1.4	1.4	1.3	1.4	1.1	1.0	1.0	1.4	1.4	2.3
1296	B	66	68.5	70.0	69.9	70.0	69.9	70.0	69.5	69.4	69.5	70.0	70.0	70.8	1.5	1.4	1.5	1.4	1.5	1.0	0.9	1.0	1.5	1.5	2.3
1297	B	66	68.5	70.1	70.1	70.1	69.9	70.1	69.5	69.4	69.5	70.1	70.1	70.9	1.6	1.6	1.6	1.4	1.6	1.0	0.9	1.0	1.6	1.6	2.4
1298	B	66	69.3	70.9	70.9	70.9	70.6	70.9	70.1	70.0	70.1	71.0	71.0	71.8	1.6	1.6	1.6	1.3	1.6	0.8	0.7	0.8	1.7	1.7	2.5
1299	B	66	68.8	70.5	70.5	70.5	70.1	70.5	69.6	69.4	69.5	70.6	70.5	71.2	1.7	1.7	1.7	1.3	1.7	0.8	0.6	0.7	1.8	1.7	2.4
1300	B	66	70.2	72.1	72.1	72.1	71.4	72.1	71.3	71.1	71.2	72.2	72.2	72.7	1.9	1.9	1.9	1.2	1.9	1.1	0.9	1.0	2.0	2.0	2.5

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1301	B	66	70.1	72.0	71.9	72.0	71.2	72.0	71.5	71.2	71.4	72.1	72.1	72.4	1.9	1.8	1.9	1.1	1.9	1.4	1.1	1.3	2.0	2.0	2.3
1302	B	66	66.9	68.8	68.7	68.8	68.4	68.8	68.0	67.7	68.0	68.7	68.7	69.0	1.9	1.8	1.9	1.5	1.9	1.1	0.8	1.1	1.8	1.8	2.1
1303	B	66	67.0	68.8	68.7	68.8	68.5	68.8	68.2	67.8	68.1	68.8	68.7	69.0	1.8	1.7	1.8	1.5	1.8	1.2	0.8	1.1	1.8	1.7	2.0
1304	B	66	67.6	69.2	69.2	69.2	69.2	69.2	69.0	69.0	69.0	69.2	69.2	70.1	1.6	1.6	1.6	1.6	1.6	1.4	1.4	1.4	1.6	1.6	2.5
1305	B	66	64.2	66.0	65.9	66.0	65.9	66.0	65.7	65.6	65.7	65.9	65.9	66.5	1.8	1.7	1.8	1.7	1.8	1.5	1.4	1.5	1.7	1.7	2.3
1306	B	66	63.6	65.4	65.4	65.4	65.4	65.4	65.2	65.1	65.2	65.4	65.4	65.9	1.8	1.8	1.8	1.8	1.8	1.6	1.5	1.6	1.8	1.8	2.3
1307	B	66	62.5	64.5	64.5	64.5	64.5	64.5	64.3	64.2	64.3	64.4	64.4	64.7	2.0	2.0	2.0	2.0	2.0	1.8	1.7	1.8	1.9	1.9	2.2
1308	B	66	62.0	64.1	64.0	64.1	64.0	64.1	63.9	63.7	63.9	64.0	64.0	64.4	2.1	2.0	2.1	2.0	2.1	1.9	1.7	1.9	2.0	2.0	2.4
1310	B	66	63.9	65.5	65.4	65.5	65.4	65.5	65.0	64.8	64.9	65.4	65.4	65.9	1.6	1.5	1.6	1.5	1.6	1.1	0.9	1.0	1.5	1.5	2.0
1311	B	66	64.1	65.7	65.7	65.7	65.6	65.7	65.1	64.9	65.1	65.7	65.6	66.1	1.6	1.6	1.6	1.5	1.6	1.0	0.8	1.0	1.6	1.5	2.0
1312	B	66	64.3	65.9	65.9	65.9	65.8	65.9	65.3	65.1	65.3	65.9	65.8	66.2	1.6	1.6	1.6	1.5	1.6	1.0	0.8	1.0	1.6	1.5	1.9
1313	B	66	64.4	66.1	66.0	66.1	66.0	66.1	65.5	65.2	65.4	66.0	65.9	66.3	1.7	1.6	1.7	1.6	1.7	1.1	0.8	1.0	1.6	1.5	1.9
1314	B	66	63.8	65.6	65.4	65.6	65.4	65.5	64.6	64.3	64.6	65.4	65.3	65.7	1.8	1.6	1.8	1.6	1.7	0.8	0.5	0.8	1.6	1.5	1.9
1315	B	66	64.0	65.7	65.6	65.8	65.5	65.7	64.8	64.2	64.7	65.6	65.4	65.8	1.7	1.6	1.8	1.5	1.7	0.8	0.2	0.7	1.6	1.4	1.8
1316	B	66	64.3	65.8	65.7	66.0	65.7	65.8	65.0	64.3	65.0	65.7	65.5	65.9	1.5	1.4	1.7	1.4	1.5	0.7	0.0	0.7	1.4	1.2	1.6
1317	B	66	62.1	63.5	63.4	63.8	63.4	63.5	62.9	62.0	63.0	63.2	62.9	63.6	1.4	1.3	1.7	1.3	1.4	0.8	-0.1	0.9	1.1	0.8	1.5
1318	B	66	61.0	62.6	62.5	62.7	62.4	62.6	62.0	61.5	62.0	62.4	62.3	63.0	1.6	1.5	1.7	1.4	1.6	1.0	0.5	1.0	1.4	1.3	2.0
1319	B	66	60.5	62.1	62.0	62.2	61.9	62.1	61.6	61.1	61.6	61.9	61.8	62.5	1.6	1.5	1.7	1.4	1.6	1.1	0.6	1.1	1.4	1.3	2.0
1320	B	66	61.1	62.6	62.6	62.7	62.6	62.6	62.2	61.8	62.2	62.5	62.4	63.2	1.5	1.5	1.6	1.5	1.5	1.1	0.7	1.1	1.4	1.3	2.1
1321	E	71	68.3	69.8	69.7	69.9	70.0	69.8	71.9	71.5	71.9	69.8	69.8	69.9	1.5	1.4	1.6	1.7	1.5	3.6	3.2	3.6	1.5	1.5	1.6
1322	B	66	61.8	68.0	68.0	68.1	68.0	68.0	67.9	67.6	67.9	67.8	67.8	68.1	6.2	6.2	6.3	6.2	6.2	6.1	5.8	6.1	6.0	6.0	6.3
1323	B	66	61.5	67.8	67.8	67.8	67.8	67.8	67.7	67.4	67.7	67.6	67.6	67.8	6.3	6.3	6.3	6.3	6.3	6.2	5.9	6.2	6.1	6.1	6.3
1324	B	66	61.2	67.7	67.7	67.7	67.7	67.7	67.6	67.3	67.5	67.5	67.5	67.7	6.5	6.5	6.5	6.5	6.5	6.4	6.1	6.3	6.3	6.3	6.5
1325	B	66	60.9	67.3	67.4	67.4	67.4	67.3	67.2	67.0	67.2	67.2	67.2	67.4	6.4	6.5	6.5	6.5	6.4	6.3	6.1	6.3	6.3	6.3	6.5
1326	B	66	60.6	67.1	67.1	67.1	67.1	67.1	67.0	66.7	66.9	67.0	66.9	67.1	6.5	6.5	6.5	6.5	6.5	6.4	6.1	6.3	6.4	6.3	6.5
1327	B	66	60.4	67.0	67.0	67.0	67.0	67.0	66.9	66.6	66.8	66.9	66.9	67.0	6.6	6.6	6.6	6.6	6.6	6.5	6.2	6.4	6.5	6.5	6.6
1328	B	66	60.1	67.1	67.1	67.1	67.1	67.1	67.0	66.8	67.0	67.0	67.0	67.1	7.0	7.0	7.0	7.0	7.0	6.9	6.7	6.9	6.9	6.9	7.0
1329	B	66	59.9	67.1	67.1	67.1	67.1	67.1	67.0	66.7	66.9	67.0	67.0	67.1	7.2	7.2	7.2	7.2	7.2	7.1	6.8	7.0	7.1	7.1	7.2
1330	B	66	59.2	64.4	64.4	64.4	64.4	64.4	64.2	63.9	64.2	64.4	64.3	64.5	5.2	5.2	5.2	5.2	5.2	5.0	4.7	5.0	5.2	5.1	5.3
1331	B	66	59.8	64.3	64.3	64.3	64.2	64.3	64.1	63.9	64.1	64.2	64.1	64.3	4.5	4.5	4.5	4.4	4.5	4.3	4.1	4.3	4.4	4.3	4.5
1333	B	66	63.3	64.9	64.9	65.0	64.8	64.9	64.4	63.5	64.1	64.7	64.7	64.9	1.6	1.6	1.7	1.5	1.6	1.1	0.2	0.8	1.4	1.4	1.6
1334	B	66	62.7	64.4	64.4	64.5	64.4	64.4	63.7	63.0	63.5	64.3	64.2	64.4	1.7	1.7	1.8	1.7	1.7	1.0	0.3	0.8	1.6	1.5	1.7
1335	B	66	62.2	64.1	64.1	64.2	64.0	64.1	63.5	62.8	63.2	63.9	63.9	64.2	1.9	1.9	2.0	1.8	1.9	1.3	0.6	1.0	1.7	1.7	2.0
1336	B	66	61.7	63.9	63.8	63.9	63.7	63.9	63.2	62.5	63.0	63.7	63.7	63.9	2.2	2.1	2.2	2.0	2.2	1.5	0.8	1.3	2.0	2.0	2.2
1337	B	66	61.4	63.6	63.5	63.6	63.4	63.6	62.9	62.4	62.7	63.5	63.4	63.6	2.2	2.1	2.2	2.0	2.2	1.5	1.0	1.3	2.1	2.0	2.2
1338	B	66	61.3	63.5	63.4	63.5	63.4	63.5	63.0	62.5	62.8	63.4	63.3	63.6	2.2	2.1	2.2	2.1	2.2	1.7	1.2	1.5	2.1	2.0	2.3
1339	B	66	61.5	63.7	63.6	63.7	63.5	63.7	63.4	63.1	63.4	63.6	63.5	63.8	2.2	2.1	2.2	2.0	2.2	1.9	1.6	1.9	2.1	2.0	2.3
1340	B	66	61.9	64.0	63.9	64.0	63.9	64.0	63.7	63.4	63.7	63.9	63.9	64.1	2.1	2.0	2.1	2.0	2.1	1.8	1.5	1.8	2.0	2.0	2.2
1341	B	66	62.4	64.5	64.4	64.5	64.4	64.5	64.3	64.1	64.2	64.4	64.4	64.6	2.1	2.0	2.1	2.0	2.1	1.9	1.7	1.8	2.0	2.0	2.2
1344	B	66	63.9	66.4	66.4	66.5	66.4	66.4	66.4	66.3	66.4	66.4	66.4	66.5	2.5	2.5	2.6	2.5	2.5	2.5	2.4	2.5	2.5	2.5	2.6
1345	B	66	64.0	66.4	66.4	66.5	66.4	66.4	66.3	66.3	66.3	66.4	66.4	66.5	2.4	2.4	2.5	2.4	2.4	2.3	2.3	2.3	2.4	2.4	2.5
1346	B	66	65.9	68.3	68.3	68.4	68.3	68.3	68.3	68.2	68.3	68.3	68.3	68.4	2.4	2.4	2.5	2.4	2.4	2.4	2.3	2.4	2.4	2.4	2.5
1347	B	66	65.1	67.3	67.3	67.3	67.3	67.3	67.2	67.1	67.2	67.3	67.3	67.5	2.2	2.2	2.2	2.2	2.2	2.1	2.0	2.1	2.2	2.2	2.4
1348	B	66	65.7	67.6	67.4	67.6	67.2	67.6	66.9	66.1	66.6	67.2	67.2	67.7	1.9	1.7	1.9	1.5	1.9	1.2	0.4	0.9	1.5	1.5	2.0
1349	B	66	65.7	67.5	67.4	67.5	67.2	67.5	66.5	65.9	66.3	67.2	67.2	67.7	1.8	1.7	1.8	1.5	1.8	0.8	0.2	0.6	1.5	1.5	2.0
1350	B	66	65.4	67.3	67.2	67.3	67.0	67.3	66.2	65.7	66.1	67.1	67.0	67.5	1.9	1.8	1.9	1.6	1.9	0.8	0.3	0.7	1.7	1.6	2.1
1351	B	66	65.4	67.3	67.2	67.3	67.1	67.3	66.2	65.8	66.1	67.2	67.2	67.6	1.9	1.8	1.9	1.7	1.9	0.8	0.4	0.7	1.8	1.8	2.2

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1352	B	66	65.4	67.2	67.1	67.2	67.1	67.2	66.2	65.9	66.2	67.1	67.1	67.5	1.8	1.7	1.8	1.7	1.8	0.8	0.5	0.8	1.7	1.7	2.1
1353	B	66	66.1	67.8	67.8	67.8	67.7	67.8	67.1	66.9	67.1	67.8	67.8	68.3	1.7	1.7	1.7	1.6	1.7	1.0	0.8	1.0	1.7	1.7	2.2
1354	B	66	65.8	67.5	67.5	67.5	67.4	67.5	66.9	66.8	66.9	67.5	67.5	67.9	1.7	1.7	1.7	1.6	1.7	1.1	1.0	1.1	1.7	1.7	2.1
1355	B	66	66.2	67.7	67.7	67.7	67.7	67.7	67.5	67.3	67.5	67.7	67.7	68.1	1.5	1.5	1.5	1.5	1.5	1.3	1.1	1.3	1.5	1.5	1.9
1356	B	66	65.8	67.3	67.3	67.3	67.2	67.3	67.1	66.9	67.0	67.3	67.2	67.7	1.5	1.5	1.5	1.4	1.5	1.3	1.1	1.2	1.5	1.4	1.9
1357	B	66	67.3	69.3	69.3	69.3	69.3	69.3	69.2	69.2	69.2	69.3	69.3	69.5	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	2.0	2.0	2.2
1358	B	66	68.2	70.1	70.0	70.1	70.0	70.1	70.0	70.0	70.0	70.0	70.0	70.5	1.9	1.8	1.9	1.8	1.9	1.8	1.8	1.8	1.8	1.8	2.3
1359	B	66	70.4	71.3	71.3	71.4	71.3	71.3	71.3	71.2	71.3	71.4	71.3	72.8	0.9	0.9	1.0	0.9	0.9	0.9	0.8	0.9	1.0	0.9	2.4
1360	C	66	55.6	59.9	59.8	58.7	59.8	59.9	59.9	59.8	58.7	59.8	58.7	59.9	4.3	4.2	3.1	4.2	4.3	4.3	4.2	3.1	4.2	3.1	4.3
1361	B	66	61.2	62.0	61.8	62.8	61.8	62.0	61.7	60.4	62.4	61.6	60.7	62.1	0.8	0.6	1.6	0.6	0.8	0.5	-0.8	1.2	0.4	-0.5	0.9
1362	B	66	60.9	61.3	61.1	62.6	61.2	61.3	61.2	60.1	62.3	60.9	59.8	61.4	0.4	0.2	1.7	0.3	0.4	0.3	-0.8	1.4	0.0	-1.1	0.5
1363	B	66	60.1	60.7	60.5	61.8	60.6	60.7	60.6	59.6	61.6	60.3	59.3	60.8	0.6	0.4	1.7	0.5	0.6	0.5	-0.5	1.5	0.2	-0.8	0.7
1364	B	66	59.4	60.3	60.1	61.5	60.2	60.3	60.1	59.2	61.2	59.9	58.9	60.4	0.9	0.7	2.1	0.8	0.9	0.7	-0.2	1.8	0.5	-0.5	1.0
1365	B	66	60.5	61.7	61.5	62.3	61.5	61.7	61.5	60.5	62.0	61.4	60.7	61.8	1.2	1.0	1.8	1.0	1.2	1.0	0.0	1.5	0.9	0.2	1.3
1366	B	66	59.1	60.0	59.8	61.1	59.8	60.0	59.8	58.9	60.8	59.6	58.7	60.1	0.9	0.7	2.0	0.7	0.9	0.7	-0.2	1.7	0.5	-0.4	1.0
1369	B	66	59.2	59.8	59.6	61.4	59.6	59.8	59.7	59.0	60.9	59.4	58.1	59.9	0.6	0.4	2.2	0.4	0.6	0.5	-0.2	1.7	0.2	-1.1	0.7
1370	B	66	58.1	59.1	58.8	60.5	58.9	59.1	59.0	58.5	60.2	58.7	57.4	59.2	1.0	0.7	2.4	0.8	1.0	0.9	0.4	2.1	0.6	-0.7	1.1
1371	B	66	57.5	58.6	58.4	60.0	58.4	58.6	58.3	57.8	59.3	58.2	57.2	58.7	1.1	0.9	2.5	0.9	1.1	0.8	0.3	1.8	0.7	-0.3	1.2
1372	B	66	58.5	59.1	58.9	60.9	58.8	59.1	58.9	59.1	60.5	58.7	57.2	59.1	0.6	0.4	2.4	0.3	0.6	0.4	0.6	2.0	0.2	-1.3	0.6
1373	B	66	57.8	58.6	58.4	60.2	58.3	58.6	58.5	58.6	59.8	58.2	56.8	58.7	0.8	0.6	2.4	0.5	0.8	0.7	0.8	2.0	0.4	-1.0	0.9
1374	B	66	57.2	58.2	57.9	59.7	58.0	58.2	58.1	58.0	59.3	57.8	56.6	58.3	1.0	0.7	2.5	0.8	1.0	0.9	0.8	2.1	0.6	-0.6	1.1
1376	B	66	57.5	58.5	58.0	59.8	58.0	58.5	58.4	59.1	59.5	57.9	56.5	58.5	1.0	0.5	2.3	0.5	1.0	0.9	1.6	2.0	0.4	-1.0	1.0
1377	B	66	57.0	58.2	57.8	59.4	57.8	58.2	58.0	58.5	59.0	57.6	56.2	58.3	1.2	0.8	2.4	0.8	1.2	1.0	1.5	2.0	0.6	-0.8	1.3
1378	B	66	56.6	57.8	57.5	59.0	57.5	57.8	57.7	58.1	58.7	57.3	56.1	57.9	1.2	0.9	2.4	0.9	1.2	1.1	1.5	2.1	0.7	-0.5	1.3
1379	B	66	57.2	58.2	57.9	59.4	57.9	58.2	58.1	59.2	59.1	57.8	56.5	58.3	1.0	0.7	2.2	0.7	1.0	0.9	2.0	1.9	0.6	-0.7	1.1
1380	B	66	56.7	57.9	57.6	58.9	57.6	57.9	57.8	58.7	58.6	57.4	56.1	58.0	1.2	0.9	2.2	0.9	1.2	1.1	2.0	1.9	0.7	-0.6	1.3
1381	B	66	56.0	57.5	57.1	58.3	57.1	57.5	57.3	57.9	58.0	56.9	55.6	57.5	1.5	1.1	2.3	1.1	1.5	1.3	1.9	2.0	0.9	-0.4	1.5
1382	B	66	60.8	62.2	61.0	63.1	61.0	62.2	62.1	63.3	63.0	61.0	60.0	62.2	1.4	0.2	2.3	0.2	1.4	1.3	2.5	2.2	0.2	-0.8	1.4
1383	B	66	56.7	58.3	57.8	58.8	57.8	58.3	58.2	59.1	58.6	57.8	56.1	58.3	1.6	1.1	2.1	1.1	1.6	1.5	2.4	1.9	1.1	-0.6	1.6
1384	B	66	56.5	58.3	57.9	58.7	57.9	58.3	58.2	59.1	58.5	57.9	56.1	58.4	1.8	1.4	2.2	1.4	1.8	1.7	2.6	2.0	1.4	-0.4	1.9
1385	B	66	56.0	57.7	57.2	58.0	57.2	57.7	57.6	58.3	57.8	57.2	55.5	57.8	1.7	1.2	2.0	1.2	1.7	1.6	2.3	1.8	1.2	-0.5	1.8
1386	B	66	55.9	57.7	57.3	57.8	57.3	57.7	57.6	58.3	57.7	57.2	55.4	57.8	1.8	1.4	1.9	1.4	1.8	1.7	2.4	1.8	1.3	-0.5	1.9
1387	B	66	55.4	57.2	56.8	57.5	56.8	57.2	57.1	57.7	57.2	56.7	55.1	57.3	1.8	1.4	2.1	1.4	1.8	1.7	2.3	1.8	1.3	-0.3	1.9
1388	B	66	55.3	57.2	56.8	57.3	56.8	57.2	57.1	57.7	57.1	56.7	55.0	57.3	1.9	1.5	2.0	1.5	1.9	1.8	2.4	1.8	1.4	-0.3	2.0
1389	B	66	59.5	62.3	61.2	62.2	61.2	62.3	62.2	62.7	62.1	61.2	59.6	62.3	2.8	1.7	2.7	1.7	2.8	2.7	3.2	2.6	1.7	0.1	2.8
1390	B	66	55.8	59.1	58.9	58.1	58.9	59.1	59.0	59.5	58.0	58.8	56.0	59.1	3.3	3.1	2.3	3.1	3.3	3.2	3.7	2.2	3.0	0.2	3.3
1391	B	66	55.2	59.3	59.3	57.3	59.2	59.3	59.2	59.6	57.2	59.2	55.5	59.3	4.1	4.1	2.1	4.0	4.1	4.0	4.4	2.0	4.0	0.3	4.1
1392	B	66	54.4	57.6	57.5	56.5	57.5	57.6	57.4	58.1	56.4	57.4	54.6	57.6	3.2	3.1	2.1	3.1	3.2	3.0	3.7	2.0	3.0	0.2	3.2
1393	B	66	54.0	57.4	57.3	56.1	57.3	57.4	57.3	57.8	55.9	57.3	54.3	57.4	3.4	3.3	2.1	3.3	3.4	3.3	3.8	1.9	3.3	0.3	3.4
1395	B	66	53.1	57.0	56.9	54.9	56.9	57.0	57.0	57.1	54.7	56.9	53.6	57.1	3.9	3.8	1.8	3.8	3.9	3.9	4.0	1.6	3.8	0.5	4.0
1396	B	66	53.9	57.6	57.5	55.7	57.5	57.6	57.6	57.7	55.6	57.5	54.3	57.6	3.7	3.6	1.8	3.6	3.7	3.7	3.8	1.7	3.6	0.4	3.7
1397	B	66	54.4	58.4	58.3	56.3	58.2	58.4	58.4	58.5	56.2	58.2	54.8	58.4	4.0	3.9	1.9	3.8	4.0	4.0	4.1	1.8	3.8	0.4	4.0
1398	B	66	54.9	59.2	59.0	56.8	59.0	59.2	59.1	59.3	56.7	59.0	55.4	59.2	4.3	4.1	1.9	4.1	4.3	4.2	4.4	1.8	4.1	0.5	4.3
1399	B	66	54.3	58.6	58.6	55.8	58.6	58.6	58.6	58.7	55.7	58.6	54.9	58.6	4.3	4.3	1.5	4.3	4.3	4.3	4.4	1.4	4.3	0.6	4.3
1400	B	66	53.6	57.9	57.8	55.2	57.8	57.9	57.9	57.9	55.1	57.8	54.2	57.9	4.3	4.2	1.6	4.2	4.3	4.3	4.3	1.5	4.2	0.6	4.3
1401	B	66	53.2	57.4	57.4	54.9	57.4	57.4	57.4	57.5	54.7	57.4	53.8	57.4	4.2	4.2	1.7	4.2	4.2	4.2	4.3	1.5	4.2	0.6	4.2
1403	B	66	54.0	58.4	58.2	55.5	58.2	58.4	58.4	58.2	55.3	58.2	54.8	58.4	4.4	4.2	1.5	4.2	4.4	4.4	4.2	1.3	4.2	0.8	4.4

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1404	B	66	53.9	58.3	58.1	55.3	58.1	58.3	58.3	58.1	55.2	58.1	54.6	58.3	4.4	4.2	1.4	4.2	4.4	4.4	4.2	1.3	4.2	0.7	4.4
1405	B	66	54.0	58.3	58.1	55.3	58.1	58.3	58.3	58.2	55.2	58.1	54.7	58.3	4.3	4.1	1.3	4.1	4.3	4.3	4.2	1.2	4.1	0.7	4.3
1406	B	66	53.9	58.3	58.2	55.3	58.2	58.3	58.3	58.2	55.2	58.2	54.7	58.4	4.4	4.3	1.4	4.3	4.4	4.4	4.3	1.3	4.3	0.8	4.5
1407	B	66	53.8	58.4	58.2	55.1	58.2	58.4	58.3	58.2	55.0	58.2	54.6	58.4	4.6	4.4	1.3	4.4	4.6	4.5	4.4	1.2	4.4	0.8	4.6
1408	B	66	52.3	56.5	56.4	53.7	56.4	56.5	56.5	56.5	53.6	56.4	53.1	56.5	4.2	4.1	1.4	4.1	4.2	4.2	4.2	1.3	4.1	0.8	4.2
1410	B	66	58.5	63.0	62.5	59.7	62.5	63.0	63.0	62.5	59.6	62.5	59.3	63.1	4.5	4.0	1.2	4.0	4.5	4.5	4.0	1.1	4.0	0.8	4.6
1411	B	66	57.1	61.6	61.3	58.3	61.3	61.6	61.6	61.3	58.2	61.3	57.9	61.6	4.5	4.2	1.2	4.2	4.5	4.5	4.2	1.1	4.2	0.8	4.5
1412	B	66	56.0	60.6	60.3	57.3	60.3	60.6	60.6	60.4	57.3	60.3	56.8	60.6	4.6	4.3	1.3	4.3	4.6	4.6	4.4	1.3	4.3	0.8	4.6
1413	B	66	56.0	60.4	60.4	57.3	60.4	60.4	60.4	60.4	57.2	60.4	56.9	60.4	4.4	4.4	1.3	4.4	4.4	4.4	4.4	1.2	4.4	0.9	4.4
1414	B	66	57.4	62.4	62.0	58.5	62.0	62.4	62.4	62.0	58.5	62.0	58.3	62.4	5.0	4.6	1.1	4.6	5.0	5.0	4.6	1.1	4.6	0.9	5.0
1415	B	66	56.3	61.2	60.9	57.5	60.9	61.2	61.1	60.9	57.4	60.9	57.2	61.2	4.9	4.6	1.2	4.6	4.9	4.8	4.6	1.1	4.6	0.9	4.9
1416	B	66	58.7	65.3	64.6	59.8	64.6	65.3	65.3	64.5	59.8	64.5	59.6	65.3	6.6	5.9	1.1	5.9	6.6	6.6	5.8	1.1	5.8	0.9	6.6
1417	B	66	57.6	63.5	62.9	58.7	62.9	63.5	63.5	62.9	58.7	62.8	58.5	63.5	5.9	5.3	1.1	5.3	5.9	5.9	5.3	1.1	5.2	0.9	5.9
1418	B	66	56.6	61.8	61.5	57.8	61.5	61.8	61.8	61.5	57.7	61.5	57.6	61.8	5.2	4.9	1.2	4.9	5.2	5.2	4.9	1.1	4.9	1.0	5.2
1419	B	66	53.9	58.6	58.6	55.2	58.6	58.6	58.6	58.5	55.1	58.6	54.8	58.6	4.7	4.7	1.3	4.7	4.7	4.7	4.6	1.2	4.7	0.9	4.7
1420	B	66	52.9	57.7	57.6	54.3	57.6	57.7	57.7	57.6	54.1	57.6	53.8	57.7	4.8	4.7	1.4	4.7	4.8	4.8	4.7	1.2	4.7	0.9	4.8
1422	B	66	54.0	58.9	58.8	55.3	58.8	58.9	58.9	58.8	55.2	58.9	55.0	58.9	4.9	4.8	1.3	4.8	4.9	4.9	4.8	1.2	4.9	1.0	4.9
1423	B	66	54.0	59.2	59.1	55.3	59.1	59.2	59.2	59.0	55.2	59.1	55.0	59.2	5.2	5.1	1.3	5.1	5.2	5.2	5.0	1.2	5.1	1.0	5.2
1425	B	66	54.4	59.6	59.4	55.8	59.4	59.6	59.6	59.4	55.7	59.4	55.8	59.6	5.2	5.0	1.4	5.0	5.2	5.2	5.0	1.3	5.0	1.4	5.2
1426	B	66	53.6	58.8	58.5	55.1	58.5	58.8	58.8	58.5	55.0	58.6	54.9	58.9	5.2	4.9	1.5	4.9	5.2	5.2	4.9	1.4	5.0	1.3	5.3
1427	B	66	53.1	58.2	57.8	54.6	57.8	58.2	58.1	57.8	54.5	57.9	54.3	58.2	5.1	4.7	1.5	4.7	5.1	5.0	4.7	1.4	4.8	1.2	5.1
1430	B	66	53.2	58.1	57.7	54.9	57.7	58.1	58.0	57.7	54.8	57.7	54.7	58.1	4.9	4.5	1.7	4.5	4.9	4.8	4.5	1.6	4.5	1.5	4.9
1431	B	66	54.2	59.1	58.9	55.7	58.9	59.1	59.1	58.9	55.6	58.9	55.5	59.1	4.9	4.7	1.5	4.7	4.9	4.9	4.7	1.4	4.7	1.3	4.9
1432	B	66	60.9	65.9	65.0	62.1	65.0	65.9	65.9	65.0	62.0	65.0	62.0	65.9	5.0	4.1	1.2	4.1	5.0	5.0	4.1	1.1	4.1	1.1	5.0
1433	B	66	59.0	63.8	62.9	60.4	62.9	63.8	63.8	62.9	60.3	62.9	60.3	63.8	4.8	3.9	1.4	3.9	4.8	4.8	3.9	1.3	3.9	1.3	4.8
1434	B	66	56.7	61.1	60.8	58.2	60.8	61.1	61.1	60.8	58.2	60.8	58.1	61.1	4.4	4.1	1.5	4.1	4.4	4.4	4.1	1.5	4.1	1.4	4.4
1435	B	66	54.1	58.7	58.5	55.9	58.5	58.7	58.7	58.5	55.9	58.5	55.8	58.7	4.6	4.4	1.8	4.4	4.6	4.6	4.4	1.8	4.4	1.7	4.6
1436	B	66	54.0	58.6	58.3	56.4	58.3	58.6	58.6	58.3	56.3	58.3	56.3	58.6	4.6	4.3	2.4	4.3	4.6	4.6	4.3	2.3	4.3	2.3	4.6
1437	B	66	53.4	58.1	57.9	55.3	57.9	58.1	58.1	57.9	55.3	57.9	55.2	58.2	4.7	4.5	1.9	4.5	4.7	4.7	4.5	1.9	4.5	1.8	4.8
1438	B	66	52.7	57.5	57.3	54.6	57.3	57.5	57.5	57.3	54.6	57.3	54.5	57.5	4.8	4.6	1.9	4.6	4.8	4.8	4.6	1.9	4.6	1.8	4.8
1441	B	66	52.7	57.7	57.8	56.1	57.8	57.7	57.7	57.8	56.1	57.8	56.1	57.7	5.0	5.1	3.4	5.1	5.0	5.0	5.1	3.4	5.1	3.4	5.0
1442	B	66	52.1	57.2	57.4	55.6	57.4	57.2	57.2	57.4	55.6	57.4	55.6	57.2	5.1	5.3	3.5	5.3	5.1	5.1	5.3	3.5	5.3	3.5	5.1
1443	B	66	52.8	58.2	58.4	56.8	58.4	58.2	58.2	58.4	56.8	58.4	56.8	58.2	5.4	5.6	4.0	5.6	5.4	5.4	5.6	4.0	5.6	4.0	5.4
1444	B	66	52.3	58.2	58.3	57.0	58.3	58.2	58.2	58.3	57.0	58.3	56.9	58.2	5.9	6.0	4.7	6.0	5.9	5.9	6.0	4.7	6.0	4.6	5.9
1445	B	66	53.6	60.6	60.7	59.7	60.7	60.6	60.6	60.7	59.7	60.7	59.7	60.6	7.0	7.1	6.1	7.1	7.0	7.0	7.1	6.1	7.1	6.1	7.0
1446	B	66	53.0	60.2	60.3	59.4	60.3	60.2	60.2	60.3	59.3	60.3	59.3	60.2	7.2	7.3	6.4	7.3	7.2	7.2	7.3	6.3	7.3	6.3	7.2
1447	B	66	52.3	59.6	59.8	58.8	59.8	59.6	59.6	59.8	58.8	59.8	58.8	59.6	7.3	7.5	6.5	7.5	7.3	7.3	7.5	6.5	7.5	6.5	7.3
1448	C	66	63.4	67.4	66.3	66.7	66.3	67.4	67.4	67.9	66.6	66.3	64.3	67.4	4.0	2.9	3.3	2.9	4.0	4.0	4.5	3.2	2.9	0.9	4.0
1449	D	51	47.1	49.7	49.1	48.3	49.1	49.7	49.7	49.1	48.3	49.1	48.3	49.7	2.6	2.0	1.2	2.0	2.6	2.6	2.0	1.2	2.0	1.2	2.6
1450	B	66	68.0	69.7	69.6	69.7	69.6	69.7	67.2	66.8	67.2	69.9	69.9	69.7	1.7	1.6	1.7	1.6	1.7	-0.8	-1.2	-0.8	1.9	1.9	1.7
1451	B	66	67.9	69.6	69.6	69.6	69.6	69.6	65.6	65.2	65.7	69.4	69.4	69.6	1.7	1.7	1.7	1.7	1.7	-2.3	-2.7	-2.2	1.5	1.5	1.7
1452	B	66	67.8	69.4	69.4	69.4	69.4	69.4	65.3	64.9	65.3	69.2	69.2	69.4	1.6	1.6	1.6	1.6	1.6	-2.5	-2.9	-2.5	1.4	1.4	1.6
1453	B	66	68.4	70.0	70.0	70.0	70.0	70.0	65.4	65.0	65.4	69.5	69.5	70.1	1.6	1.6	1.6	1.6	1.6	-3.0	-3.4	-3.0	1.1	1.1	1.7
1454	B	66	68.4	70.1	70.0	70.1	70.1	70.1	66.1	65.8	66.0	69.4	69.4	70.1	1.7	1.6	1.7	1.7	1.7	-2.3	-2.6	-2.4	1.0	1.0	1.7
1455	B	66	63.0	64.3	64.3	64.6	64.3	64.3	63.2	61.6	63.2	63.6	63.3	64.3	1.3	1.3	1.6	1.3	1.3	0.2	-1.4	0.2	0.6	0.3	1.3
1456	B	66	62.8	64.3	64.3	64.5	64.3	64.3	62.9	61.6	62.9	63.5	63.2	64.3	1.5	1.5	1.7	1.5	1.5	0.1	-1.2	0.1	0.7	0.4	1.5
1457	B	66	62.5	64.0	64.0	64.2	64.0	64.1	62.2	61.3	62.2	62.9	62.6	64.1	1.5	1.5	1.7	1.5	1.6	-0.3	-1.2	-0.3	0.4	0.1	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1458	B	66	62.7	64.1	64.2	64.2	64.2	64.1	62.2	61.4	62.2	62.9	62.6	64.1	1.4	1.5	1.5	1.5	1.4	-0.5	-1.3	-0.5	0.2	-0.1	1.4
1459	B	66	62.8	64.4	64.4	64.5	64.4	64.4	62.4	61.7	62.3	62.9	62.7	64.4	1.6	1.6	1.7	1.6	1.6	-0.4	-1.1	-0.5	0.1	-0.1	1.6
1460	B	66	59.7	61.2	61.2	61.4	61.2	61.2	60.2	59.3	60.3	59.9	59.4	61.2	1.5	1.5	1.7	1.5	1.5	0.5	-0.4	0.6	0.2	-0.3	1.5
1461	B	66	59.9	61.3	61.3	61.6	61.3	61.3	60.5	59.3	60.6	60.3	59.8	61.3	1.4	1.4	1.7	1.4	1.4	0.6	-0.6	0.7	0.4	-0.1	1.4
1462	B	66	60.4	61.7	61.7	62.2	61.7	61.8	61.2	59.6	61.3	61.0	60.3	61.7	1.3	1.3	1.8	1.3	1.4	0.8	-0.8	0.9	0.6	-0.1	1.3
1463	B	66	61.1	62.3	62.2	62.8	62.2	62.3	61.9	60.1	62.0	61.7	60.9	62.3	1.2	1.1	1.7	1.1	1.2	0.8	-1.0	0.9	0.6	-0.2	1.2
1464	B	66	62.0	63.0	63.0	63.7	63.0	63.0	62.9	60.8	63.0	62.6	61.7	63.0	1.0	1.0	1.7	1.0	1.0	0.9	-1.2	1.0	0.6	-0.3	1.0
1465	B	66	64.2	65.3	64.7	66.3	64.7	65.3	65.8	62.4	66.3	64.7	62.5	65.3	1.1	0.5	2.1	0.5	1.1	1.6	-1.8	2.1	0.5	-1.7	1.1
1466	B	66	62.4	63.3	62.9	64.3	62.9	63.3	63.6	60.8	64.2	62.9	61.2	63.3	0.9	0.5	1.9	0.5	0.9	1.2	-1.6	1.8	0.5	-1.2	0.9
1467	B	66	61.1	62.1	61.9	63.2	61.9	62.1	62.2	59.9	62.7	61.7	60.3	62.1	1.0	0.8	2.1	0.8	1.0	1.1	-1.2	1.6	0.6	-0.8	1.0
1468	B	66	60.0	61.2	61.0	61.9	61.0	61.2	61.1	59.1	61.5	60.6	59.4	61.2	1.2	1.0	1.9	1.0	1.2	1.1	-0.9	1.5	0.6	-0.6	1.2
1469	B	66	59.1	60.4	60.3	61.1	60.3	60.4	60.1	58.5	60.5	59.8	58.8	60.4	1.3	1.2	2.0	1.2	1.3	1.0	-0.6	1.4	0.7	-0.3	1.3
1470	B	66	62.7	64.1	63.3	65.3	63.3	64.1	64.1	61.3	65.2	63.2	60.9	64.0	1.4	0.6	2.6	0.6	1.4	1.4	-1.4	2.5	0.5	-1.8	1.3
1471	B	66	61.1	62.2	61.7	63.3	61.7	62.2	62.1	59.9	63.1	61.5	59.6	62.2	1.1	0.6	2.2	0.6	1.1	1.0	-1.2	2.0	0.4	-1.5	1.1
1472	B	66	59.7	61.0	60.7	62.1	60.7	61.0	60.8	58.9	61.7	60.4	58.8	61.0	1.3	1.0	2.4	1.0	1.3	1.1	-0.8	2.0	0.7	-0.9	1.3
1473	B	66	58.8	60.2	59.9	61.2	59.9	60.2	59.9	58.2	60.7	59.6	58.1	60.2	1.4	1.1	2.4	1.1	1.4	1.1	-0.6	1.9	0.8	-0.7	1.4
1474	B	66	58.0	59.4	59.2	60.4	59.2	59.4	59.2	57.6	59.8	58.9	57.6	59.5	1.4	1.2	2.4	1.2	1.4	1.2	-0.4	1.8	0.9	-0.4	1.5
1475	B	66	61.5	62.6	61.9	64.9	61.9	62.6	62.6	61.1	64.5	61.8	59.9	62.6	1.1	0.4	3.4	0.4	1.1	1.1	-0.4	3.0	0.3	-1.6	1.1
1476	B	66	59.9	61.0	60.5	62.9	60.5	61.0	60.9	59.7	62.5	60.4	58.6	61.0	1.1	0.6	3.0	0.6	1.1	1.0	-0.2	2.6	0.5	-1.3	1.1
1477	B	66	58.5	59.8	59.4	61.4	59.4	59.8	59.6	58.6	61.0	59.2	57.5	59.8	1.3	0.9	2.9	0.9	1.3	1.1	0.1	2.5	0.7	-1.0	1.3
1478	B	66	57.8	59.1	58.7	60.4	58.7	59.1	58.9	57.9	60.1	58.4	56.9	59.1	1.3	0.9	2.6	0.9	1.3	1.1	0.1	2.3	0.6	-0.9	1.3
1479	B	66	57.0	58.4	58.1	59.6	58.1	58.4	58.1	57.2	59.1	57.8	56.4	58.4	1.4	1.1	2.6	1.1	1.4	1.1	0.2	2.1	0.8	-0.6	1.4
1480	B	66	60.4	61.6	60.8	64.4	60.8	61.6	61.3	61.9	64.1	60.7	59.2	61.6	1.2	0.4	4.0	0.4	1.2	0.9	1.5	3.7	0.3	-1.2	1.2
1481	B	66	59.0	60.2	59.6	62.6	59.6	60.2	59.9	60.4	62.3	59.5	58.1	60.2	1.2	0.6	3.6	0.6	1.2	0.9	1.4	3.3	0.5	-0.9	1.2
1482	B	66	57.9	59.0	58.6	61.1	58.6	59.0	58.8	59.0	60.7	58.5	57.0	59.0	1.1	0.7	3.2	0.7	1.1	0.9	1.1	2.8	0.6	-0.9	1.1
1483	B	66	57.0	58.2	57.9	60.0	57.9	58.2	58.0	58.1	59.6	57.8	56.3	58.2	1.2	0.9	3.0	0.9	1.2	1.0	1.1	2.6	0.8	-0.7	1.2
1484	B	66	56.2	57.4	57.2	58.9	57.1	57.4	57.2	57.2	58.5	57.0	55.6	57.4	1.2	1.0	2.7	0.9	1.2	1.0	1.0	2.3	0.8	-0.6	1.2
1485	B	66	57.2	58.3	58.0	60.2	58.0	58.3	58.1	59.6	60.0	57.9	56.6	58.3	1.1	0.8	3.0	0.8	1.1	0.9	2.4	2.8	0.7	-0.6	1.1
1486	B	66	59.8	65.6	64.5	60.8	64.5	65.6	65.6	64.5	60.8	64.5	60.7	65.6	5.8	4.7	1.0	4.7	5.8	5.8	4.7	1.0	4.7	0.9	5.8
1487	B	66	57.8	63.3	62.5	59.0	62.5	63.3	63.3	62.5	58.9	62.5	58.8	63.3	5.5	4.7	1.2	4.7	5.5	5.5	4.7	1.1	4.7	1.0	5.5
1488	B	66	59.8	66.0	64.9	60.9	64.9	66.0	66.0	64.9	60.8	64.9	60.8	66.0	6.2	5.1	1.1	5.1	6.2	6.2	5.1	1.0	5.1	1.0	6.2
1489	B	66	57.5	63.3	62.6	58.8	62.6	63.3	63.3	62.6	58.7	62.6	58.6	63.3	5.8	5.1	1.3	5.1	5.8	5.8	5.1	1.2	5.1	1.1	5.8
1490	B	66	56.8	61.5	60.9	58.1	60.9	61.5	61.5	60.9	58.1	60.9	57.9	61.5	4.7	4.1	1.3	4.1	4.7	4.7	4.1	1.3	4.1	1.1	4.7
1491	B	66	56.7	61.9	61.3	58.0	61.3	61.9	61.8	61.3	57.9	61.3	57.8	61.9	5.2	4.6	1.3	4.6	5.2	5.1	4.6	1.2	4.6	1.1	5.2
1492	B	66	56.6	62.3	61.8	57.9	61.8	62.3	62.3	61.8	57.8	61.8	57.7	62.3	5.7	5.2	1.3	5.2	5.7	5.7	5.2	1.2	5.2	1.1	5.7
1493	B	66	56.5	62.6	62.1	57.8	62.1	62.6	62.6	62.1	57.7	62.1	57.6	62.6	6.1	5.6	1.3	5.6	6.1	6.1	5.6	1.2	5.6	1.1	6.1
1494	B	66	53.6	58.5	58.2	55.1	58.2	58.5	58.5	58.2	55.0	58.2	54.7	58.5	4.9	4.6	1.5	4.6	4.9	4.9	4.6	1.4	4.6	1.1	4.9
1495	B	66	53.4	58.5	58.2	54.9	58.2	58.5	58.4	58.2	54.8	58.2	54.6	58.5	5.1	4.8	1.5	4.8	5.1	5.0	4.8	1.4	4.8	1.2	5.1
1496	B	66	53.4	58.5	58.3	54.9	58.3	58.5	58.5	58.2	54.8	58.2	54.6	58.5	5.1	4.9	1.5	4.9	5.1	5.1	4.8	1.4	4.8	1.2	5.1
1497	B	66	53.5	58.6	58.4	55.2	58.4	58.6	58.6	58.4	55.1	58.4	54.9	58.6	5.1	4.9	1.7	4.9	5.1	5.1	4.9	1.6	4.9	1.4	5.1
1498	B	66	53.0	58.0	57.7	54.6	57.7	58.0	58.0	57.7	54.5	57.7	54.2	58.0	5.0	4.7	1.6	4.7	5.0	5.0	4.7	1.5	4.7	1.2	5.0
1499	B	66	53.0	58.0	57.7	54.5	57.7	58.0	58.0	57.7	54.4	57.7	54.1	58.0	5.0	4.7	1.5	4.7	5.0	5.0	4.7	1.4	4.7	1.1	5.0
1500	B	66	52.9	58.0	57.9	54.6	57.9	58.0	58.0	57.8	54.4	57.8	54.2	58.0	5.1	5.0	1.7	5.0	5.1	5.1	4.9	1.5	4.9	1.3	5.1
1501	B	66	64.2	72.3	71.4	65.2	71.4	72.3	72.3	71.4	65.2	71.4	65.2	72.3	8.1	7.2	1.0	7.2	8.1	8.1	7.2	1.0	7.2	1.0	8.1
1502	B	66	60.4	68.2	67.2	61.5	67.2	68.2	68.2	67.2	61.5	67.2	61.4	68.2	7.8	6.8	1.1	6.8	7.8	7.8	6.8	1.1	6.8	1.0	7.8
1503	B	66	58.2	65.5	64.7	59.4	64.7	65.5	65.5	64.7	59.4	64.7	59.3	65.6	7.3	6.5	1.2	6.5	7.3	7.3	6.5	1.2	6.5	1.1	7.4
1504	B	66	56.8	63.5	62.9	58.1	62.9	63.5	63.5	62.9	58.0	62.9	57.9	63.5	6.7	6.1	1.3	6.1	6.7	6.7	6.1	1.2	6.1	1.1	6.7

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1505	B	66	56.2	62.4	62.0	57.6	62.0	62.4	62.4	62.0	57.5	62.0	57.4	62.4	6.2	5.8	1.4	5.8	6.2	6.2	5.8	1.3	5.8	1.2	6.2
1506	B	66	64.2	70.9	70.0	65.2	70.0	70.9	70.9	70.0	65.2	70.0	65.2	70.9	6.7	5.8	1.0	5.8	6.7	6.7	5.8	1.0	5.8	1.0	6.7
1507	B	66	60.6	67.3	66.4	61.7	66.4	67.3	67.3	66.4	61.7	66.4	61.7	67.3	6.7	5.8	1.1	5.8	6.7	6.7	5.8	1.1	5.8	1.1	6.7
1508	B	66	58.5	65.1	64.2	59.7	64.2	65.1	65.1	64.2	59.7	64.2	59.6	65.1	6.6	5.7	1.2	5.7	6.6	6.6	5.7	1.2	5.7	1.1	6.6
1509	B	66	57.0	63.0	62.5	58.3	62.5	63.0	63.0	62.5	58.3	62.5	58.2	63.0	6.0	5.5	1.3	5.5	6.0	6.0	5.5	1.3	5.5	1.2	6.0
1510	B	66	56.1	61.8	61.4	57.5	61.4	61.8	61.7	61.4	57.5	61.4	57.4	61.8	5.7	5.3	1.4	5.3	5.7	5.6	5.3	1.4	5.3	1.3	5.7
1511	B	66	54.0	59.3	59.3	55.5	59.3	59.4	59.3	59.3	55.5	59.3	55.3	59.4	5.3	5.3	1.5	5.3	5.4	5.3	5.3	1.5	5.3	1.3	5.4
1512	B	66	53.4	58.5	58.5	55.0	58.5	58.5	58.5	58.4	54.9	58.4	54.7	58.5	5.1	5.1	1.6	5.1	5.1	5.1	5.0	1.5	5.0	1.3	5.1
1513	B	66	52.9	57.8	57.8	54.5	57.8	57.8	57.8	57.7	54.4	57.7	54.2	57.8	4.9	4.9	1.6	4.9	4.9	4.9	4.8	1.5	4.8	1.3	4.9
1514	B	66	53.7	59.0	58.9	55.3	58.9	59.0	59.0	58.9	55.2	58.9	55.1	59.0	5.3	5.2	1.6	5.2	5.3	5.3	5.2	1.5	5.2	1.4	5.3
1515	B	66	53.8	59.0	59.0	55.4	59.0	59.0	59.0	58.9	55.4	58.9	55.2	59.0	5.2	5.2	1.6	5.2	5.2	5.2	5.1	1.6	5.1	1.4	5.2
1516	B	66	53.9	59.0	58.9	55.5	58.9	59.0	59.0	58.9	55.4	58.9	55.3	59.0	5.1	5.0	1.6	5.0	5.1	5.1	5.0	1.5	5.0	1.4	5.1
1517	B	66	60.3	65.2	64.3	61.5	64.3	65.2	65.2	64.3	61.5	64.3	61.4	65.2	4.9	4.0	1.2	4.0	4.9	4.9	4.0	1.2	4.0	1.1	4.9
1518	B	66	58.4	63.2	62.5	59.7	62.5	63.2	63.2	62.5	59.7	62.5	59.7	63.2	4.8	4.1	1.3	4.1	4.8	4.8	4.1	1.3	4.1	1.3	4.8
1519	B	66	58.8	62.7	62.0	60.3	62.0	62.7	62.7	62.0	60.3	62.0	60.3	62.7	3.9	3.2	1.5	3.2	3.9	3.9	3.2	1.5	3.2	1.5	3.9
1520	B	66	57.4	61.2	60.8	59.1	60.8	61.2	61.2	60.8	59.1	60.8	59.1	61.2	3.8	3.4	1.7	3.4	3.8	3.8	3.4	1.7	3.4	1.7	3.8
1521	B	66	57.3	61.9	61.4	58.8	61.4	61.9	61.9	61.4	58.7	61.4	58.7	61.9	4.6	4.1	1.5	4.1	4.6	4.6	4.1	1.4	4.1	1.4	4.6
1522	B	66	56.2	60.6	60.3	57.8	60.3	60.6	60.6	60.3	57.8	60.3	57.7	60.6	4.4	4.1	1.6	4.1	4.4	4.4	4.1	1.6	4.1	1.5	4.4
1523	B	66	56.3	60.4	60.1	58.1	60.1	60.4	60.3	60.1	58.0	60.1	58.0	60.4	4.1	3.8	1.8	3.8	4.1	4.0	3.8	1.7	3.8	1.7	4.1
1524	B	66	53.8	58.5	58.4	55.6	58.4	58.5	58.5	58.4	55.5	58.4	55.4	58.5	4.7	4.6	1.8	4.6	4.7	4.7	4.6	1.7	4.6	1.6	4.7
1525	B	66	53.9	58.5	58.4	55.8	58.4	58.5	58.5	58.4	55.8	58.4	55.7	58.5	4.6	4.5	1.9	4.5	4.6	4.6	4.5	1.9	4.5	1.8	4.6
1526	B	66	53.9	58.4	58.3	55.9	58.3	58.4	58.3	58.2	55.9	58.3	55.8	58.4	4.5	4.4	2.0	4.4	4.5	4.4	4.3	2.0	4.4	1.9	4.5
1527	B	66	53.9	58.3	58.2	56.0	58.2	58.3	58.3	58.2	56.0	58.2	55.9	58.3	4.4	4.3	2.1	4.3	4.4	4.4	4.3	2.1	4.3	2.0	4.4
1528	B	66	54.0	58.4	58.3	56.4	58.3	58.4	58.4	58.2	56.3	58.2	56.3	58.4	4.4	4.3	2.4	4.3	4.4	4.4	4.2	2.3	4.2	2.3	4.4
1529	B	66	52.7	57.2	57.1	55.1	57.1	57.2	57.2	57.1	55.1	57.1	55.0	57.2	4.5	4.4	2.4	4.4	4.5	4.5	4.4	2.4	4.4	2.3	4.5
1530	B	66	52.6	57.3	57.3	54.6	57.2	57.3	57.3	57.2	54.5	57.2	54.5	57.3	4.7	4.7	2.0	4.6	4.7	4.7	4.6	1.9	4.6	1.9	4.7
1531	B	66	54.1	58.7	58.6	57.1	58.6	58.7	58.6	58.5	57.0	58.5	57.0	58.7	4.6	4.5	3.0	4.5	4.6	4.5	4.4	2.9	4.4	2.9	4.6
1532	B	66	54.2	58.8	58.7	57.3	58.7	58.8	58.8	58.7	57.2	58.7	57.2	58.8	4.6	4.5	3.1	4.5	4.6	4.6	4.5	3.0	4.5	3.0	4.6
1533	B	66	54.1	58.9	58.8	57.5	58.8	58.9	58.9	58.8	57.5	58.8	57.4	58.9	4.8	4.7	3.4	4.7	4.8	4.8	4.7	3.4	4.7	3.3	4.8
1534	B	66	54.2	59.2	59.2	57.9	59.2	59.2	59.2	59.1	57.9	59.1	57.8	59.2	5.0	5.0	3.7	5.0	5.0	5.0	4.9	3.7	4.9	3.6	5.0
1535	B	66	54.3	59.6	59.5	58.3	59.5	59.6	59.5	59.5	58.3	59.5	58.2	59.6	5.3	5.2	4.0	5.2	5.3	5.2	5.2	4.0	5.2	3.9	5.3
1536	B	66	53.4	59.3	59.2	58.1	59.2	59.3	59.3	59.2	58.1	59.2	58.1	59.3	5.9	5.8	4.7	5.8	5.9	5.9	5.8	4.7	5.8	4.7	5.9
1537	B	66	54.4	61.7	61.6	60.7	61.7	61.7	61.7	61.6	60.7	61.6	60.7	61.7	7.3	7.2	6.3	7.3	7.3	7.3	7.2	6.3	7.2	6.3	7.3
1538	B	66	54.5	66.2	66.2	65.8	66.2	66.2	66.2	66.2	65.8	66.2	65.8	66.2	11.7	11.7	11.3	11.7	11.7	11.7	11.7	11.3	11.7	11.3	11.7
1539	B	66	54.4	*Acquisition*	*Acquisition*	*Acquisition*	*Acquisition*	*Acquisition*	*Acquisition*	*Acquisition*	*Acquisition*	*Acquisition*	*Acquisition*	*Acquisition*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1540	B	66	53.0	64.3	64.4	64.0	64.4	64.3	64.3	64.4	64.0	64.4	64.0	64.3	11.3	11.4	11.0	11.4	11.3	11.3	11.4	11.0	11.4	11.0	11.3
1541	B	66	53.2	61.4	61.4	60.6	61.4	61.4	61.4	61.4	60.6	61.4	60.6	61.4	8.2	8.2	7.4	8.2	8.2	8.2	8.2	7.4	8.2	7.4	8.2
1542	B	66	58.4	65.8	65.3	64.3	65.3	65.8	65.8	65.3	64.3	65.3	64.3	65.8	7.4	6.9	5.9	6.9	7.4	7.4	6.9	5.9	6.9	5.9	7.4
1543	B	66	57.5	64.5	64.1	63.0	64.1	64.5	64.5	64.1	63.0	64.1	63.0	64.5	7.0	6.6	5.5	6.6	7.0	7.0	6.6	5.5	6.6	5.5	7.0
1544	B	66	57.3	62.9	62.5	61.3	62.5	62.9	62.9	62.5	61.2	62.5	61.2	62.9	5.6	5.2	4.0	5.2	5.6	5.6	5.2	3.9	5.2	3.9	5.6
1545	B	66	56.9	61.3	60.8	59.8	60.8	61.3	61.3	60.8	59.8	60.8	59.8	61.3	4.4	3.9	2.9	3.9	4.4	4.4	3.9	2.9	3.9	2.9	4.4
1546	B	66	56.9	61.2	60.6	59.7	60.6	61.2	61.2	60.6	59.7	60.6	59.6	61.2	4.3	3.7	2.8	3.7	4.3	4.3	3.7	2.8	3.7	2.7	4.3
1547	B	66	56.6	60.7	60.1	59.3	60.1	60.7	60.7	60.1	59.3	60.1	59.2	60.7	4.1	3.5	2.7	3.5	4.1	4.1	3.5	2.7	3.5	2.6	4.1
1548	B	66	56.7	60.5	60.0	59.1	60.0	60.5	60.5	60.0	59.1	60.0	59.1	60.5	3.8	3.3	2.4	3.3	3.8	3.8	3.3	2.4	3.3	2.4	3.8
1549	B	66	57.6	61.2	60.5	59.6	60.5	61.2	61.2	60.5	59.6	60.5	59.6	61.2	3.6	2.9	2.0	2.9	3.6	3.6	2.9	2.0	2.9	2.0	3.6
1550	B	66	53.9	59.2	59.0	58.0	59.0	59.2	59.2	59.0	58.0	59.0	57.9	59.2	5.3	5.1	4.1	5.1	5.3	5.3	5.1	4.1	5.1	4.0	5.3
1551	B	66	53.9	59.0	58.8	57.8	58.8	59.0	59.0	58.8	57.7	58.7	57.6	59.0	5.1	4.9	3.9	4.9	5.1	5.1	4.9	3.8	4.8	3.7	5.1

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1552	B	66	53.8	58.8	58.6	57.5	58.6	58.8	58.8	58.5	57.5	58.5	57.4	58.8	5.0	4.8	3.7	4.8	5.0	5.0	4.7	3.7	4.7	3.6	5.0
1553	B	66	53.8	58.5	58.3	57.3	58.3	58.5	58.5	58.3	57.3	58.2	57.2	58.5	4.7	4.5	3.5	4.5	4.7	4.7	4.5	3.5	4.4	3.4	4.7
1554	B	66	53.8	58.1	57.9	56.9	57.9	58.1	58.1	57.9	56.9	57.8	56.8	58.1	4.3	4.1	3.1	4.1	4.3	4.3	4.1	3.1	4.0	3.0	4.3
1555	D	51	40.9	37.5	37.4	42.2	37.4	37.5	37.5	37.8	38.7	37.4	37.4	37.5	-3.4	-3.5	1.3	-3.5	-3.4	-3.4	-3.1	-2.2	-3.5	-3.5	-3.4
1562	B	66	58.6	57.0	56.7	59.9	56.7	57.0	57.0	57.5	57.5	56.7	56.6	57.0	-1.6	-1.9	1.3	-1.9	-1.6	-1.6	-1.1	-1.1	-1.9	-2.0	-1.6
1563	B	66	57.9	56.7	56.2	59.3	56.2	56.7	56.7	57.1	56.9	56.3	56.1	56.6	-1.2	-1.7	1.4	-1.7	-1.2	-1.2	-0.8	-1.0	-1.6	-1.8	-1.3
1564	B	66	57.2	56.3	55.8	58.7	55.7	56.3	56.3	56.5	56.4	55.8	55.6	56.2	-0.9	-1.4	1.5	-1.5	-0.9	-0.9	-0.7	-0.8	-1.4	-1.6	-1.0
1566	B	66	58.7	56.9	56.5	60.0	56.5	56.9	56.9	57.3	57.4	56.6	56.4	56.9	-1.8	-2.2	1.3	-2.2	-1.8	-1.8	-1.4	-1.3	-2.1	-2.3	-1.8
1567	B	66	58.0	56.5	56.1	59.4	56.1	56.5	56.5	56.8	56.8	56.1	56.0	56.5	-1.5	-1.9	1.4	-1.9	-1.5	-1.5	-1.2	-1.2	-1.9	-2.0	-1.5
1568	B	66	57.3	56.1	55.6	58.7	55.6	56.1	56.1	56.3	56.2	55.6	55.5	56.1	-1.2	-1.7	1.4	-1.7	-1.2	-1.2	-1.0	-1.1	-1.7	-1.8	-1.2
1570	B	66	58.6	56.7	56.4	59.9	56.4	56.7	56.6	57.1	57.1	56.3	56.2	56.7	-1.9	-2.2	1.3	-2.2	-1.9	-2.0	-1.5	-1.5	-2.3	-2.4	-1.9
1571	B	66	57.8	56.3	55.9	59.2	55.9	56.3	56.2	56.5	56.5	55.8	55.7	56.3	-1.5	-1.9	1.4	-1.9	-1.5	-1.6	-1.3	-1.3	-2.0	-2.1	-1.5
1572	B	66	57.2	55.9	55.4	58.6	55.4	55.9	55.8	56.0	56.0	55.4	55.2	55.9	-1.3	-1.8	1.4	-1.8	-1.3	-1.4	-1.2	-1.2	-1.8	-2.0	-1.3
1574	B	66	58.7	56.6	56.3	60.0	56.3	56.6	56.5	56.8	57.1	56.2	56.0	56.6	-2.1	-2.4	1.3	-2.4	-2.1	-2.2	-1.9	-1.6	-2.5	-2.7	-2.1
1575	B	66	58.0	56.1	55.7	59.3	55.7	56.1	56.0	56.3	56.5	55.7	55.5	56.1	-1.9	-2.3	1.3	-2.3	-1.9	-2.0	-1.7	-1.5	-2.3	-2.5	-1.9
1576	B	66	57.4	55.7	55.3	58.8	55.3	55.7	55.6	55.8	56.0	55.3	55.1	55.7	-1.7	-2.1	1.4	-2.1	-1.7	-1.8	-1.6	-1.4	-2.1	-2.3	-1.7
1578	B	66	58.4	56.1	55.8	59.9	55.8	56.1	56.0	56.0	56.6	55.9	55.7	56.1	-2.3	-2.6	1.5	-2.6	-2.3	-2.4	-2.4	-1.8	-2.5	-2.7	-2.3
1579	B	66	55.1	54.5	53.8	56.5	53.7	54.5	54.4	53.7	54.8	53.8	53.7	54.5	-0.6	-1.3	1.4	-1.4	-0.6	-0.7	-1.4	-0.3	-1.3	-1.4	-0.6
1580	B	66	56.0	55.1	54.5	57.3	54.5	55.1	55.0	54.4	55.6	54.5	54.4	55.1	-0.9	-1.5	1.3	-1.5	-0.9	-1.0	-1.6	-0.4	-1.5	-1.6	-0.9
1581	B	66	56.8	55.5	55.1	58.1	55.1	55.5	55.5	55.0	56.2	55.1	55.1	55.5	-1.3	-1.7	1.3	-1.7	-1.3	-1.3	-1.8	-0.6	-1.7	-1.7	-1.3
1582	B	66	55.5	54.4	53.8	56.8	53.8	54.4	54.4	53.7	54.7	53.8	53.8	54.4	-1.1	-1.7	1.3	-1.7	-1.1	-1.1	-1.8	-0.8	-1.7	-1.7	-1.1
1583	B	66	59.3	56.9	56.6	60.4	56.6	56.9	56.9	56.5	58.2	56.6	56.9	56.9	-2.4	-2.7	1.1	-2.7	-2.4	-2.4	-2.8	-1.1	-2.7	-2.4	-2.4
1584	B	66	57.9	55.9	55.5	59.1	55.5	55.9	55.9	55.5	56.8	55.5	55.8	55.9	-2.0	-2.4	1.2	-2.4	-2.0	-2.0	-2.4	-1.1	-2.4	-2.1	-2.0
1585	B	66	56.8	55.2	54.7	58.1	54.7	55.2	55.1	54.6	55.8	54.7	54.8	55.2	-1.6	-2.1	1.3	-2.1	-1.6	-1.7	-2.2	-1.0	-2.1	-2.0	-1.6
1586	B	66	56.0	54.5	53.8	57.3	53.8	54.5	54.4	53.8	54.9	53.8	54.0	54.5	-1.5	-2.2	1.3	-2.2	-1.5	-1.6	-2.2	-1.1	-2.2	-2.0	-1.5
1588	B	66	62.1	58.9	58.2	62.6	58.2	58.9	58.9	58.2	60.0	58.2	59.1	58.9	-3.2	-3.9	0.5	-3.9	-3.2	-3.2	-3.9	-2.1	-3.9	-3.0	-3.2
1589	B	66	61.2	58.2	57.6	61.9	57.6	58.2	58.2	57.6	59.3	57.6	58.4	58.2	-3.0	-3.6	0.7	-3.6	-3.0	-3.0	-3.6	-1.9	-3.6	-2.8	-3.0
1590	B	66	60.5	57.6	57.1	61.4	57.1	57.6	57.6	57.1	58.9	57.1	57.8	57.6	-2.9	-3.4	0.9	-3.4	-2.9	-2.9	-3.4	-1.6	-3.4	-2.7	-2.9
1591	B	66	59.9	57.1	56.7	60.9	56.7	57.1	57.1	56.7	58.4	56.7	57.2	57.1	-2.8	-3.2	1.0	-3.2	-2.8	-2.8	-3.2	-1.5	-3.2	-2.7	-2.8
1592	B	66	60.8	57.6	57.2	61.7	57.2	57.6	57.6	57.1	58.9	57.1	57.9	57.6	-3.2	-3.6	0.9	-3.6	-3.2	-3.2	-3.7	-1.9	-3.7	-2.9	-3.2
1593	B	66	60.2	57.1	56.7	61.2	56.7	57.1	57.1	56.7	58.5	56.7	57.3	57.1	-3.1	-3.5	1.0	-3.5	-3.1	-3.1	-3.5	-1.7	-3.5	-2.9	-3.1
1594	B	66	59.6	56.6	56.3	60.6	56.3	56.6	56.6	56.3	57.9	56.3	56.8	56.6	-3.0	-3.3	1.0	-3.3	-3.0	-3.0	-3.3	-1.7	-3.3	-2.8	-3.0
1595	B	66	58.7	56.0	55.7	59.8	55.7	56.0	56.0	55.7	57.2	55.7	56.2	56.0	-2.7	-3.0	1.1	-3.0	-2.7	-2.7	-3.0	-1.5	-3.0	-2.5	-2.7
1596	B	66	56.8	54.2	53.8	58.0	53.8	54.2	54.2	53.8	55.0	53.8	54.2	54.2	-2.6	-3.0	1.2	-3.0	-2.6	-2.6	-3.0	-1.8	-3.0	-2.6	-2.6
1598	B	66	56.1	54.0	53.4	57.3	53.4	54.0	54.0	53.4	54.5	53.4	53.7	54.0	-2.1	-2.7	1.2	-2.7	-2.1	-2.1	-2.7	-1.6	-2.7	-2.4	-2.1
1599	B	66	56.7	54.5	54.0	57.9	54.0	54.5	54.5	54.0	55.1	54.0	54.3	54.5	-2.2	-2.7	1.2	-2.7	-2.2	-2.2	-2.7	-1.6	-2.7	-2.4	-2.2
1600	B	66	58.1	55.2	54.9	59.2	54.9	55.2	55.2	54.9	56.2	54.9	55.3	55.2	-2.9	-3.2	1.1	-3.2	-2.9	-2.9	-3.2	-1.9	-3.2	-2.8	-2.9
1601	B	66	57.8	55.1	54.8	58.9	54.8	55.1	55.1	54.8	56.0	54.8	55.1	55.1	-2.7	-3.0	1.1	-3.0	-2.7	-2.7	-3.0	-1.8	-3.0	-2.7	-2.7
1602	B	66	57.7	55.1	54.8	58.9	54.8	55.1	55.1	54.7	56.0	54.8	55.2	55.1	-2.6	-2.9	1.2	-2.9	-2.6	-2.6	-3.0	-1.7	-2.9	-2.5	-2.6
1603	B	66	57.5	55.1	54.7	58.7	54.7	55.1	55.0	54.6	55.9	54.7	55.0	55.1	-2.4	-2.8	1.2	-2.8	-2.4	-2.5	-2.9	-1.6	-2.8	-2.5	-2.4
1604	B	66	59.4	56.1	55.9	60.5	55.9	56.1	56.1	55.8	57.5	55.9	56.4	56.1	-3.3	-3.5	1.1	-3.5	-3.3	-3.3	-3.6	-1.9	-3.5	-3.0	-3.3
1605	B	66	59.2	56.0	55.8	60.2	55.8	56.0	56.0	55.8	57.4	55.8	56.3	56.0	-3.2	-3.4	1.0	-3.4	-3.2	-3.2	-3.4	-1.8	-3.4	-2.9	-3.2
1606	B	66	58.9	55.9	55.6	60.0	55.6	55.9	55.9	55.6	57.2	55.6	56.2	55.9	-3.0	-3.3	1.1	-3.3	-3.0	-3.0	-3.3	-1.7	-3.3	-2.7	-3.0
1607	B	66	58.7	55.9	55.6	59.8	55.6	55.9	55.9	55.6	57.1	55.6	56.1	55.9	-2.8	-3.1	1.1	-3.1	-2.8	-2.8	-3.1	-1.6	-3.1	-2.6	-2.8
1608	C	66	56.7	54.9	54.6	58.3	54.6	54.9	54.9	54.8	54.8	54.6	54.4	54.9	-1.8	-2.1	1.6	-2.1	-1.8	-1.8	-1.9	-1.9	-2.1	-2.3	-1.8
1609	B	66	62.3	70.1	70.0	70.1	70.0	70.1	70.1	69.7	70.0	69.0	68.9	70.1	7.8	7.7	7.8	7.7	7.8	7.8	7.4	7.7	6.7	6.6	7.8
1610	B	66	61.8	70.1	70.1	70.1	70.1	70.1	70.1	69.8	70.0	69.3	69.3	70.1	8.3	8.3	8.3	8.3	8.3	8.3	8.0	8.2	7.5	7.5	8.3

Receptor ID	Land Use	NAC dB(A)	2012 Existing	Hourly Leq(h) dBA 2035 Build											Difference between Existing/Build										
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1611	B	66	61.4	70.5	70.5	70.5	70.5	70.5	70.4	70.2	70.4	69.6	69.6	70.5	9.1	9.1	9.1	9.1	9.1	9.0	8.8	9.0	8.2	8.2	9.1
1612	B	66	61.0	70.9	70.9	70.9	70.9	70.9	70.9	70.7	70.9	69.8	69.8	70.9	9.9	9.9	9.9	9.9	9.9	9.9	9.7	9.9	8.8	8.8	9.9
1613	B	66	62.5	66.7	66.5	66.5	66.5	66.7	66.5	65.7	66.4	65.8	65.8	66.7	4.2	4.0	4.0	4.0	4.2	4.0	3.2	3.9	3.3	3.3	4.2
1614	B	66	62.2	66.7	66.6	66.6	66.6	66.7	66.6	65.9	66.5	65.9	65.8	66.7	4.5	4.4	4.4	4.4	4.5	4.4	3.7	4.3	3.7	3.6	4.5
1615	B	66	61.7	66.5	66.5	66.5	66.5	66.5	66.3	65.8	66.2	65.8	65.7	66.5	4.8	4.8	4.8	4.8	4.8	4.6	4.1	4.5	4.1	4.0	4.8
1616	B	66	61.2	66.4	66.4	66.3	66.4	66.4	66.2	65.7	66.1	65.7	65.7	66.4	5.2	5.2	5.1	5.2	5.2	5.0	4.5	4.9	4.5	4.5	5.2
1617	B	66	54.9	54.6	54.3	56.6	54.3	54.6	54.6	54.2	54.9	54.3	54.1	54.6	-0.3	-0.6	1.7	-0.6	-0.3	-0.3	-0.7	0.0	-0.6	-0.8	-0.3
1618	B	66	55.7	55.3	54.9	57.3	54.9	55.3	55.2	54.8	55.6	54.9	54.8	55.3	-0.4	-0.8	1.6	-0.8	-0.4	-0.5	-0.9	-0.1	-0.8	-0.9	-0.4
1619	B	66	56.7	56.1	55.7	58.3	55.7	56.1	56.1	55.7	56.7	55.7	55.7	56.1	-0.6	-1.0	1.6	-1.0	-0.6	-0.6	-1.0	0.0	-1.0	-1.0	-0.6
1620	B	66	58.1	57.3	56.9	59.6	56.9	57.3	57.3	56.9	58.1	56.9	57.0	57.3	-0.8	-1.2	1.5	-1.2	-0.8	-0.8	-1.2	0.0	-1.2	-1.1	-0.8
1621	B	66	59.7	58.9	58.3	61.1	58.3	58.9	58.9	58.3	59.7	58.3	58.6	58.9	-0.8	-1.4	1.4	-1.4	-0.8	-0.8	-1.4	0.0	-1.4	-1.1	-0.8
1622	B	66	60.3	59.9	59.1	61.6	59.1	59.9	59.9	59.1	60.3	59.1	59.2	59.9	-0.4	-1.2	1.3	-1.2	-0.4	-0.4	-1.2	0.0	-1.2	-1.1	-0.4
1623	B	66	60.8	60.5	59.6	62.1	59.6	60.5	60.5	59.6	60.7	59.6	59.7	60.5	-0.3	-1.2	1.3	-1.2	-0.3	-0.3	-1.2	-0.1	-1.2	-1.1	-0.3
1624	B	66	60.6	60.1	59.2	61.8	59.2	60.1	60.1	59.2	60.4	59.2	59.3	60.1	-0.5	-1.4	1.2	-1.4	-0.5	-0.5	-1.4	-0.2	-1.4	-1.3	-0.5
1625	B	66	60.5	60.0	59.1	61.7	59.1	60.0	60.0	59.1	60.2	59.1	59.3	60.0	-0.5	-1.4	1.2	-1.4	-0.5	-0.5	-1.4	-0.3	-1.4	-1.2	-0.5
1626	B	66	60.8	60.2	59.2	62.0	59.2	60.2	60.2	59.2	60.4	59.2	59.4	60.2	-0.6	-1.6	1.2	-1.6	-0.6	-0.6	-1.6	-0.4	-1.6	-1.4	-0.6
1627	B	66	60.7	60.0	59.0	62.0	59.0	60.0	60.0	59.0	60.3	59.0	59.3	60.0	-0.7	-1.7	1.3	-1.7	-0.7	-0.7	-1.7	-0.4	-1.7	-1.4	-0.7
1628	B	66	60.8	60.0	59.0	62.1	59.0	60.0	60.0	58.9	60.3	59.0	59.2	60.0	-0.8	-1.8	1.3	-1.8	-0.8	-0.8	-1.9	-0.5	-1.8	-1.6	-0.8
1629	B	66	61.2	60.3	59.2	62.6	59.2	60.3	60.3	59.2	60.6	59.2	59.6	60.3	-0.9	-2.0	1.4	-2.0	-0.9	-0.9	-2.0	-0.6	-2.0	-1.6	-0.9
1630	B	66	61.1	60.0	59.0	62.5	59.0	60.0	60.0	59.0	60.4	59.0	59.3	60.0	-1.1	-2.1	1.4	-2.1	-1.1	-1.1	-2.1	-0.7	-2.1	-1.8	-1.1
1631	B	66	61.4	60.1	59.1	62.9	59.1	60.1	60.1	59.0	60.7	59.1	59.5	60.1	-1.3	-2.3	1.5	-2.3	-1.3	-1.3	-2.4	-0.7	-2.3	-1.9	-1.3
1632	B	66	61.4	59.8	58.9	62.8	58.9	59.8	59.8	58.8	60.6	58.9	59.4	59.8	-1.6	-2.5	1.4	-2.5	-1.6	-1.6	-2.6	-0.8	-2.5	-2.0	-1.6
1633	B	66	61.5	59.8	58.8	63.0	58.8	59.8	59.8	58.8	60.6	58.8	59.4	59.8	-1.7	-2.7	1.5	-2.7	-1.7	-1.7	-2.7	-0.9	-2.7	-2.1	-1.7
1634	B	66	61.8	59.8	58.8	63.3	58.8	59.8	59.8	58.8	60.8	58.8	59.6	59.8	-2.0	-3.0	1.5	-3.0	-2.0	-2.0	-3.0	-1.0	-3.0	-2.2	-2.0
1635	B	66	61.9	59.7	58.7	63.5	58.7	59.7	59.7	58.7	60.9	58.7	59.6	59.7	-2.2	-3.2	1.6	-3.2	-2.2	-2.2	-3.2	-1.0	-3.2	-2.3	-2.2
1636	B	66	62.1	59.5	58.6	63.7	58.6	59.5	59.5	58.6	60.9	58.6	59.5	59.5	-2.6	-3.5	1.6	-3.5	-2.6	-2.6	-3.5	-1.2	-3.5	-2.6	-2.6
1637	B	66	54.6	54.2	53.7	56.2	53.7	54.2	54.2	53.7	54.4	53.7	53.7	54.2	-0.4	-0.9	1.6	-0.9	-0.4	-0.4	-0.9	-0.2	-0.9	-0.9	-0.4
1638	B	66	55.6	55.2	54.7	57.1	54.7	55.2	55.2	54.7	55.4	54.7	54.6	55.2	-0.4	-0.9	1.5	-0.9	-0.4	-0.4	-0.9	-0.2	-0.9	-1.0	-0.4
1639	B	66	56.6	56.2	55.7	58.2	55.7	56.2	56.2	55.7	56.5	55.7	55.6	56.2	-0.4	-0.9	1.6	-0.9	-0.4	-0.4	-0.9	-0.1	-0.9	-1.0	-0.4
1640	B	66	56.6	56.1	55.8	58.1	55.8	56.1	56.1	55.8	56.4	55.8	55.7	56.1	-0.5	-0.8	1.5	-0.8	-0.5	-0.5	-0.8	-0.2	-0.8	-0.9	-0.5
1641	B	66	56.6	55.9	55.4	58.1	55.4	55.9	55.8	55.4	56.3	55.4	55.4	55.9	-0.7	-1.2	1.5	-1.2	-0.7	-0.8	-1.2	-0.3	-1.2	-1.2	-0.7
1642	B	66	56.7	55.9	55.4	58.2	55.4	55.9	55.9	55.4	56.3	55.4	55.5	55.9	-0.8	-1.3	1.5	-1.3	-0.8	-0.8	-1.3	-0.4	-1.3	-1.2	-0.8
1643	B	66	56.9	55.9	55.4	58.5	55.4	55.9	55.8	55.4	56.4	55.4	55.4	55.9	-1.0	-1.5	1.6	-1.5	-1.0	-1.1	-1.5	-0.5	-1.5	-1.5	-1.0
1644	B	66	56.0	55.1	54.6	57.6	54.6	55.1	55.1	54.6	55.5	54.6	54.6	55.1	-0.9	-1.4	1.6	-1.4	-0.9	-0.9	-1.4	-0.5	-1.4	-1.4	-0.9
1645	B	66	55.0	54.2	53.6	56.5	53.6	54.2	54.2	53.6	54.4	53.6	53.6	54.2	-0.8	-1.4	1.5	-1.4	-0.8	-0.8	-1.4	-0.6	-1.4	-1.4	-0.8
1646	B	66	57.4	55.9	55.4	59.0	55.4	55.9	55.9	55.4	56.7	55.4	55.6	55.9	-1.5	-2.0	1.6	-2.0	-1.5	-1.5	-2.0	-0.7	-2.0	-1.8	-1.5
1647	B	66	56.1	54.7	54.2	57.7	54.2	54.7	54.7	54.2	55.3	54.2	54.4	54.8	-1.4	-1.9	1.6	-1.9	-1.4	-1.4	-1.9	-0.8	-1.9	-1.7	-1.3
1649	B	66	57.7	55.4	54.9	59.3	54.9	55.4	55.3	54.9	56.5	54.9	55.4	55.4	-2.3	-2.8	1.6	-2.8	-2.3	-2.4	-2.8	-1.2	-2.8	-2.3	-2.3
1650	B	66	56.4	54.3	53.8	58.0	53.8	54.3	54.3	53.8	55.2	53.8	54.1	54.3	-2.1	-2.6	1.6	-2.6	-2.1	-2.1	-2.6	-1.2	-2.6	-2.3	-2.1
1651	B	66	55.6	53.8	53.3	57.2	53.3	53.8	53.8	53.2	54.5	53.3	53.6	53.8	-1.8	-2.3	1.6	-2.3	-1.8	-1.8	-2.4	-1.1	-2.3	-2.0	-1.8
1652	B	66	64.8	61.2	59.8	66.4	59.8	61.2	61.2	59.8	62.7	59.8	61.0	61.2	-3.6	-5.0	1.6	-5.0	-3.6	-3.6	-5.0	-2.1	-5.0	-3.8	-3.6
1653	B	66	65.4	62.5	61.0	66.9	61.0	62.5	62.5	61.0	63.6	61.0	61.9	62.5	-2.9	-4.4	1.5	-4.4	-2.9	-2.9	-4.4	-1.8	-4.4	-3.5	-2.9
1654	B	66	62.4	58.3	57.4	64.0	57.4	58.3	58.3	57.4	60.4	57.4	58.5	58.3	-4.1	-5.0	1.6	-5.0	-4.1	-4.1	-5.0	-2.0	-5.0	-3.9	-4.1
1655	B	66	62.9	59.6	58.5	64.5	58.5	59.6	59.5	58.5	61.3	58.5	59.6	59.6	-3.3	-4.4	1.6	-4.4	-3.3	-3.4	-4.4	-1.6	-4.4	-3.3	-3.3
1656	B	66	60.4	56.4	55.9	62.1	55.9	56.4	56.3	55.8	58.5	55.9	56.7	56.4	-4.0	-4.5	1.7	-4.5	-4.0	-4.1	-4.6	-1.9	-4.5	-3.7	-4.0
1657	B	66	61.0	57.5	56.9	62.7	56.9	57.5	57.5	56.8	59.4	56.9	57.8	57.5	-3.5	-4.1	1.7	-4.1	-3.5	-3.5	-4.2	-1.6	-4.1	-3.2	-3.5
1658	B	66	59.1	55.2	54.9	60.8	54.9	55.2	55.2	54.8	57.2	54.9	55.7	55.2	-3.9	-4.2	1.7	-4.2	-3.9	-3.9	-4.3	-1.9	-4.2	-3.4	-3.9

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA											Difference between Existing/Build									
			2012 Existing	2035 Build																			
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1659	B	66	59.5	56.1	55.7	61.2	55.7	56.1	56.1	55.7	57.9	55.7	56.5	56.1	-3.4	-3.8	1.7	-3.8	-3.4	-3.4	-3.8	-1.6	-3.8	-3.0	-3.4
1660	B	66	58.7	55.4	55.0	60.4	55.0	55.4	55.4	55.0	57.1	55.0	55.7	55.4	-3.3	-3.7	1.7	-3.7	-3.3	-3.3	-3.7	-1.6	-3.7	-3.0	-3.3
1661	B	66	57.6	54.5	54.0	59.2	54.0	54.5	54.4	54.0	55.9	54.0	54.6	54.5	-3.1	-3.6	1.6	-3.6	-3.1	-3.2	-3.6	-1.7	-3.6	-3.0	-3.1
1662	B	66	56.5	53.6	53.1	58.1	53.1	53.6	53.6	53.1	54.9	53.1	53.6	53.6	-2.9	-3.4	1.6	-3.4	-2.9	-2.9	-3.4	-1.6	-3.4	-2.9	-2.9
1663	B	66	58.2	54.0	53.6	59.9	53.6	54.0	54.0	53.6	56.0	53.6	54.4	54.0	-4.2	-4.6	1.7	-4.6	-4.2	-4.2	-4.6	-2.2	-4.6	-3.8	-4.2
1664	B	66	57.2	53.3	52.8	58.8	52.8	53.3	53.3	52.8	55.1	52.8	53.5	53.3	-3.9	-4.4	1.6	-4.4	-3.9	-3.9	-4.4	-2.1	-4.4	-3.7	-3.9
1666	B	66	65.7	67.3	67.3	67.3	67.3	67.3	67.2	67.2	67.2	68.3	68.3	67.3	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	2.6	2.6	1.6
1667	B	66	67.0	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	69.4	69.4	68.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.4	2.4	1.5
1668	B	66	68.2	69.8	69.8	69.8	69.8	69.8	69.8	69.8	69.8	70.5	70.5	69.8	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.3	2.3	1.6
1669	B	66	66.0	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	68.8	68.8	67.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.8	2.8	1.5
1670	B	66	66.9	68.5	68.5	68.5	68.5	68.5	68.5	68.5	68.5	69.6	69.6	68.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.7	2.7	1.6
1671	B	66	68.2	69.7	69.7	69.7	69.7	69.7	69.7	69.7	69.7	70.7	70.7	69.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.5	1.5
1672	B	66	69.7	71.3	71.3	71.3	71.3	71.3	71.2	71.2	71.2	72.0	72.0	71.3	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	2.3	2.3	1.6
1673	B	66	63.1	64.7	64.7	64.7	64.7	64.7	64.6	64.6	64.6	65.7	65.7	64.7	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	2.6	2.6	1.6
1674	B	66	62.3	63.9	63.9	63.9	63.9	63.9	63.8	63.8	63.8	64.8	64.8	63.9	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	2.5	2.5	1.6
1675	B	66	61.6	63.1	63.1	63.2	63.1	63.1	63.1	63.1	63.1	64.0	64.0	63.1	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5	2.4	2.4	1.5
1676	B	66	61.0	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	63.4	63.4	62.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.4	2.4	1.6
1677	B	66	63.1	64.6	64.6	64.6	64.6	64.6	64.6	64.6	64.6	65.8	65.8	64.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.7	2.7	1.5
1678	B	66	62.4	63.9	63.9	64.0	63.9	63.9	63.9	63.9	63.9	65.1	65.1	63.9	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5	2.7	2.7	1.5
1679	B	66	61.6	63.2	63.2	63.2	63.2	63.2	63.1	63.1	63.1	64.2	64.2	63.2	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	2.6	2.6	1.6
1680	B	66	61.0	62.6	62.6	62.6	62.6	62.6	62.6	62.6	62.6	63.7	63.6	62.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.7	2.6	1.6
1681	B	66	66.1	67.7	67.7	67.7	67.7	67.7	67.7	67.7	67.7	69.8	69.8	67.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.7	3.7	1.6
1682	B	66	65.4	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	69.1	69.1	67.0	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.7	3.7	1.6
1683	B	66	64.5	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	67.9	67.9	66.1	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.4	3.4	1.6
1684	B	66	64.0	65.5	65.5	65.5	65.5	65.5	65.5	65.5	65.5	67.2	67.2	65.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	3.2	3.2	1.5
1685	B	66	67.7	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	71.2	71.2	69.3	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	3.5	3.5	1.6
1686	B	66	67.0	68.5	68.6	68.6	68.6	68.5	68.5	68.5	68.5	70.6	70.6	68.6	1.5	1.6	1.6	1.6	1.5	1.5	1.5	1.5	3.6	3.6	1.6
1687	B	66	65.8	67.4	67.4	67.4	67.4	67.4	67.3	67.3	67.3	69.3	69.3	67.4	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	3.5	3.5	1.6
1688	B	66	65.2	66.8	66.8	66.8	66.8	66.8	66.7	66.7	66.7	68.6	68.6	66.8	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	3.4	3.4	1.6
1689	B	66	62.1	63.7	63.7	63.7	63.7	63.7	63.6	63.6	63.7	65.7	65.7	63.7	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.6	3.6	3.6	1.6
1690	B	66	61.7	63.4	63.4	63.4	63.4	63.4	63.3	63.3	63.3	65.7	65.7	63.4	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	4.0	4.0	1.7
1691	B	66	61.2	62.8	62.8	62.8	62.8	62.8	62.7	62.7	62.7	66.2	66.2	62.8	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	5.0	5.0	1.6
1692	B	66	60.8	62.4	62.4	62.5	62.4	62.4	62.4	62.4	62.4	67.6	67.6	62.4	1.6	1.6	1.7	1.6	1.6	1.6	1.6	1.6	6.8	6.8	1.6
1693	B	66	62.8	64.4	64.4	64.4	64.4	64.4	64.4	64.3	64.4	66.3	66.3	64.4	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.6	3.5	3.5	1.6
1694	B	66	62.5	64.1	64.1	64.1	64.1	64.1	64.0	64.0	64.0	66.0	66.0	64.1	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	3.5	3.5	1.6
1695	B	66	61.9	63.5	63.5	63.5	63.5	63.5	63.5	63.4	63.5	65.7	65.7	63.5	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.6	3.8	3.8	1.6
1696	B	66	61.5	63.2	63.2	63.2	63.2	63.2	63.1	63.1	63.1	65.8	65.8	63.2	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	4.3	4.3	1.7
1697	B	66	61.4	63.1	63.1	63.1	63.1	63.1	63.0	63.0	63.0	65.6	65.5	63.1	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	4.2	4.1	1.7
1698	B	66	60.8	62.5	62.5	62.5	62.5	62.5	62.4	62.4	62.4	66.8	66.8	62.5	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	6.0	6.0	1.7
1699	B	66	61.8	63.5	63.5	63.5	63.5	63.5	63.4	63.4	63.5	65.1	65.1	63.5	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.7	3.3	3.3	1.7
1700	B	66	61.3	63.0	63.0	63.0	63.0	63.0	62.9	62.9	62.9	65.4	65.4	63.0	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	4.1	4.1	1.7
1701	B	66	65.8	67.2	67.2	67.3	67.2	67.2	67.2	67.2	67.2	67.2	67.2	67.2	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
1702	B	66	64.0	65.5	65.5	65.6	65.5	65.5	65.5	65.5	65.5	65.6	65.6	65.5	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.6	1.6	1.5
1703	B	66	61.9	63.5	63.5	63.5	63.5	63.5	63.4	63.4	63.4	64.0	64.0	63.5	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	2.1	2.1	1.6
1704	B	66	61.0	62.5	62.5	62.6	62.5	62.5	62.5	62.5	62.5	63.9	63.9	62.5	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5	2.9	2.9	1.5
1705	B	66	59.8	61.4	61.4	61.4	61.4	61.4	61.3	61.3	61.3	65.1	65.1	61.4	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	5.3	5.3	1.6
1706	B	66	59.9	61.5	61.5	61.5	61.5	61.5	61.4	61.4	61.4	65.5	65.5	61.5	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	5.6	5.6	1.6

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1707	B	66	60.2	61.8	61.8	61.8	61.8	61.8	61.7	61.7	61.7	63.8	63.7	61.8	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	3.6	3.5	1.6
1708	B	66	60.6	62.1	62.1	62.1	62.1	62.1	62.0	62.0	62.0	64.0	64.0	62.1	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	3.4	3.4	1.5
1709	B	66	65.5	66.9	66.9	67.0	66.9	66.9	66.9	66.9	66.9	66.3	66.3	66.9	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	0.8	0.8	1.4
1710	B	66	64.1	65.6	65.6	65.7	65.6	65.6	65.6	65.6	65.6	65.3	65.3	65.6	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.2	1.2	1.5
1711	B	66	62.4	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.8	63.8	63.9	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.5
1712	B	66	61.5	63.1	63.1	63.1	63.1	63.1	63.1	63.0	63.0	63.5	63.5	63.1	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.5	2.0	2.0	1.6
1713	B	66	60.7	62.3	62.3	62.3	62.3	62.3	62.2	62.2	62.2	63.2	63.1	62.3	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	2.5	2.4	1.6
1714	B	66	60.7	62.3	62.3	62.3	62.3	62.3	62.2	62.2	62.2	63.0	63.0	62.3	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	2.3	2.3	1.6
1715	B	66	60.6	62.1	62.1	62.1	62.1	62.1	62.1	62.0	62.1	61.8	61.8	62.1	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.5	1.2	1.2	1.5
1716	B	66	60.7	62.2	62.2	62.3	62.2	62.2	62.2	62.2	62.2	61.8	61.8	62.2	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.1	1.1	1.5
1735	B	66	71.3	73.1	73.1	73.1	73.1	73.1	69.6	69.5	69.5	72.2	72.2	73.1	1.8	1.8	1.8	1.8	1.8	-1.7	-1.8	-1.8	0.9	0.9	1.8
1736	B	66	68.2	70.0	70.0	70.0	70.0	70.0	67.1	66.9	67.0	68.7	68.7	70.0	1.8	1.8	1.8	1.8	1.8	-1.1	-1.3	-1.2	0.5	0.5	1.8
1737	B	66	70.0	71.8	71.8	71.8	71.8	71.8	70.8	70.8	70.8	70.5	70.5	71.8	1.8	1.8	1.8	1.8	1.8	0.8	0.8	0.8	0.5	0.5	1.8
1738	B	66	65.8	67.5	67.5	67.5	67.5	67.5	65.1	64.9	65.1	65.4	65.3	67.5	1.7	1.7	1.7	1.7	1.7	-0.7	-0.9	-0.7	-0.4	-0.5	1.7
1739	B	66	65.9	67.7	67.7	67.7	67.7	67.7	66.7	66.6	66.7	64.7	64.7	67.7	1.8	1.8	1.8	1.8	1.8	0.8	0.7	0.8	-1.2	-1.2	1.8
1740	B	66	64.4	66.1	66.1	66.1	66.1	66.1	63.8	63.6	63.8	63.6	63.5	66.1	1.7	1.7	1.7	1.7	1.7	-0.6	-0.8	-0.6	-0.8	-0.9	1.7
1741	B	66	64.4	66.2	66.2	66.2	66.2	66.1	65.0	64.9	65.0	62.8	62.7	66.2	1.8	1.8	1.8	1.8	1.7	0.6	0.5	0.6	-1.6	-1.7	1.8
1742	B	66	62.8	64.5	64.5	64.5	64.5	64.4	62.8	62.4	62.7	62.1	62.0	64.5	1.7	1.7	1.7	1.7	1.6	0.0	-0.4	-0.1	-0.7	-0.8	1.7
1743	B	66	63.0	64.8	64.8	64.8	64.8	64.8	63.8	63.7	63.8	61.4	61.2	64.8	1.8	1.8	1.8	1.8	1.8	0.8	0.7	0.8	-1.6	-1.8	1.8
1744	B	66	61.7	63.4	63.4	63.4	63.4	63.4	62.0	61.6	62.0	61.2	61.0	63.4	1.7	1.7	1.7	1.7	1.7	0.3	-0.1	0.3	-0.5	-0.7	1.7
1745	B	66	61.9	63.7	63.7	63.7	63.7	63.7	62.8	62.7	62.8	60.4	60.3	63.7	1.8	1.8	1.8	1.8	1.8	0.9	0.8	0.9	-1.5	-1.6	1.8
1746	B	66	60.6	62.4	62.4	62.5	62.4	62.4	61.2	60.8	61.3	60.2	59.9	62.4	1.8	1.8	1.9	1.8	1.8	0.6	0.2	0.7	-0.4	-0.7	1.8
1747	B	66	60.6	62.5	62.5	62.6	62.5	62.5	61.7	61.5	61.7	59.5	59.3	62.5	1.9	1.9	2.0	1.9	1.9	1.1	0.9	1.1	-1.1	-1.3	1.9
1748	B	66	59.3	61.0	61.0	61.2	61.0	61.1	60.2	59.7	60.3	59.2	58.8	61.0	1.7	1.7	1.9	1.7	1.8	0.9	0.4	1.0	-0.1	-0.5	1.7
1749	B	66	59.4	61.2	61.2	61.3	61.2	61.2	60.4	59.9	60.4	59.2	58.8	61.2	1.8	1.8	1.9	1.8	1.8	1.0	0.5	1.0	-0.2	-0.6	1.8
1750	B	66	59.3	61.1	61.1	61.2	61.1	61.1	60.4	60.0	60.4	58.8	58.5	61.1	1.8	1.8	1.9	1.8	1.8	1.1	0.7	1.1	-0.5	-0.8	1.8
1751	B	66	59.4	61.2	61.2	61.3	61.2	61.2	60.5	60.2	60.5	58.6	58.3	61.2	1.8	1.8	1.9	1.8	1.8	1.1	0.8	1.1	-0.8	-1.1	1.8
1752	B	66	66.7	68.6	68.6	68.6	68.6	68.6	68.3	68.3	68.3	65.8	65.8	68.6	1.9	1.9	1.9	1.9	1.9	1.6	1.6	1.6	-0.9	-0.9	1.9
1753	B	66	71.8	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0	73.0	73.0	74.0	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	1.2	1.2	2.2
1754	B	66	69.1	71.1	71.1	71.1	71.1	71.1	70.9	70.9	70.9	68.1	68.1	71.1	2.0	2.0	2.0	2.0	2.0	1.8	1.8	1.8	-1.0	-1.0	2.0
1755	B	66	66.9	68.8	68.8	68.8	68.8	68.8	68.7	68.6	68.7	64.6	64.5	68.8	1.9	1.9	1.9	1.9	1.9	1.8	1.7	1.8	-2.3	-2.4	1.9
1756	B	66	65.4	67.2	67.2	67.3	67.2	67.2	66.8	66.8	66.8	63.6	63.5	67.2	1.8	1.8	1.9	1.8	1.8	1.4	1.4	1.4	-1.8	-1.9	1.8
1757	B	66	65.2	67.0	67.0	67.0	67.0	67.0	66.8	66.7	66.8	62.6	62.5	67.0	1.8	1.8	1.8	1.8	1.8	1.6	1.5	1.6	-2.6	-2.7	1.8
1758	B	66	64.3	66.1	66.1	66.1	66.1	66.1	65.6	65.5	65.6	62.2	62.1	66.1	1.8	1.8	1.8	1.8	1.8	1.3	1.2	1.3	-2.1	-2.2	1.8
1759	B	66	63.2	64.9	64.9	65.0	64.9	64.9	64.4	64.4	64.4	61.1	61.0	64.9	1.7	1.7	1.8	1.7	1.7	1.2	1.2	1.2	-2.1	-2.2	1.7
1760	B	66	62.6	64.5	64.5	64.5	64.5	64.5	64.2	64.1	64.2	60.1	60.0	64.5	1.9	1.9	1.9	1.9	1.9	1.6	1.5	1.6	-2.5	-2.6	1.9
1761	B	66	62.0	63.8	63.8	63.8	63.8	63.8	63.2	63.1	63.2	60.1	60.0	63.8	1.8	1.8	1.8	1.8	1.8	1.2	1.1	1.2	-1.9	-2.0	1.8
1762	B	66	61.6	63.4	63.4	63.5	63.4	63.4	63.1	63.0	63.1	59.4	59.3	63.4	1.8	1.8	1.9	1.8	1.8	1.5	1.4	1.5	-2.2	-2.3	1.8
1763	B	66	60.5	62.4	62.4	62.4	62.4	62.4	61.8	61.7	61.8	59.1	58.9	62.4	1.9	1.9	1.9	1.9	1.9	1.3	1.2	1.3	-1.4	-1.6	1.9
1764	B	66	59.6	61.5	61.5	61.5	61.5	61.5	60.9	60.7	60.9	58.5	58.3	61.5	1.9	1.9	1.9	1.9	1.9	1.3	1.1	1.3	-1.1	-1.3	1.9
1765	B	66	59.4	61.3	61.3	61.4	61.3	61.3	60.8	60.7	60.8	58.2	58.0	61.3	1.9	1.9	2.0	1.9	1.9	1.4	1.3	1.4	-1.2	-1.4	1.9
1766	B	66	59.3	61.2	61.2	61.3	61.2	61.2	60.8	60.7	60.8	57.8	57.7	61.2	1.9	1.9	2.0	1.9	1.9	1.5	1.4	1.5	-1.5	-1.6	1.9
1767	B	66	69.3	71.2	71.2	71.2	71.2	71.2	71.2	71.2	71.2	66.5	66.5	71.2	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	-2.8	-2.8	1.9
1768	B	66	66.3	68.0	68.0	68.0	68.0	68.0	67.9	67.9	67.9	63.9	63.8	68.0	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	-2.4	-2.5	1.7
1769	B	66	64.7	66.4	66.4	66.4	66.4	66.4	66.3	66.3	66.3	62.2	62.1	66.4	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	-2.5	-2.6	1.7
1770	B	66	63.6	65.4	65.4	65.4	65.4	65.4	65.2	65.2	65.2	61.2	61.1	65.4	1.8	1.8	1.8	1.8	1.8	1.6	1.6	1.6	-2.4	-2.5	1.8
1771	B	66	62.2	64.0	64.0	64.0	64.0	64.0	63.7	63.7	63.7	60.1	60.0	64.0	1.8	1.8	1.8	1.8	1.8	1.5	1.5	1.5	-2.1	-2.2	1.8

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1772	B	66	61.3	63.1	63.1	63.1	63.1	63.1	62.8	62.8	62.8	59.3	59.2	63.1	1.8	1.8	1.8	1.8	1.8	1.5	1.5	1.5	-2.0	-2.1	1.8
1773	B	66	59.4	61.0	61.0	61.0	61.0	61.0	60.7	60.7	60.7	58.2	58.1	61.0	1.6	1.6	1.6	1.6	1.6	1.3	1.3	1.3	-1.2	-1.3	1.6
1774	B	66	59.8	61.4	61.3	61.4	61.4	61.3	61.1	61.1	61.2	58.7	58.6	61.4	1.6	1.5	1.6	1.6	1.5	1.3	1.3	1.4	-1.1	-1.2	1.6
1775	B	66	65.2	66.7	66.7	66.7	66.7	66.7	66.6	66.6	66.6	65.0	65.0	66.7	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	-0.2	-0.2	1.5
1776	B	66	64.6	66.0	66.0	66.0	66.0	66.0	65.9	65.9	65.9	64.9	64.9	66.0	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	0.3	0.3	1.4
1777	B	66	64.1	65.5	65.5	65.5	65.5	65.5	65.4	65.4	65.4	64.5	64.5	65.5	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	0.4	0.4	1.4
1778	B	66	61.8	63.2	63.2	63.2	63.2	63.2	63.0	63.0	63.1	61.7	61.7	63.2	1.4	1.4	1.4	1.4	1.4	1.2	1.2	1.3	-0.1	-0.1	1.4
1779	B	66	62.5	63.8	63.8	63.8	63.8	63.8	63.7	63.7	63.7	63.1	63.1	63.8	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	0.6	0.6	1.3
1780	B	66	68.9	70.8	70.8	70.8	70.8	70.8	64.9	64.8	64.9	70.7	70.7	70.8	1.9	1.9	1.9	1.9	1.9	-4.0	-4.1	-4.0	1.8	1.8	1.9
1781	B	66	69.2	71.1	71.1	71.1	71.1	71.1	65.4	65.2	65.3	71.0	71.0	71.1	1.9	1.9	1.9	1.9	1.9	-3.8	-4.0	-3.9	1.8	1.8	1.9
1782	B	66	69.5	71.4	71.4	71.4	71.4	71.4	66.1	66.0	66.1	71.4	71.4	71.4	1.9	1.9	1.9	1.9	1.9	-3.4	-3.5	-3.4	1.9	1.9	1.9
1783	B	66	69.5	71.4	71.4	71.5	71.4	71.4	66.6	66.5	66.6	71.5	71.5	71.4	1.9	1.9	2.0	1.9	1.9	-2.9	-3.0	-2.9	2.0	2.0	1.9
1784	B	66	69.6	71.5	71.5	71.5	71.5	71.5	68.9	68.9	68.9	71.6	71.5	71.5	1.9	1.9	1.9	1.9	1.9	-0.7	-0.7	-0.7	2.0	1.9	1.9
1785	B	66	69.6	71.5	71.5	71.6	71.5	71.5	69.4	69.4	69.4	71.6	71.6	71.5	1.9	1.9	2.0	1.9	1.9	-0.2	-0.2	-0.2	2.0	2.0	1.9
1786	B	66	69.7	71.6	71.6	71.6	71.6	71.6	70.3	70.3	70.3	71.7	71.7	71.6	1.9	1.9	1.9	1.9	1.9	0.6	0.6	0.6	2.0	2.0	1.9
1787	B	66	69.8	71.8	71.8	71.8	71.8	71.8	70.8	70.8	70.8	72.0	72.0	71.8	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	2.2	2.2	2.0
1788	B	66	65.9	67.9	67.9	67.9	67.9	67.9	63.9	63.7	63.8	67.7	67.6	67.9	2.0	2.0	2.0	2.0	2.0	-2.0	-2.2	-2.1	1.8	1.7	2.0
1789	B	66	66.1	68.0	68.0	68.1	68.0	68.0	64.2	64.0	64.1	67.8	67.8	68.0	1.9	1.9	2.0	1.9	1.9	-1.9	-2.1	-2.0	1.7	1.7	1.9
1790	B	66	66.2	68.2	68.2	68.2	68.2	68.2	64.7	64.5	64.6	68.0	67.9	68.2	2.0	2.0	2.0	2.0	2.0	-1.5	-1.7	-1.6	1.8	1.7	2.0
1791	B	66	66.4	68.3	68.3	68.3	68.3	68.3	65.0	64.9	65.0	68.0	68.0	68.3	1.9	1.9	1.9	1.9	1.9	-1.4	-1.5	-1.4	1.6	1.6	1.9
1792	B	66	63.5	65.6	65.6	65.6	65.6	65.6	63.3	63.0	63.2	65.2	65.2	65.6	2.1	2.1	2.1	2.1	2.1	-0.2	-0.5	-0.3	1.7	1.7	2.1
1793	B	66	63.5	65.6	65.6	65.6	65.6	65.6	63.3	63.0	63.2	65.1	65.1	65.6	2.1	2.1	2.1	2.1	2.1	-0.2	-0.5	-0.3	1.6	1.6	2.1
1794	B	66	63.6	65.7	65.7	65.7	65.7	65.7	63.6	63.4	63.5	65.3	65.2	65.7	2.1	2.1	2.1	2.1	2.1	0.0	-0.2	-0.1	1.7	1.6	2.1
1795	B	66	63.7	65.8	65.8	65.8	65.8	65.8	63.8	63.6	63.7	65.3	65.3	65.8	2.1	2.1	2.1	2.1	2.1	0.1	-0.1	0.0	1.6	1.6	2.1
1796	B	66	62.1	64.6	64.6	64.6	64.6	64.6	63.0	62.7	63.0	63.9	63.9	64.6	2.5	2.5	2.5	2.5	2.5	0.9	0.6	0.9	1.8	1.8	2.5
1797	B	66	62.2	64.6	64.6	64.6	64.6	64.7	63.1	62.8	63.0	64.0	64.0	64.6	2.4	2.4	2.4	2.4	2.5	0.9	0.6	0.8	1.8	1.8	2.4
1798	B	66	62.3	64.7	64.7	64.7	64.7	64.7	63.1	62.9	63.1	64.2	64.1	64.7	2.4	2.4	2.4	2.4	2.4	0.8	0.6	0.8	1.9	1.8	2.4
1799	B	66	62.3	64.7	64.7	64.7	64.7	64.7	63.2	63.0	63.2	64.2	64.2	64.7	2.4	2.4	2.4	2.4	2.4	0.9	0.7	0.9	1.9	1.9	2.4
1800	B	66	66.5	68.4	68.4	68.4	68.4	68.4	66.3	66.2	66.2	68.0	68.0	68.4	1.9	1.9	1.9	1.9	1.9	-0.2	-0.3	-0.3	1.5	1.5	1.9
1801	B	66	66.4	68.3	68.3	68.3	68.3	68.3	66.4	66.3	66.4	67.9	67.9	68.3	1.9	1.9	1.9	1.9	1.9	0.0	-0.1	0.0	1.5	1.5	1.9
1802	B	66	66.6	68.5	68.5	68.5	68.5	68.5	67.1	67.1	67.1	68.1	68.0	68.5	1.9	1.9	1.9	1.9	1.9	0.5	0.5	0.5	1.5	1.4	1.9
1803	B	66	66.7	68.6	68.6	68.6	68.6	68.6	67.4	67.4	67.4	68.1	68.1	68.6	1.9	1.9	1.9	1.9	1.9	0.7	0.7	0.7	1.4	1.4	1.9
1804	B	66	69.3	71.1	71.1	71.1	71.1	71.1	70.9	70.9	70.9	71.0	71.0	71.1	1.8	1.8	1.8	1.8	1.8	1.6	1.6	1.6	1.7	1.7	1.8
1805	B	66	68.5	70.2	70.2	70.2	70.2	70.3	70.0	70.0	70.0	69.4	69.4	70.2	1.7	1.7	1.7	1.7	1.8	1.5	1.5	1.5	0.9	0.9	1.7
1806	B	66	66.9	68.6	68.6	68.6	68.6	68.6	68.3	68.2	68.3	67.5	67.4	68.6	1.7	1.7	1.7	1.7	1.7	1.4	1.3	1.4	0.6	0.5	1.7
1807	B	66	66.1	67.9	67.9	67.9	67.9	67.9	67.5	67.5	67.5	66.5	66.5	67.9	1.8	1.8	1.8	1.8	1.8	1.4	1.4	1.4	0.4	0.4	1.8
1808	B	66	69.3	71.2	71.2	71.2	71.2	71.2	70.8	70.8	70.8	71.1	71.0	71.2	1.9	1.9	1.9	1.9	1.9	1.5	1.5	1.5	1.8	1.7	1.9
1809	B	66	68.3	70.1	70.1	70.1	70.1	70.1	69.6	69.6	69.6	69.5	69.5	70.1	1.8	1.8	1.8	1.8	1.8	1.3	1.3	1.3	1.2	1.2	1.8
1810	B	66	66.9	68.7	68.7	68.7	68.7	68.7	68.2	68.2	68.2	67.8	67.8	68.7	1.8	1.8	1.8	1.8	1.8	1.3	1.3	1.3	0.9	0.9	1.8
1811	B	66	66.0	67.8	67.8	67.8	67.8	67.8	67.3	67.2	67.3	66.9	66.8	67.8	1.8	1.8	1.8	1.8	1.8	1.3	1.2	1.3	0.9	0.8	1.8
1812	B	66	64.4	66.3	66.3	66.3	66.3	66.3	65.7	65.6	65.7	65.1	65.1	66.3	1.9	1.9	1.9	1.9	1.9	1.3	1.2	1.3	0.7	0.7	1.9
1813	B	66	64.3	66.2	66.3	66.3	66.2	66.2	65.5	65.5	65.5	65.0	65.0	66.3	1.9	2.0	2.0	1.9	1.9	1.2	1.2	1.2	0.7	0.7	2.0
1814	B	66	64.2	66.2	66.2	66.2	66.2	66.1	65.2	65.1	65.2	65.1	65.1	66.2	2.0	2.0	2.0	2.0	1.9	1.0	0.9	1.0	0.9	0.9	2.0
1815	B	66	64.0	66.0	66.0	66.0	66.0	66.0	64.9	64.8	64.9	65.0	64.9	66.0	2.0	2.0	2.0	2.0	2.0	0.9	0.8	0.9	1.0	0.9	2.0
1816	B	66	62.9	64.9	64.9	64.9	64.9	64.9	64.2	64.1	64.2	63.6	63.6	64.9	2.0	2.0	2.0	2.0	2.0	1.3	1.2	1.3	0.7	0.7	2.0
1817	B	66	62.9	64.9	64.9	64.9	64.9	64.9	64.1	64.1	64.1	63.8	63.7	64.9	2.0	2.0	2.0	2.0	2.0	1.2	1.2	1.2	0.9	0.8	2.0
1818	B	66	62.7	64.7	64.7	64.8	64.7	64.7	63.9	63.8	63.8	63.6	63.5	64.7	2.0	2.0	2.1	2.0	2.0	1.2	1.1	1.1	0.9	0.8	2.0

Receptor ID	Land Use	NAC dB(A)	Hourly Leq(h) dBA												Difference between Existing/Build										
			2012 Existing	2035 Build																					
				2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var	2A	2B	2C	2D	2E	5A	5B	5C	9A	9B	Var
Shaded cells indicate noise levels that exceed the NAC																									
1819	B	66	62.5	64.6	64.6	64.6	64.6	64.6	63.6	63.5	63.5	63.5	63.4	64.6	2.1	2.1	2.1	2.1	2.1	1.1	1.0	1.0	1.0	0.9	2.1
1820	B	66	60.0	63.4	63.4	63.4	63.4	63.4	62.7	62.5	62.6	64.6	64.6	63.4	3.4	3.4	3.4	3.4	3.4	2.7	2.5	2.6	4.6	4.6	3.4
1821	B	66	60.0	63.2	63.2	63.2	63.2	63.2	62.4	62.2	62.4	64.6	64.6	63.2	3.2	3.2	3.2	3.2	3.2	2.4	2.2	2.4	4.6	4.6	3.2
1822	B	66	60.2	62.9	62.9	62.9	62.9	62.9	62.1	62.0	62.1	64.6	64.6	62.9	2.7	2.7	2.7	2.7	2.7	1.9	1.8	1.9	4.4	4.4	2.7
1823	B	66	60.2	62.7	62.7	62.7	62.7	62.7	62.0	61.8	61.9	64.5	64.5	62.7	2.5	2.5	2.5	2.5	2.5	1.8	1.6	1.7	4.3	4.3	2.5
1824	B	66	62.8	64.3	64.3	64.3	64.3	64.3	64.2	64.2	64.2	62.2	62.2	64.3	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	-0.6	-0.6	1.5
1825	B	66	61.7	63.1	63.1	63.2	63.1	63.1	63.1	63.0	63.1	61.2	61.2	63.1	1.4	1.4	1.5	1.4	1.4	1.4	1.3	1.4	-0.5	-0.5	1.4
1826	B	66	60.6	62.0	62.0	62.0	62.0	62.0	61.9	61.9	61.9	60.4	60.4	62.0	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	-0.2	-0.2	1.4
1827	B	66	59.1	60.6	60.6	60.6	60.6	60.6	60.5	60.4	60.5	59.5	59.4	60.6	1.5	1.5	1.5	1.5	1.5	1.4	1.3	1.4	0.4	0.3	1.5
1828	B	66	58.5	59.9	59.9	59.9	59.9	59.9	59.8	59.8	59.8	59.1	59.0	59.9	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	0.6	0.5	1.4
1829	B	66	61.1	62.5	62.5	62.6	62.5	62.5	62.5	62.5	62.5	61.6	61.5	62.5	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	0.5	0.4	1.4
1830	B	66	60.3	61.8	61.8	61.8	61.8	61.8	61.7	61.7	61.7	61.1	61.0	61.8	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	0.8	0.7	1.5
1920	B	66	68.7	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	71.3	71.3	70.3	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.6	2.6	1.6
1921	B	66	64.7	66.2	66.2	66.2	66.2	66.2	66.2	66.2	66.2	67.2	67.2	66.2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.5	1.5

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 98 traffic noise impacts predicted under the Existing Alternative, 165 impacts predicted under Future Build Alternative 2A, 163 impacts predicted under Future Build Alternatives 2B, 2C, 2D, 165 impacts predicted under Future Build Alternative 2E, 146 impacts predicted under Future Build Alternative 5A, 136 impacts predicted under Future Build Alternative 5B, 141 impacts predicted under Future Build Alternative 5C, 148 impacts predicted under Future Build Alternative 9A, 141 impacts predicted under Future Build Alternative 9B, and 168 impacts predicted under Future Build Alternative Var.

Table 8: Impact Summary

Alternative	Approach/ Exceed NAC	Substantially Exceed	Total Receptors Affected
Existing	98	0	98
Build – 2A	165	0	165
Build – 2B	163	0	163
Build – 2C	163	0	163
Build – 2D	163	0	163
Build – 2E	165	0	165
Build – 5A	146	0	146
Build – 5B	136	0	136
Build – 5C	141	0	141
Build – 9A	148	0	148
Build – 9B	141	0	141
Build – Var	168	0	168

8.1. Impacts

8.1.1. Alternative 2A

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -4.2 to +11.7 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 165 traffic noise impacts are predicted to occur as a result of Alternative 2A.

8.1.2. Alternative 2B

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -5.0 to +11.7 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 163 traffic noise impacts are predicted to occur as a result of Alternative 2B.

8.1.3. Alternative 2C

The difference between the existing 2012 and the predicted 2035 Build noise levels range from +0.2 to +11.3 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 163 traffic noise impacts are predicted to occur as a result of Alternative 2C.

8.1.4. Alternative 2D

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -5.0 to +11.7 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 163 traffic noise impacts are predicted to occur as a result of Alternative 2D.

8.1.5. Alternative 2E

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -4.2 to +11.7 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 165 traffic noise impacts are predicted to occur as a result of Alternative 2E.

8.1.6. Alternative 5A

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -4.2 to +11.7 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 146 traffic noise impacts are predicted to occur as a result of Alternative 5A.

8.1.7. Alternative 5B

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -5.0 to +11.7 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 136 traffic noise impacts are predicted to occur as a result of Alternative 5B.

8.1.8. Alternative 5C

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -4.0 to +11.3 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 141 traffic noise impacts are predicted to occur as a result of Alternative 5C.

8.1.9. Alternative 9A

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -5.0 to +11.7 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 148 traffic noise impacts are predicted to occur as a result of Alternative 9A.

8.1.10. Alternative 9B

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -3.9 to +11.3 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 141 traffic noise impacts are predicted to occur as a result of Alternative 9B.

8.1.11. Alternative Var

The difference between the existing 2012 and the predicted 2035 Build noise levels range from -4.2 to +11.7 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 168 traffic noise impacts are predicted to occur as a result of Alternative Var.

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 2A, 2B, 2C, 2D, 2E, 5A, 5B, 5C, 9A, 9B, and Var 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 extend 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 in a manner that reduces or compromises the noise reduction provided by the noise barrier. 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.

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. 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 2A, 2B, 2C, 2D, 2E, 5A, 5B, 5C, 9A, 9B, and Var at 576 receptors in the Project area. There are 98 impacts predicted under the Existing Alternative, 165 impacts predicted under Future Build Alternative 2A, 163 impacts predicted under Future Build Alternatives 2B, 2C, 2D, 165 impacts predicted under Future Build Alternative 2E, 146 impacts predicted under Future Build Alternative 5A, 136 impacts predicted under Future Build Alternative 5B, 141 impacts predicted under Future Build Alternative 5C, 148 impacts predicted under Future Build Alternative 9A, 141 impacts predicted under Future Build Alternative 9B, and 168 impacts predicted under Future Build Alternative Var.

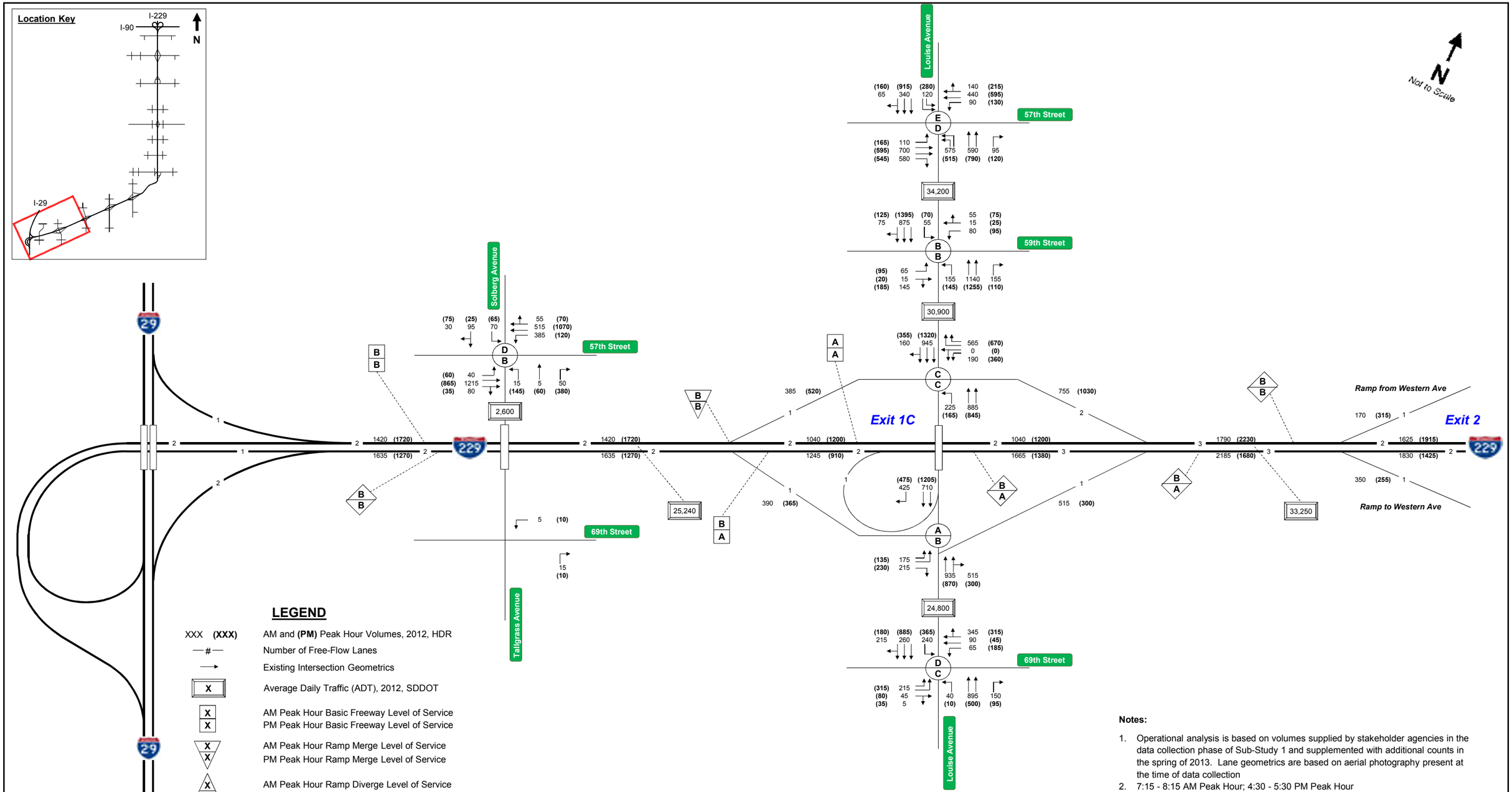
13. References

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



Notes:

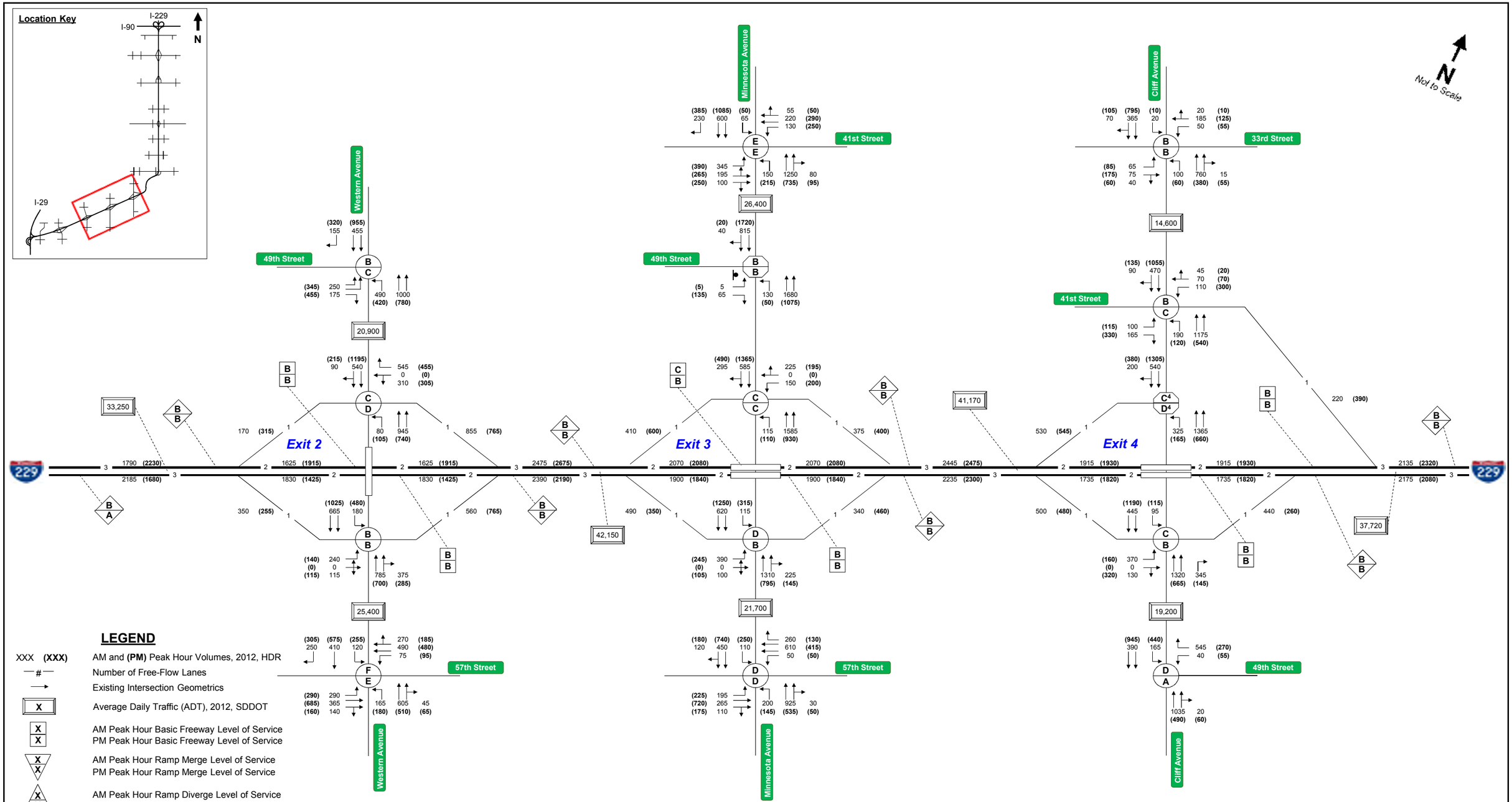
1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30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

Existing Conditions Traffic Operations Analysis

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

Date
03/05/2014

Figure
1 of 5



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:

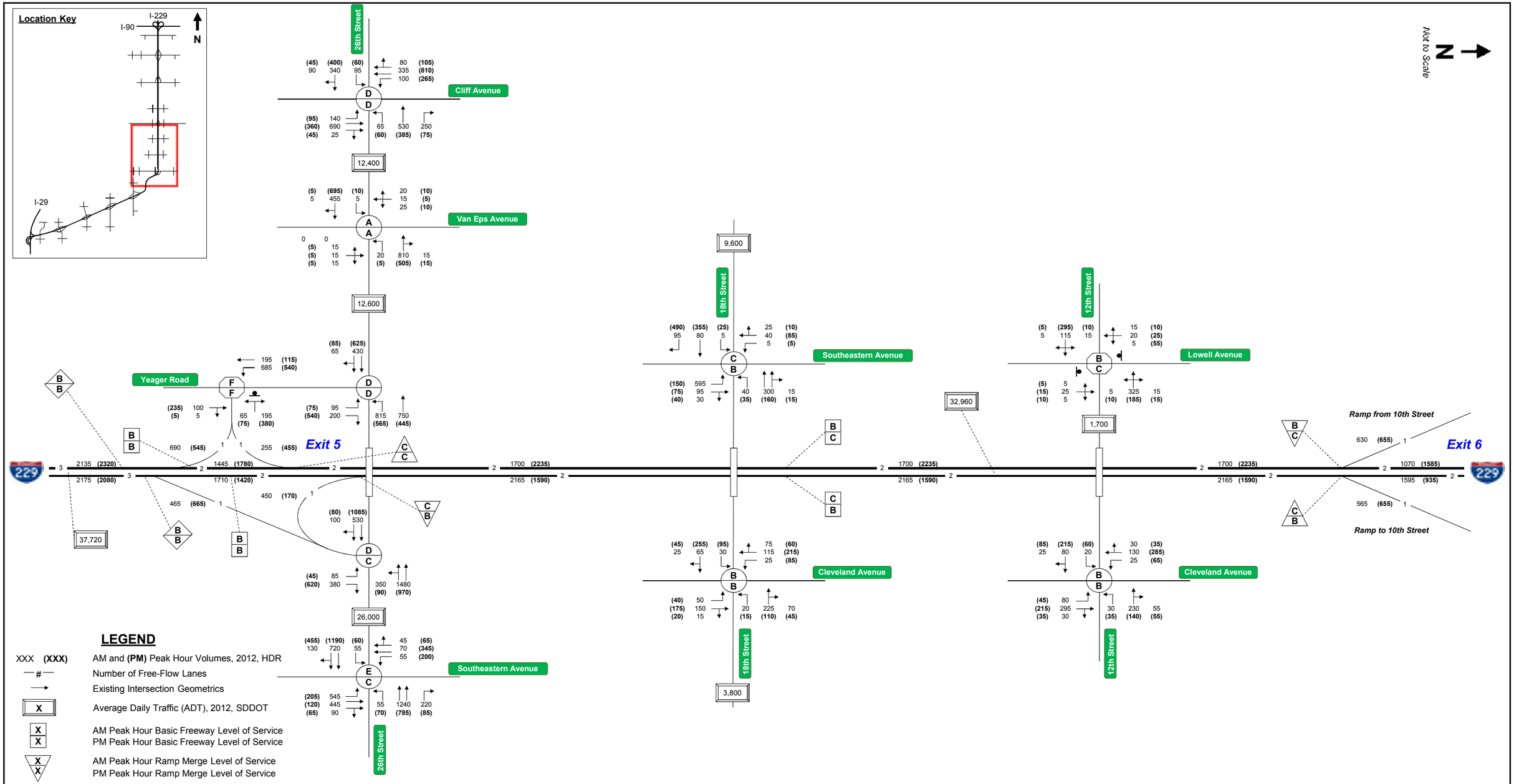
1. Operational analysis is based on volumes supplied by stakeholder agencies in the data collection phase of Sub-Study 1 and supplemented with additional counts in the spring of 2013. Lane geometrics are based on aerial photography present at the time of data collection
2. 7:15 - 8:15 AM Peak Hour; 4:30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

Existing Conditions Traffic Operations Analysis

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

Date
03/05/2014

Figure
2 of 5



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

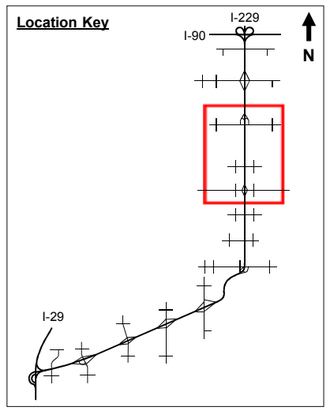
HDR

Existing Conditions Traffic Operations Analysis

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

Date
03/05/2014

Figure
3 of 5



Not to Scale

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

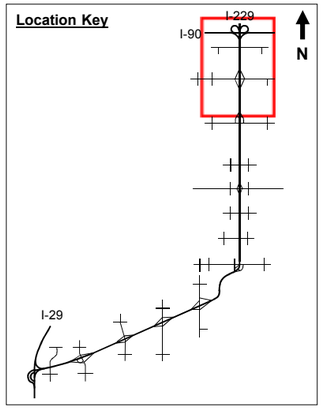
HDR

Existing Conditions Traffic Operations Analysis

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

Date
03/05/2014

Figure
4 of 5



Not to Scale

N

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

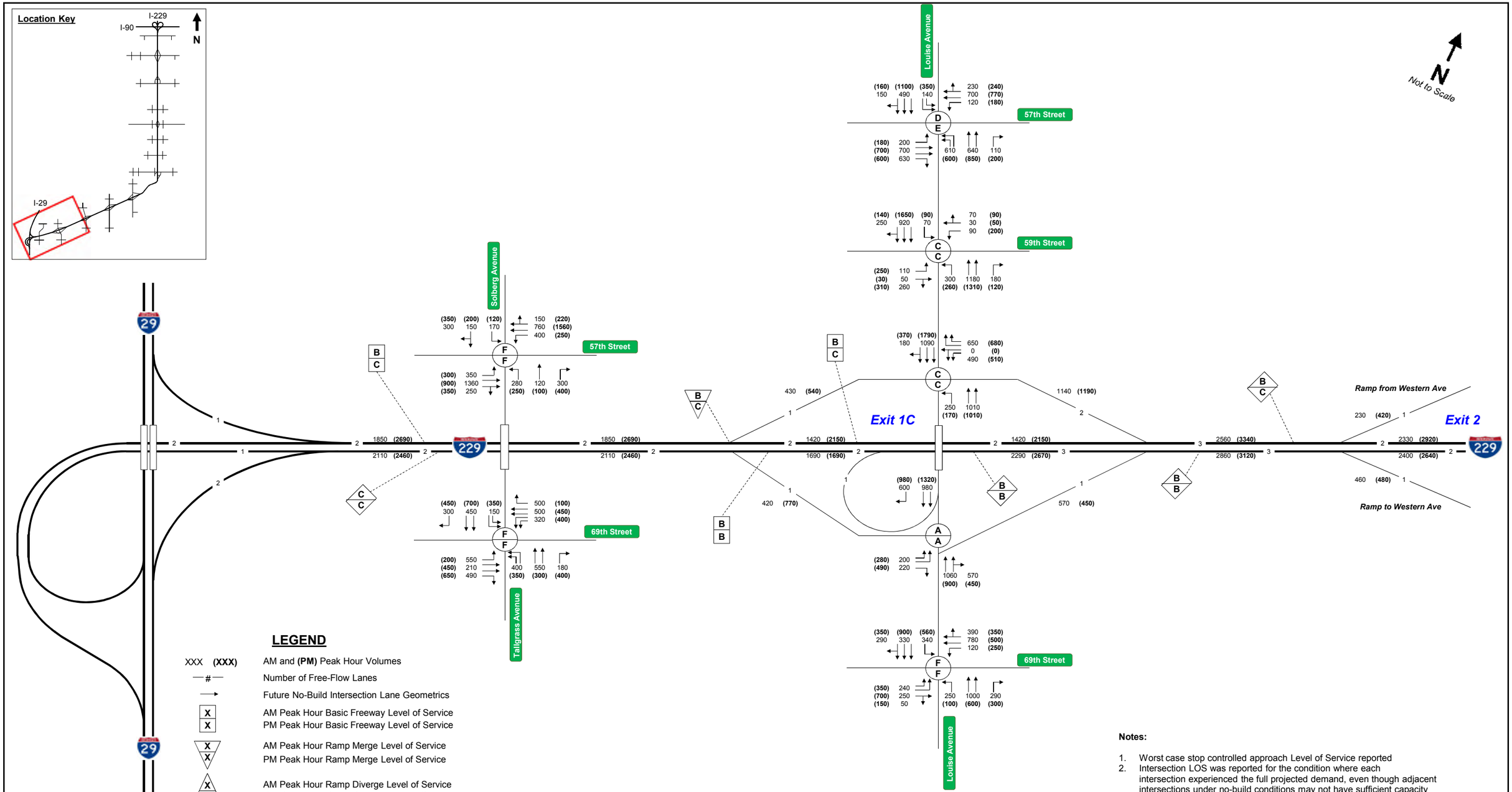
HDR

Existing Conditions Traffic Operations Analysis

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

Date
03/05/2014

Figure
5 of 5



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:

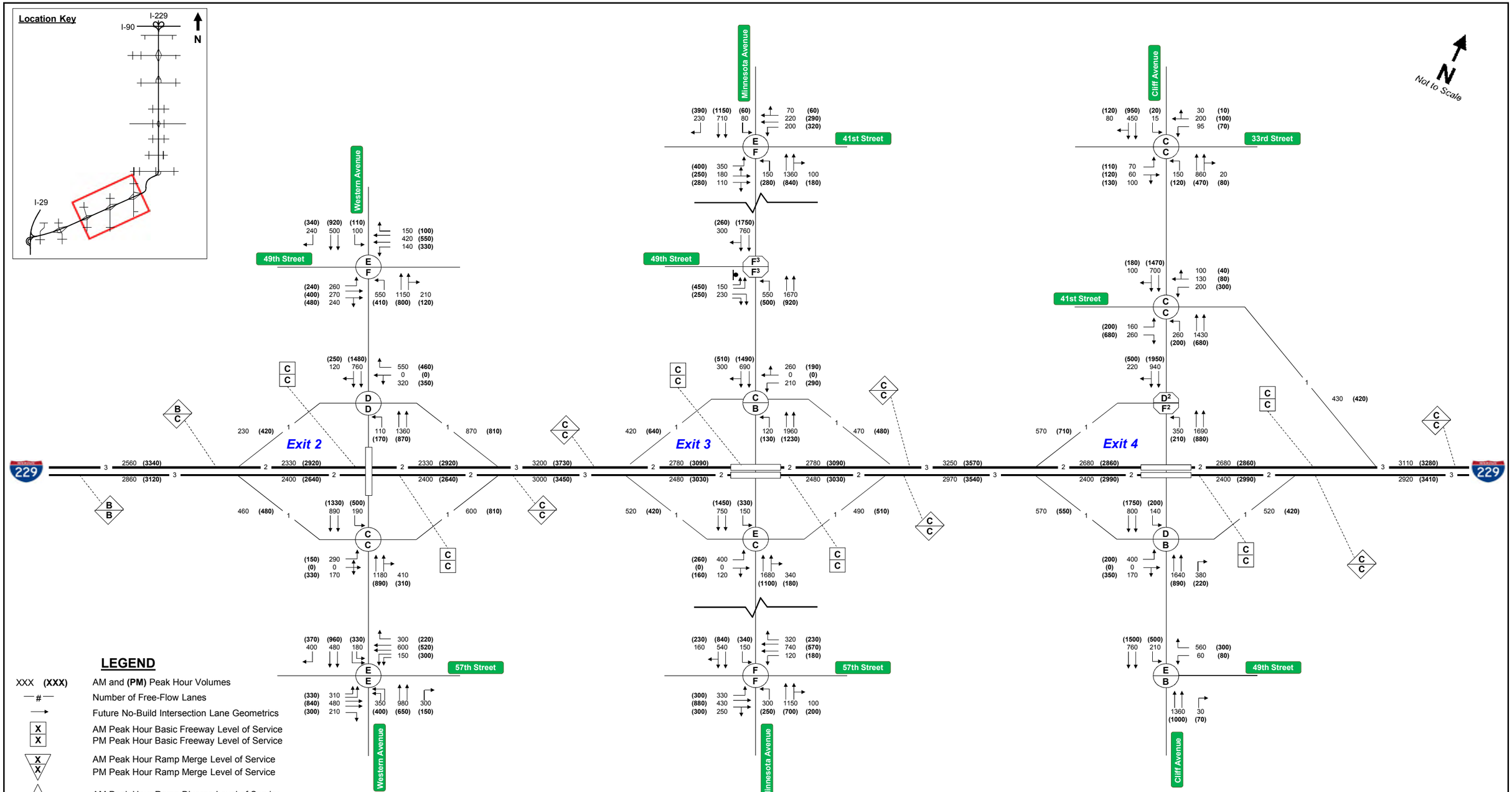
1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

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



Notes:

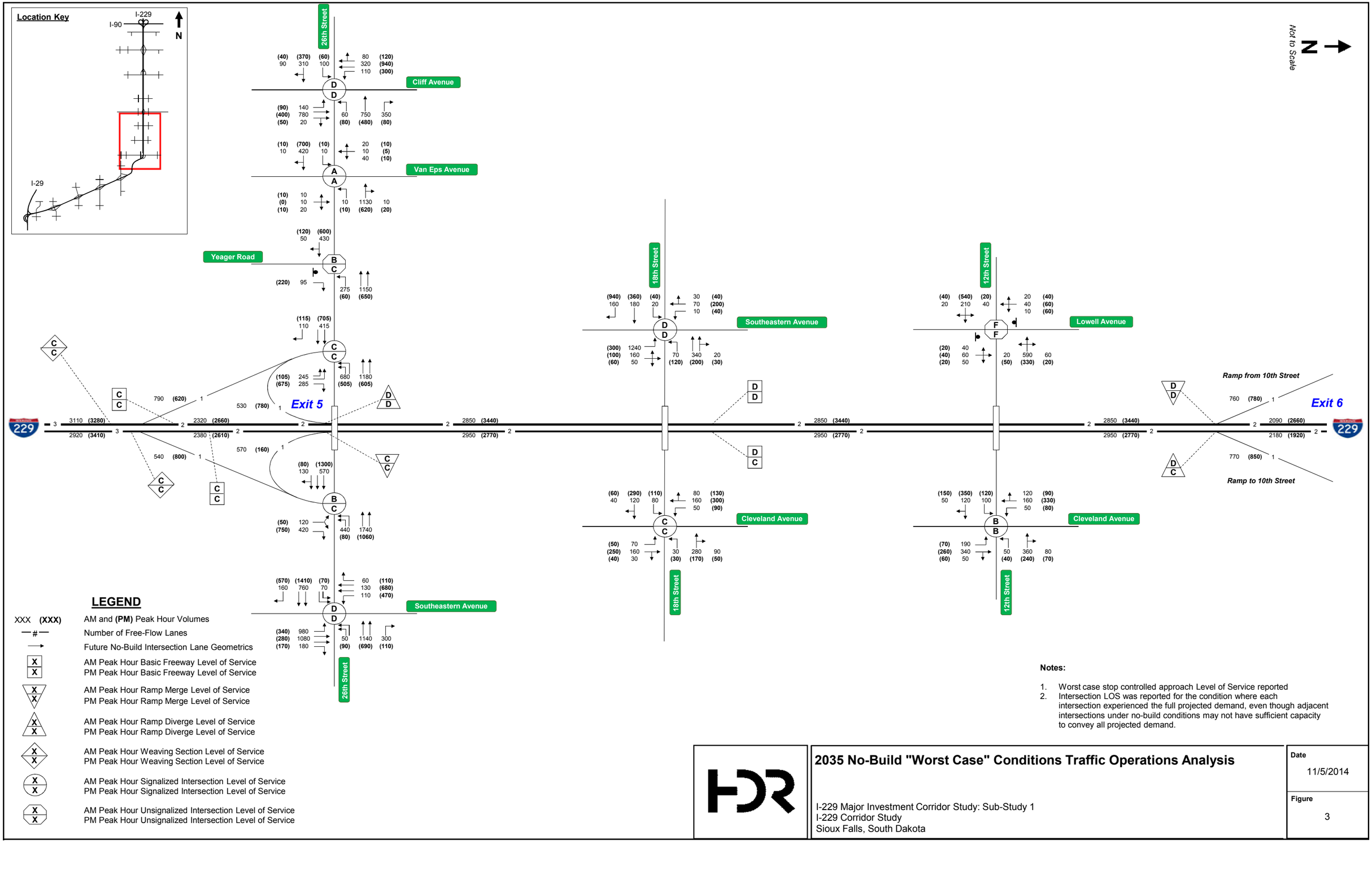
1. Worst case stop controlled approach Level of Service reported
2. Worst case stop controlled movement Level of Service reported
3. Level of Service reported from HCS 2010 analysis using a single left-turn lane and a single right-turn lane due to limitations of HCS 2010 software.
4. Intersection LOS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

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
2



Notes:

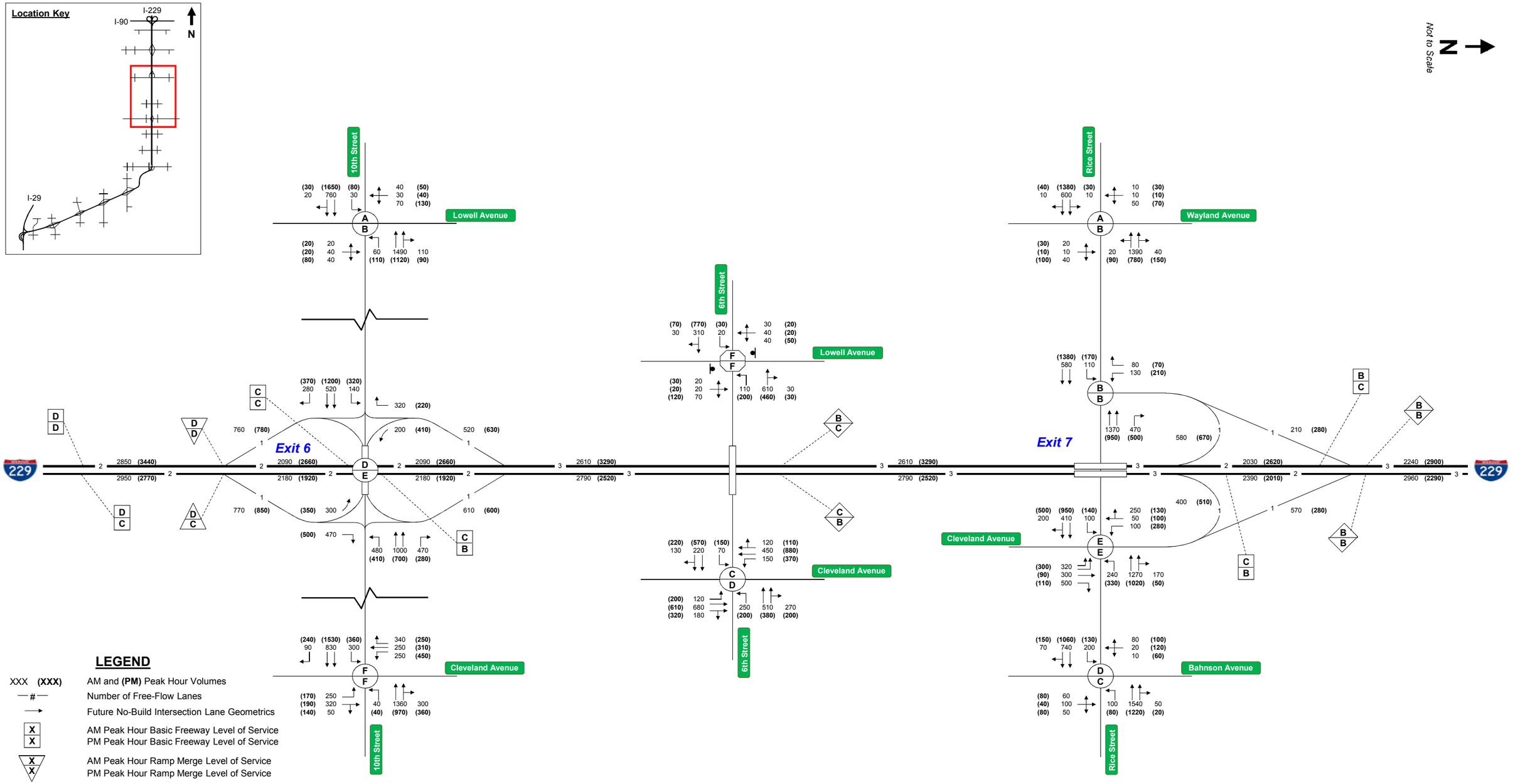
1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

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
3



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:

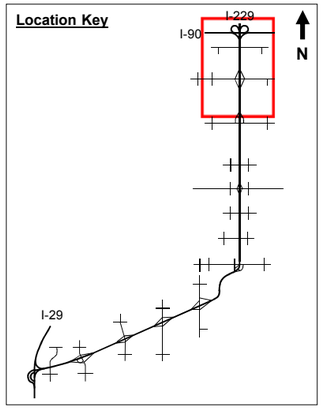
1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

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
4



Not to Scale

N

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:

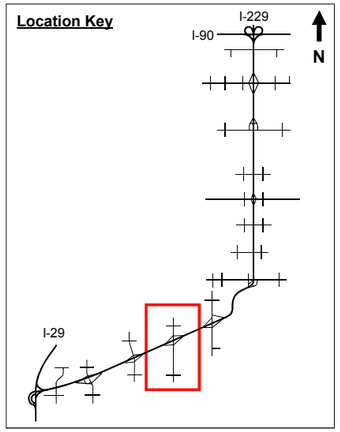
1. Worst case stop controlled approach Level of Service reported
2. Intersection LOS was reported for the condition where each intersection experienced the full projected demand, even though adjacent intersections under no-build conditions may not have sufficient capacity to convey all projected demand.

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

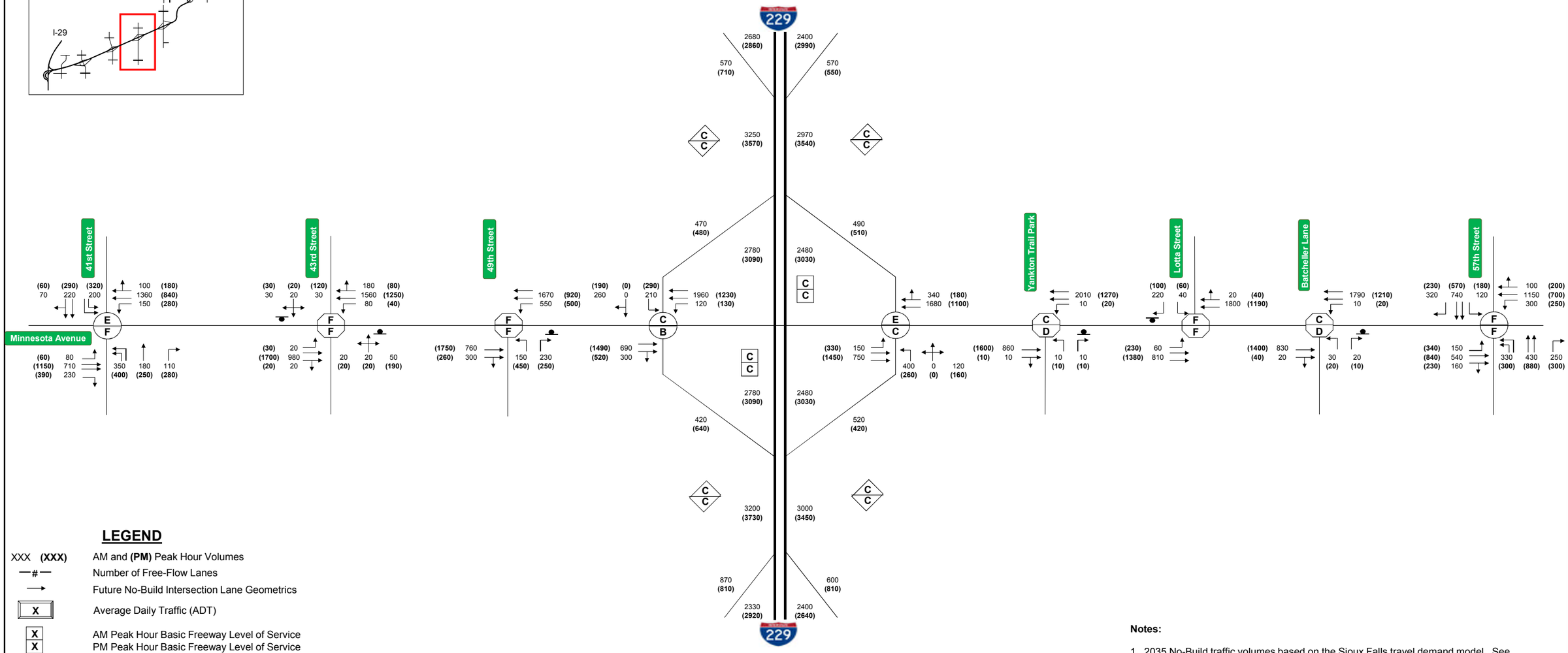
Date
11/5/2014

Figure
5



N

Not to Scale



LEGEND

XXX **(XXX)**	AM and **(PM)** Peak Hour Volumes
—#—	Number of Free-Flow Lanes
→	Future No-Build Intersection Lane Geometrics
X	Average Daily Traffic (ADT)
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. 2035 No-Build traffic volumes based on the Sioux Falls travel demand model. See report text for additional information on volume development.
2. Worst case stop controlled approach Level of Service reported

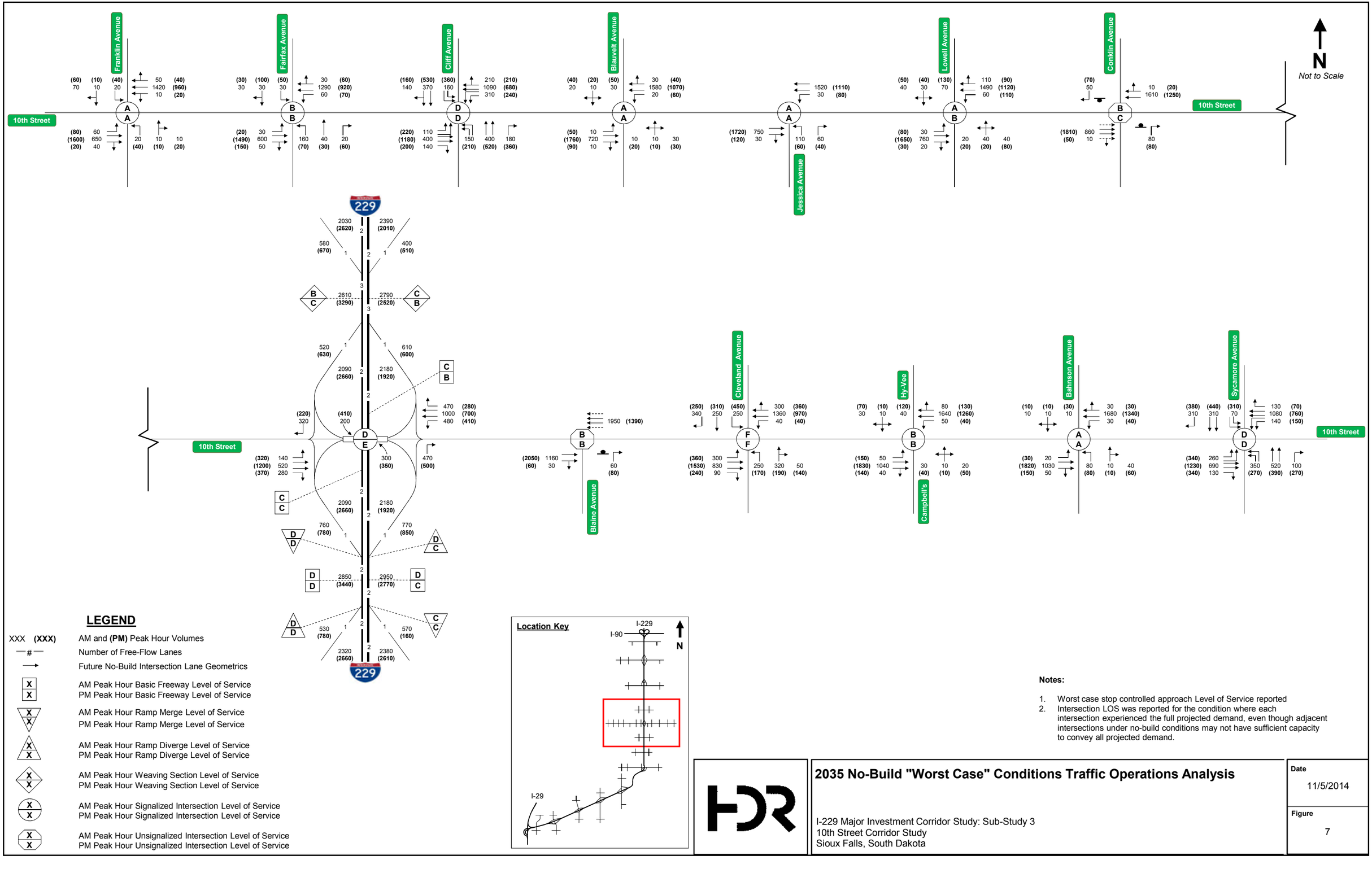
HRGreen

2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 2
Minnesota Avenue Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
6



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.

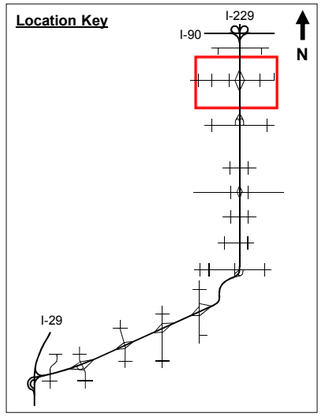
2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

I-229 Major Investment Corridor Study: Sub-Study 3
10th Street Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
7

Location Key



N

Not to Scale

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.

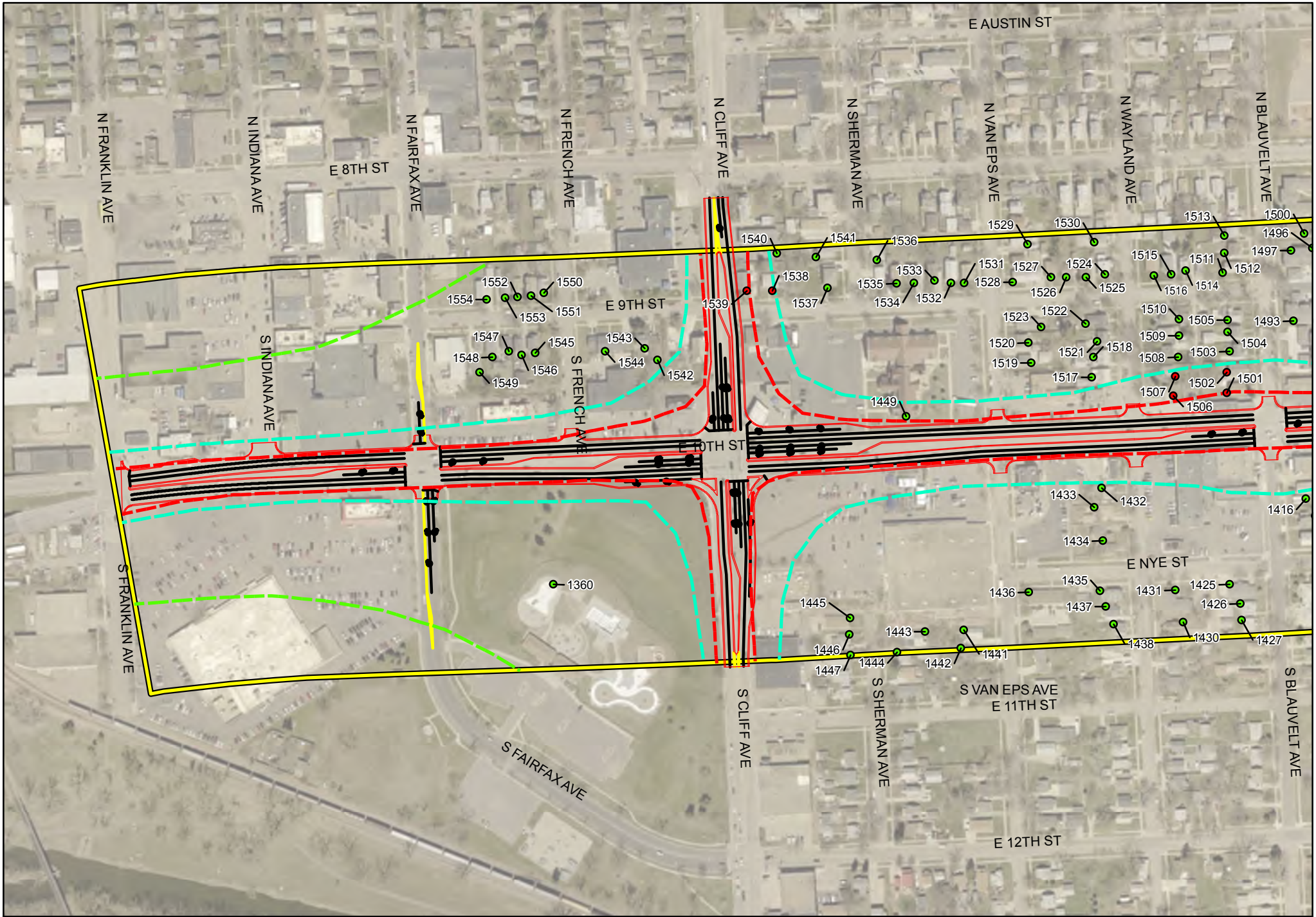
2035 No-Build "Worst Case" Conditions Traffic Operations Analysis

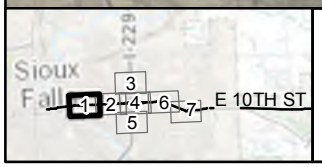
I-229 Major Investment Corridor Study: Sub-Study 4
Benson Road Corridor Study
Sioux Falls, South Dakota

Date
11/5/2014

Figure
8

Appendix B
Figures

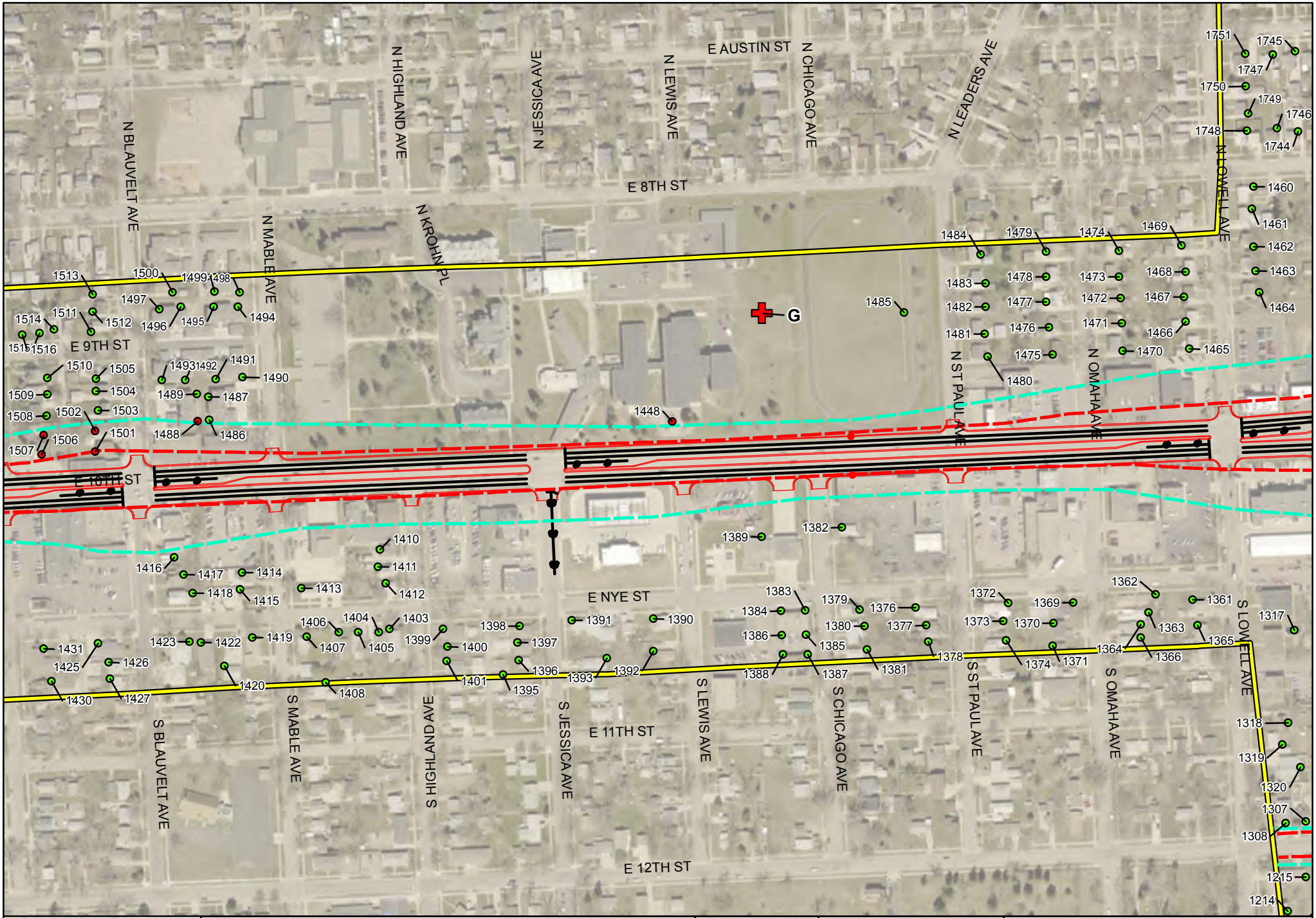


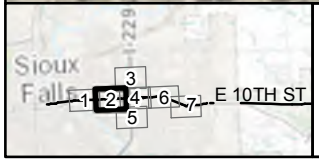


Legend

- 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 3 Concept Linework 10th-2A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2A

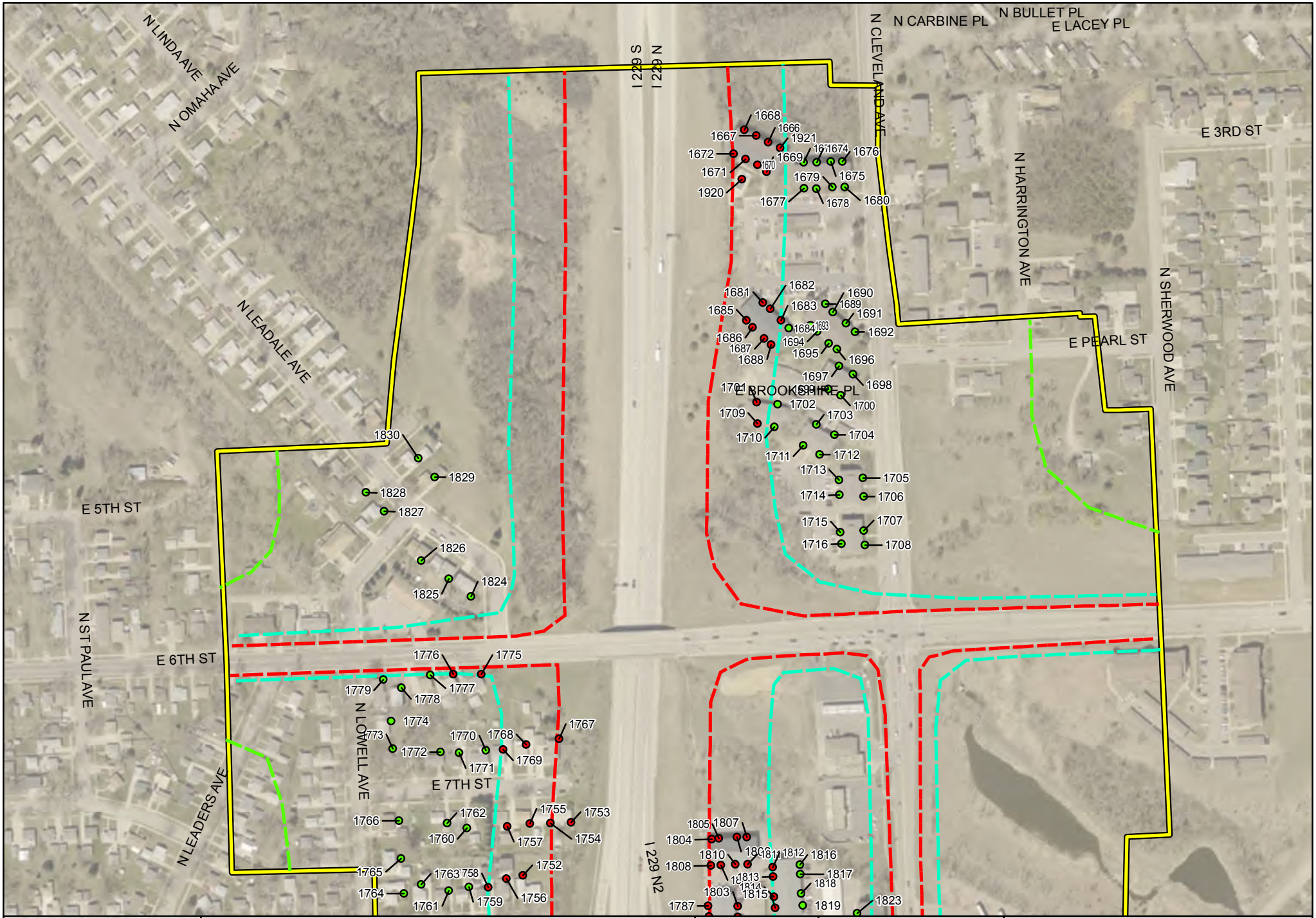




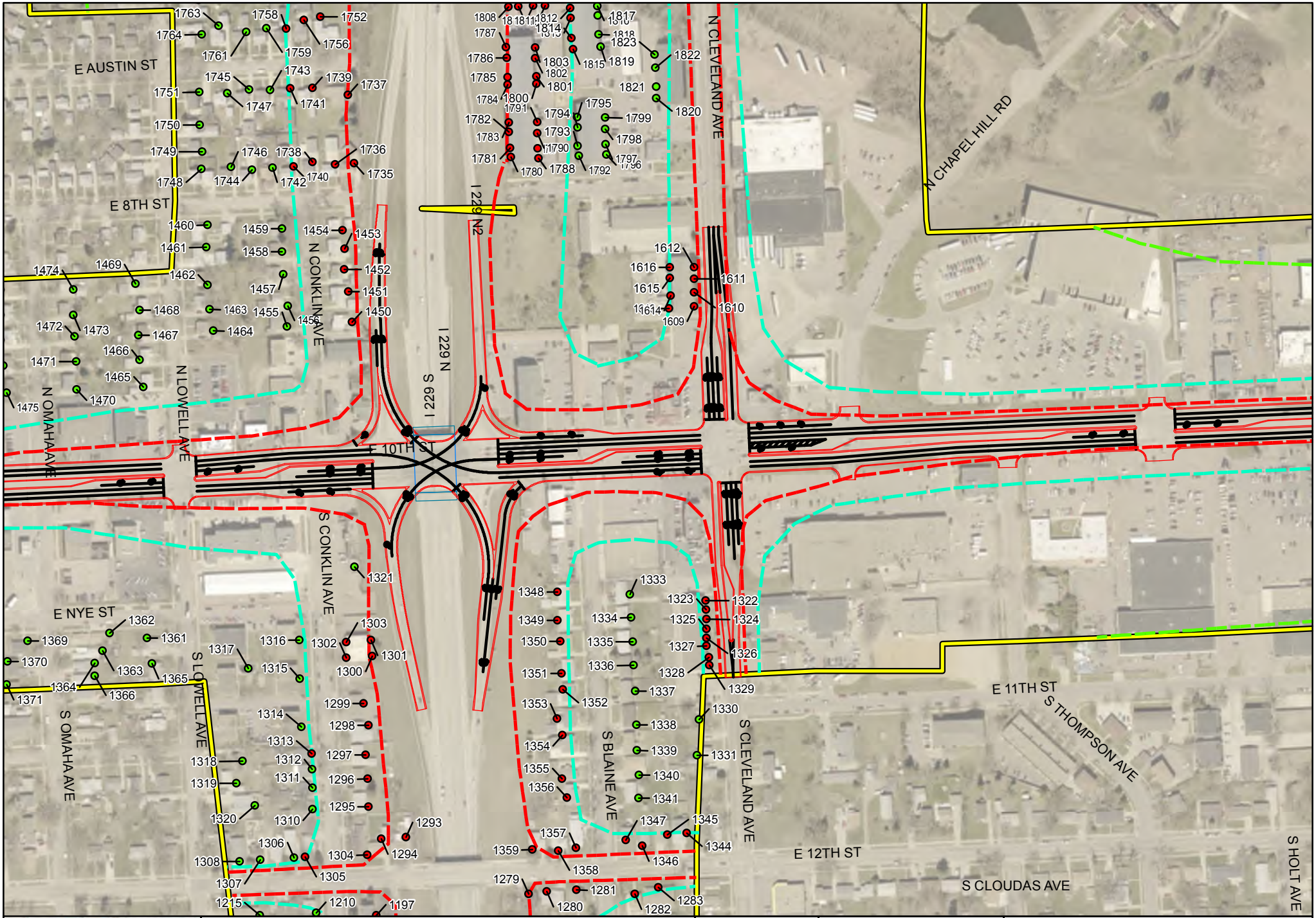
Legend

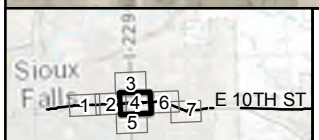
- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-2A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2A



I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2A

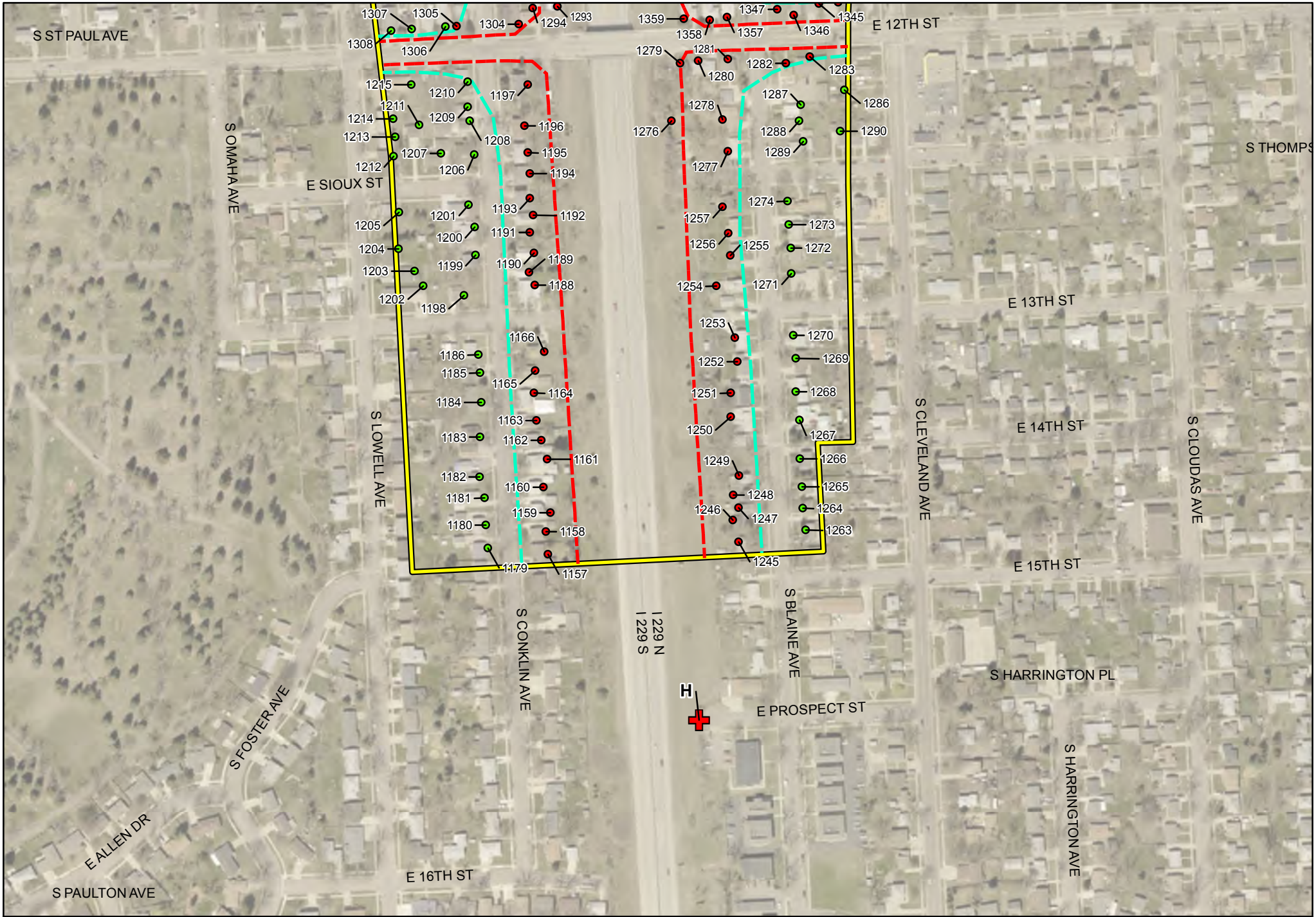


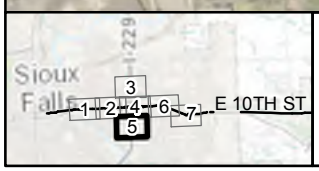


Legend

- 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 3 Concept Linework 10th-2A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2A

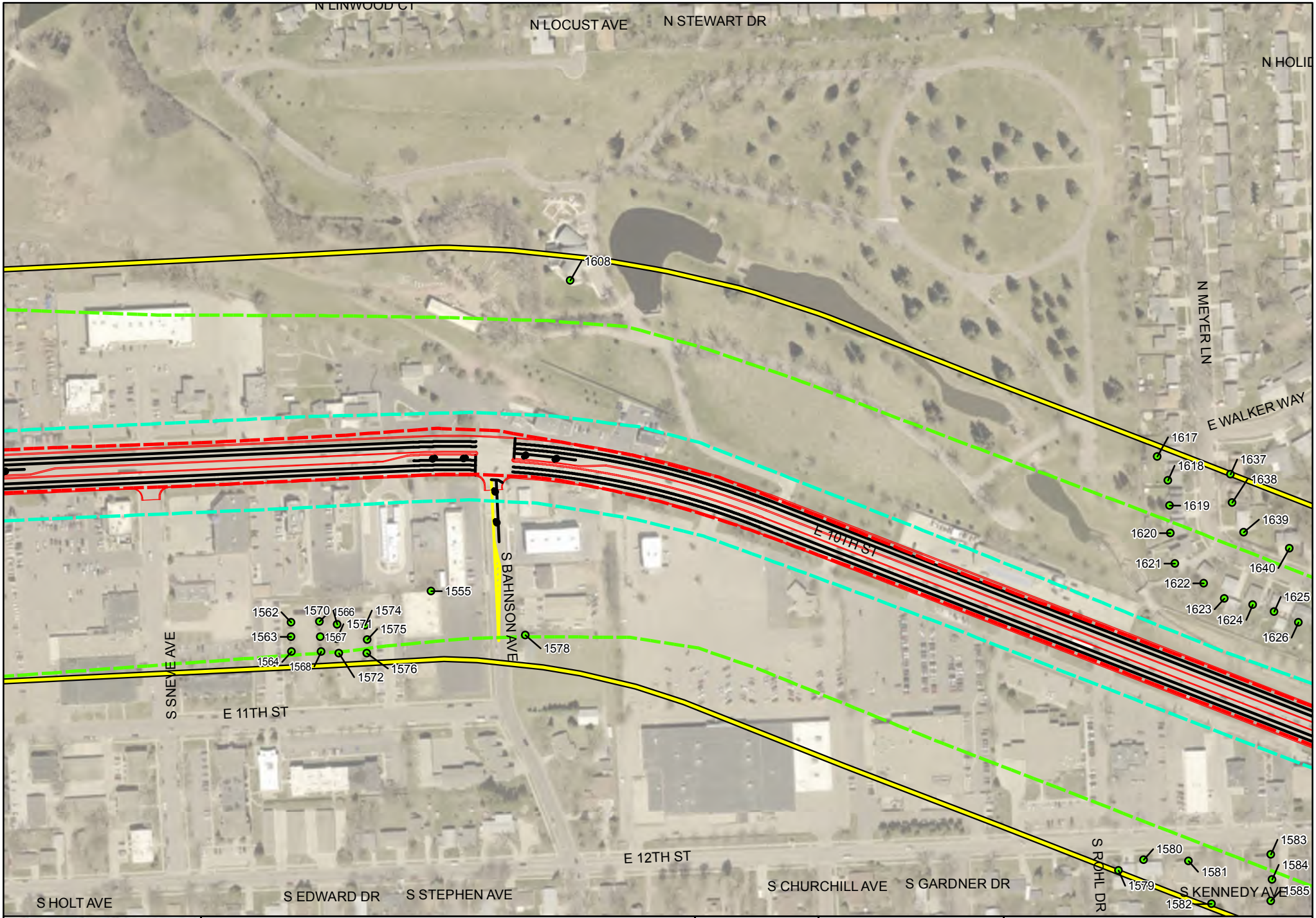


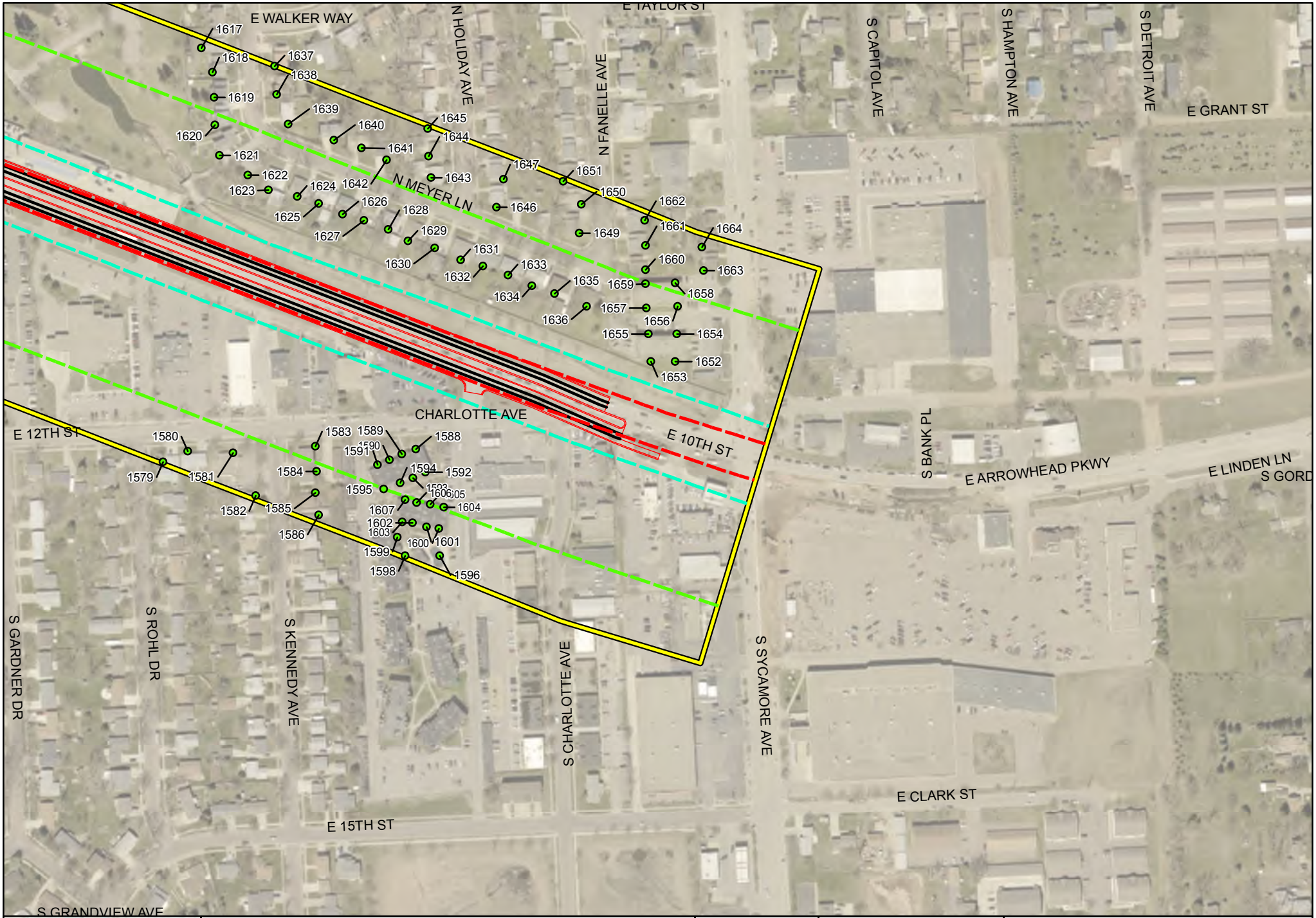


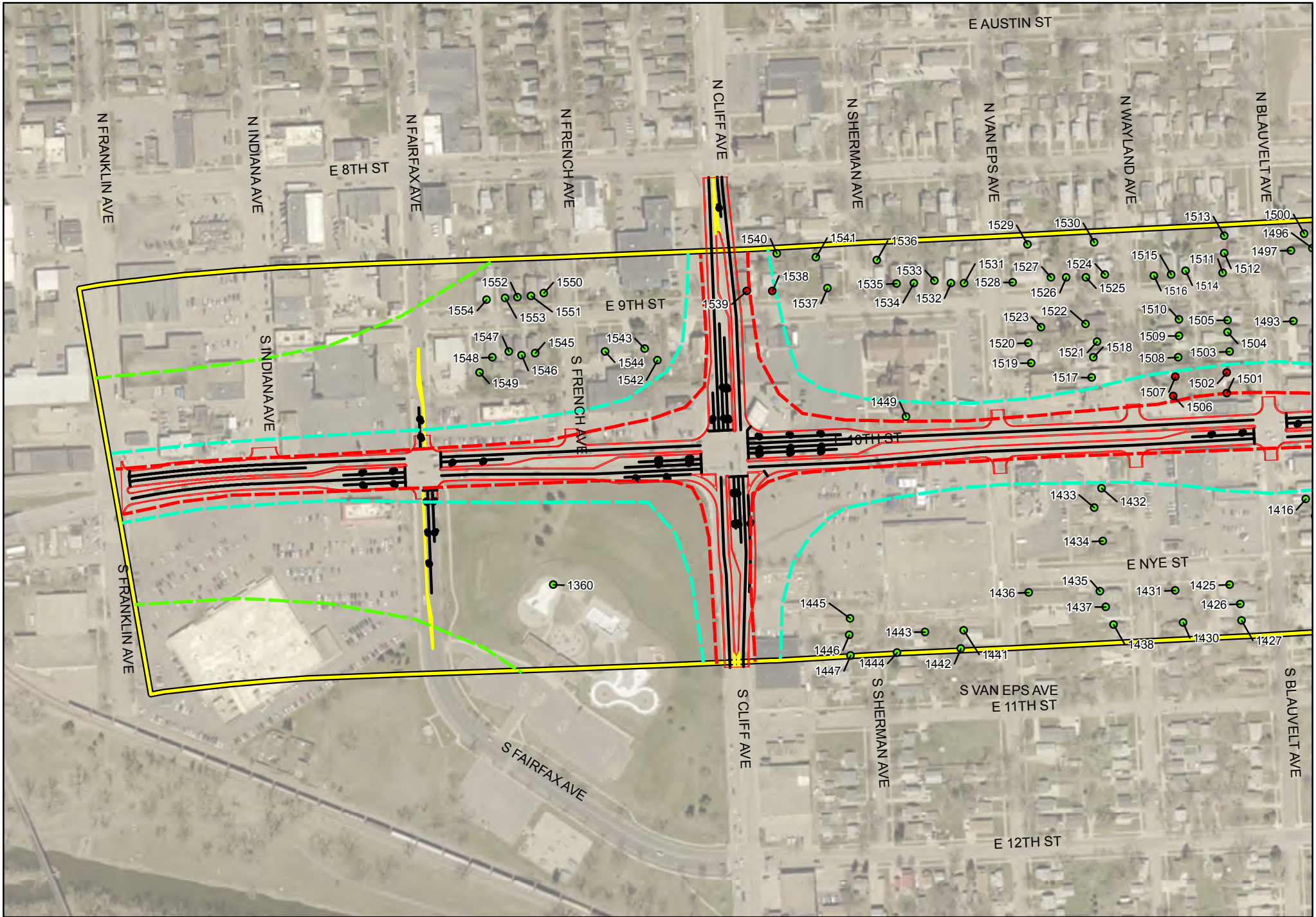
Legend

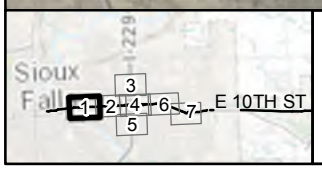
- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-2A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2A


N LINWOOD CT
N LOCUST AVE
N STEWART DR
N HOLID
N MEYER LN
E WALKER WAY
E 10TH ST
S BAHNSON AVE
S SNEVE AVE
E 11TH ST
E 12TH ST
S HOLT AVE
S EDWARD DR
S STEPHEN AVE
S CHURCHILL AVE
S GARDNER DR
S ROHL DR
S KENNEDY AVE
1608
1617
1618
1637
1638
1619
1639
1620
1640
1621
1622
1623
1624
1625
1626
1555
1562
1570
1566
1574
1571
1563
1567
1575
1564
1568
1572
1576
1578
1580
1581
1583
1584
1579
1585
1582
Sioux Falls
I-229
3
1
2
4
6
7
5
E 10TH ST
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 3 Concept Linework
10th-2A
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2A


E WALKER WAY
E TAYLOR ST
N HOLIDAY AVE
N FANELLE AVE
S CAPITOL AVE
S HAMPTON AVE
S DETROIT AVE
E GRANT ST
N MEYER LN
CHARLOTTE AVE
E 12TH ST
E 10TH ST
S BANK PL
E ARROWHEAD PKWY
E LINDEN LN
S GORD
S GARDNER DR
S ROHL DR
S KENNEDY AVE
S CHARLOTTE AVE
S SYCAMORE AVE
E CLARK ST
E 15TH ST
S GRANDVIEW AVE
1617
1618
1637
1638
1619
1639
1620
1640
1645
1644
1621
1641
1647
1651
1622
1642
1643
1623
1624
1650
1662
1625
1626
1646
1628
1661
1664
1627
1629
1649
1631
1630
1660
1663
1632
1633
1635
1659
1658
1634
1657
1636
1656
1655
1654
1652
1653
1580
1583
1589
1588
1591
1579
1581
1584
1594
1592
1595
1606
1605
1582
1585
1607
1604
1602
1586
1603
1600
1601
1599
1598
1596
Sioux Falls
I-229
1
2
3
4
5
6
7
E 10TH ST
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 3 Concept Linework
10th-2A
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2A

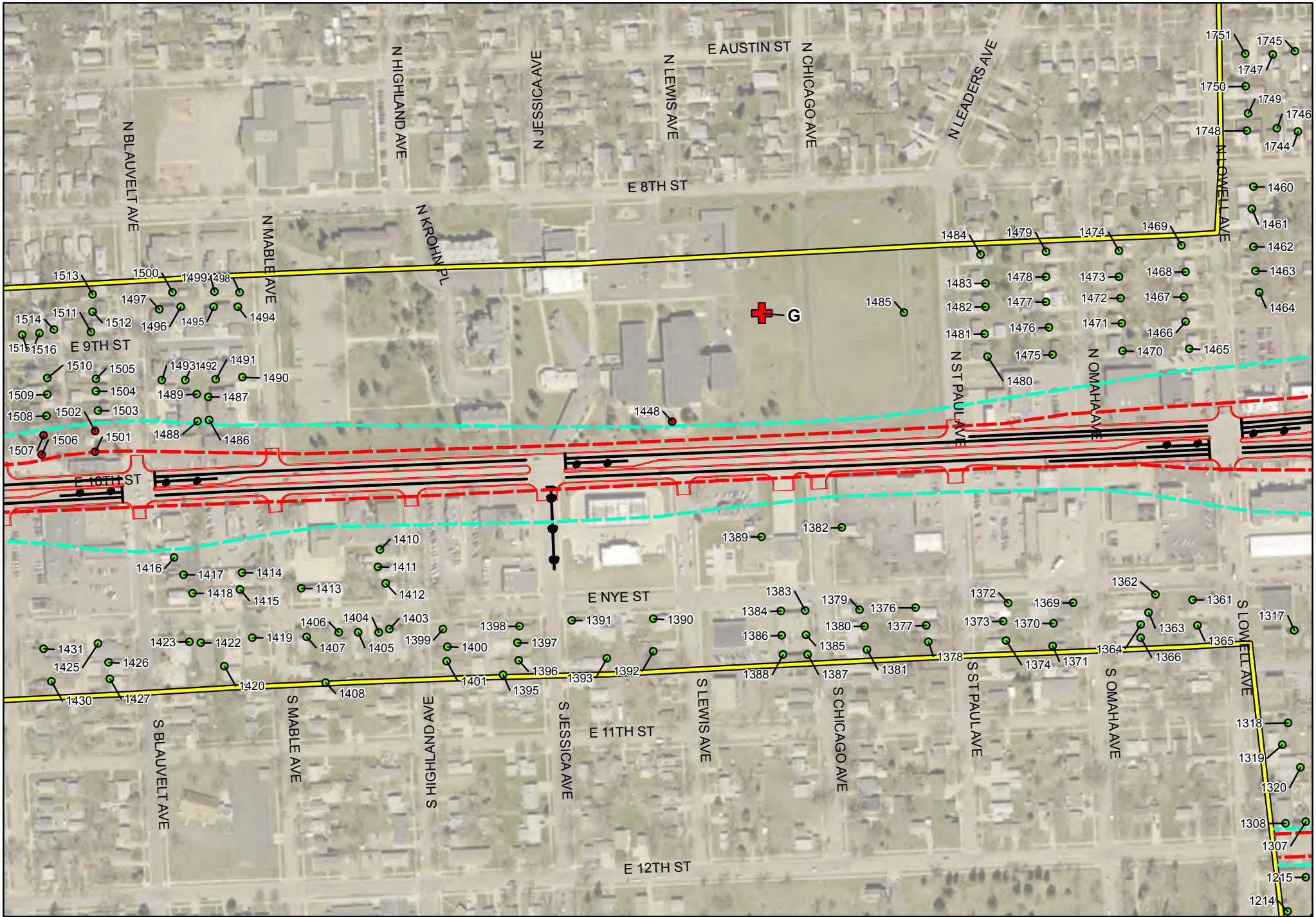


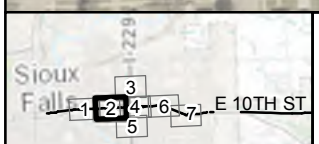


Legend

- 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 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2B

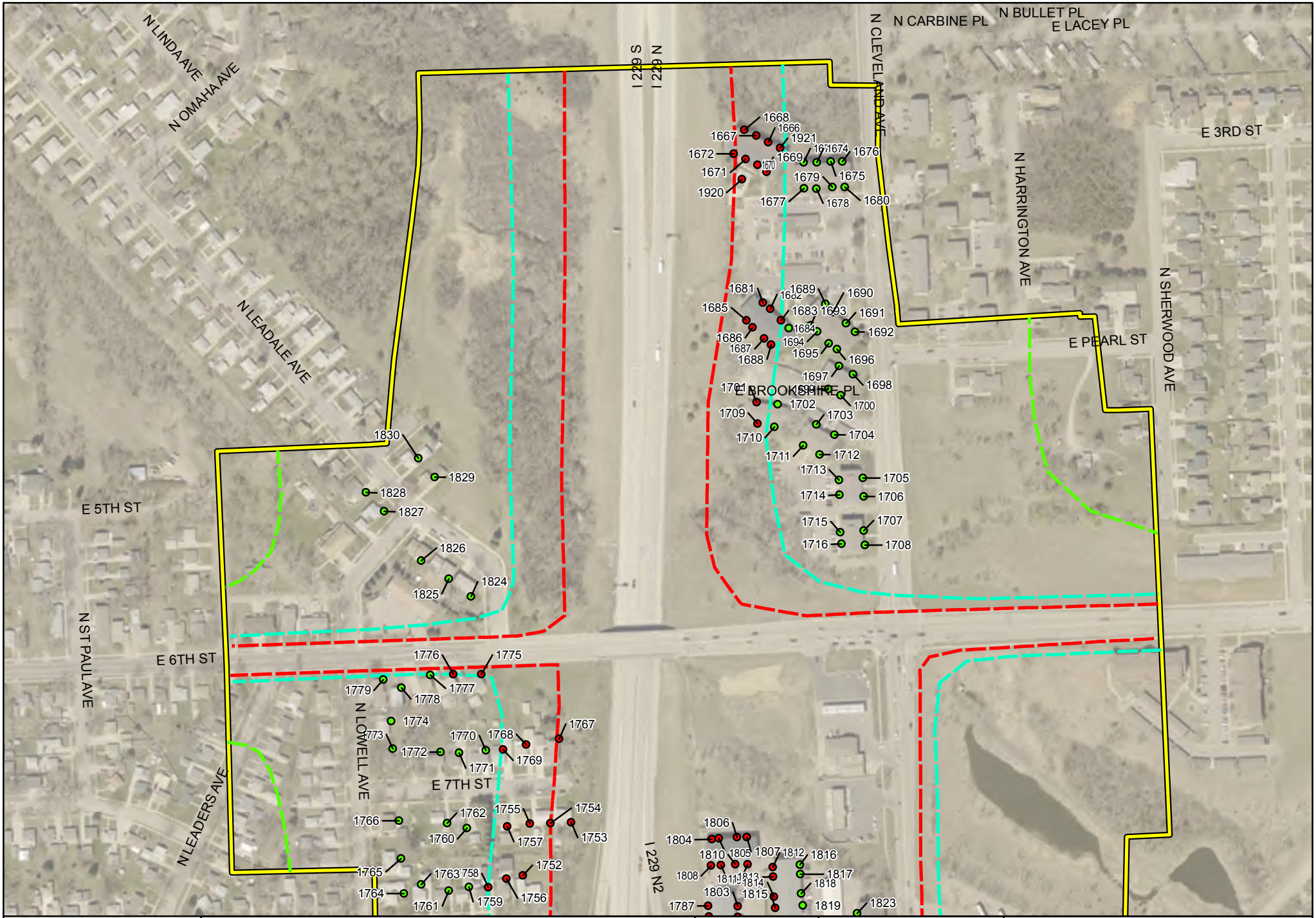


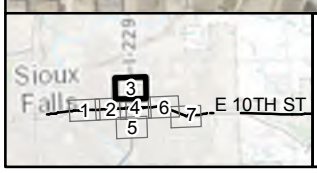


Legend

- 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 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2B



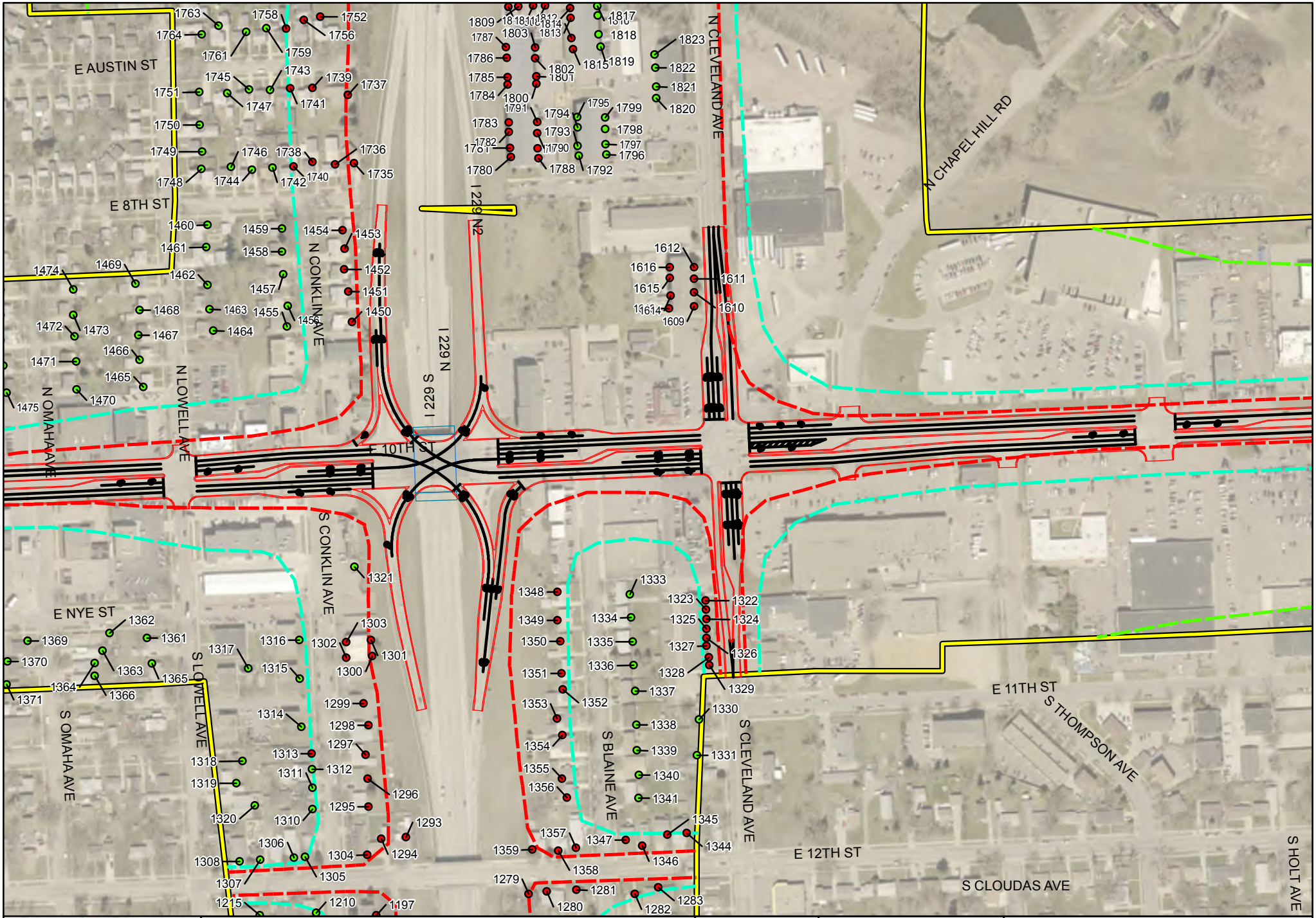


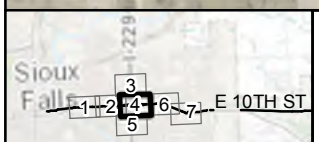
Legend

- 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 3 Concept Linework 10th-5B

HDR

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2B

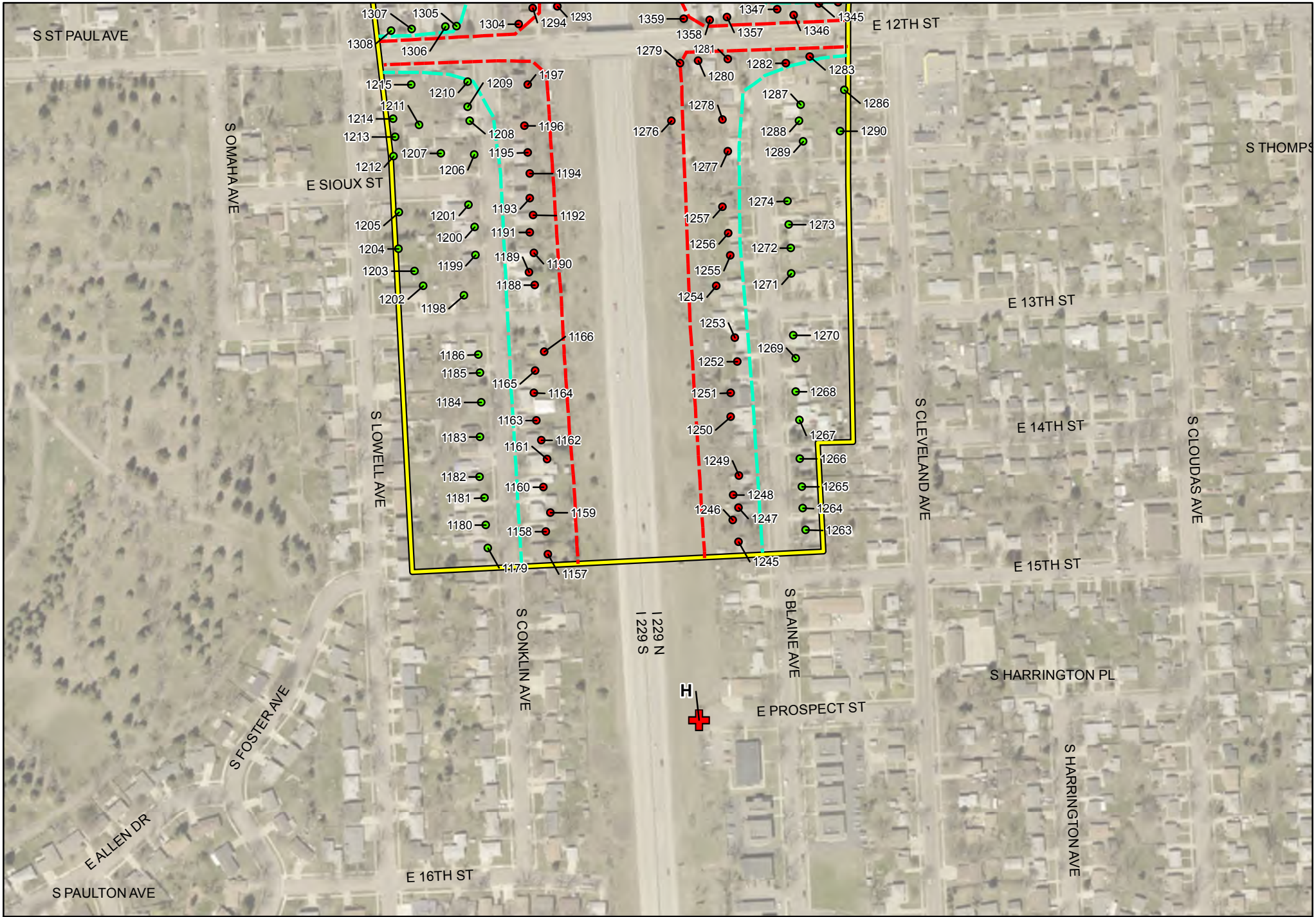


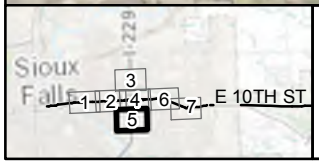


Legend

- 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 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2B

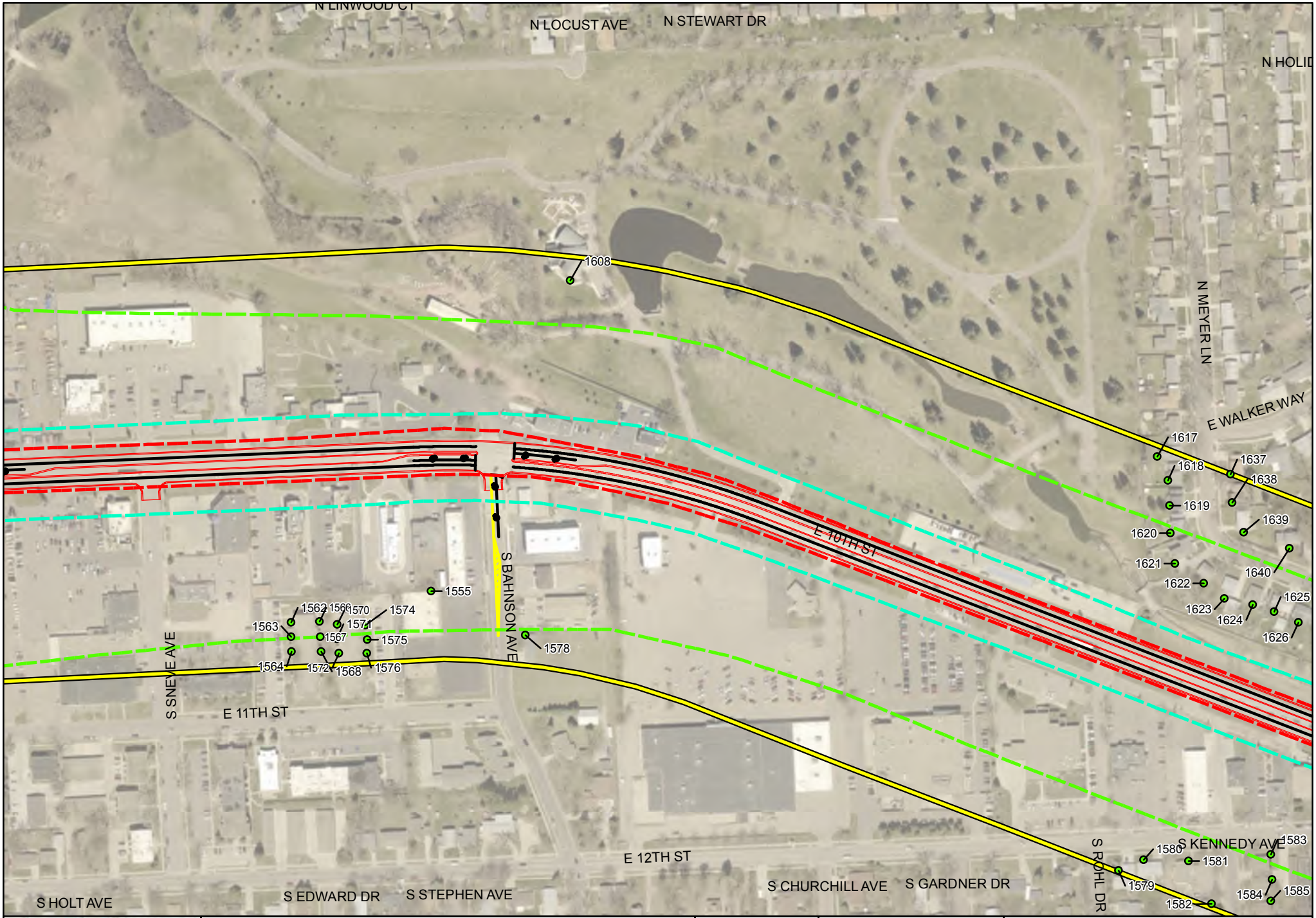


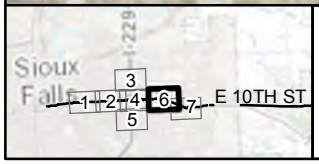


Legend

- 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 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2B

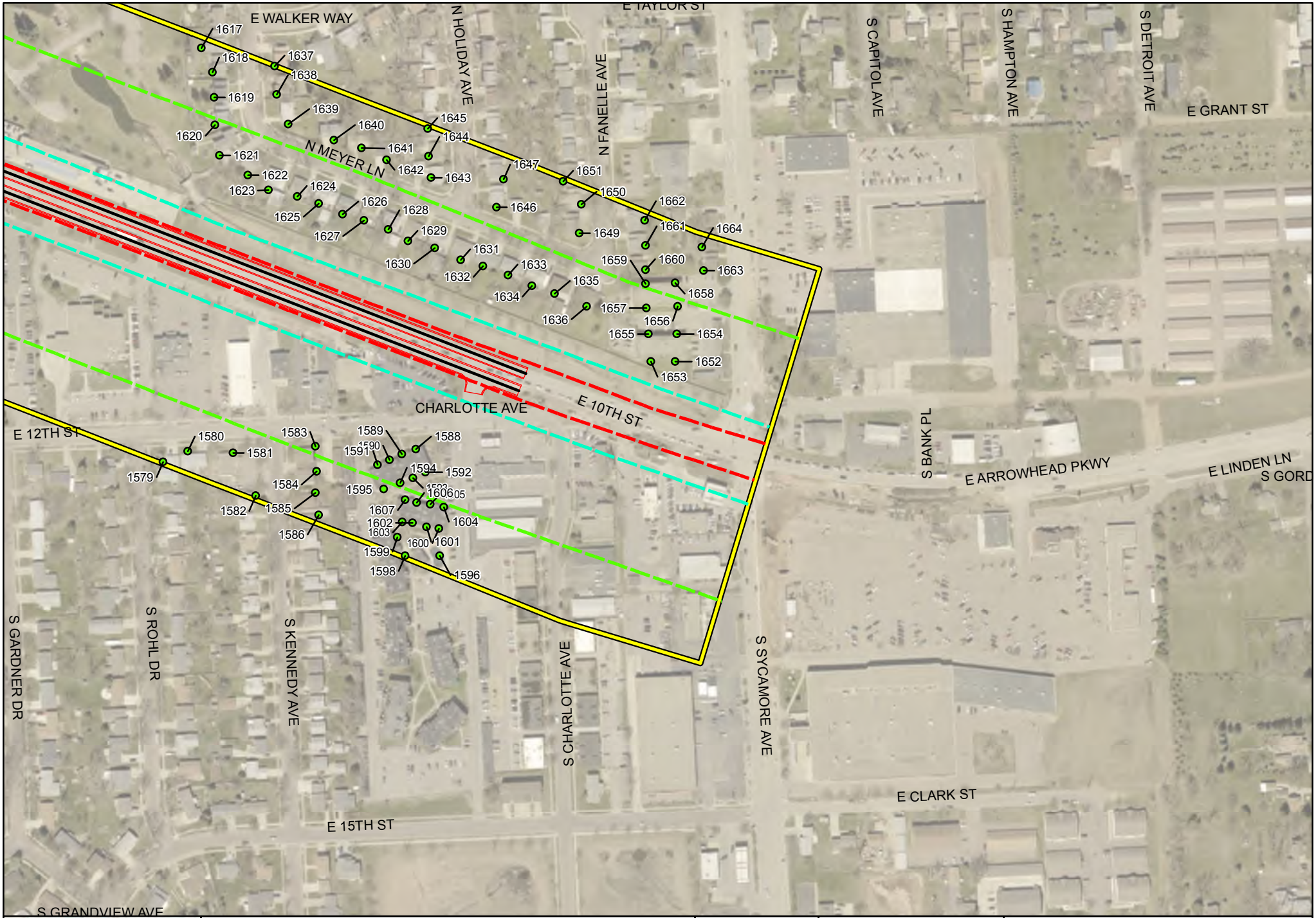


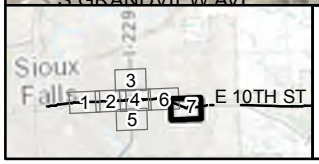


Legend

- 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 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2B

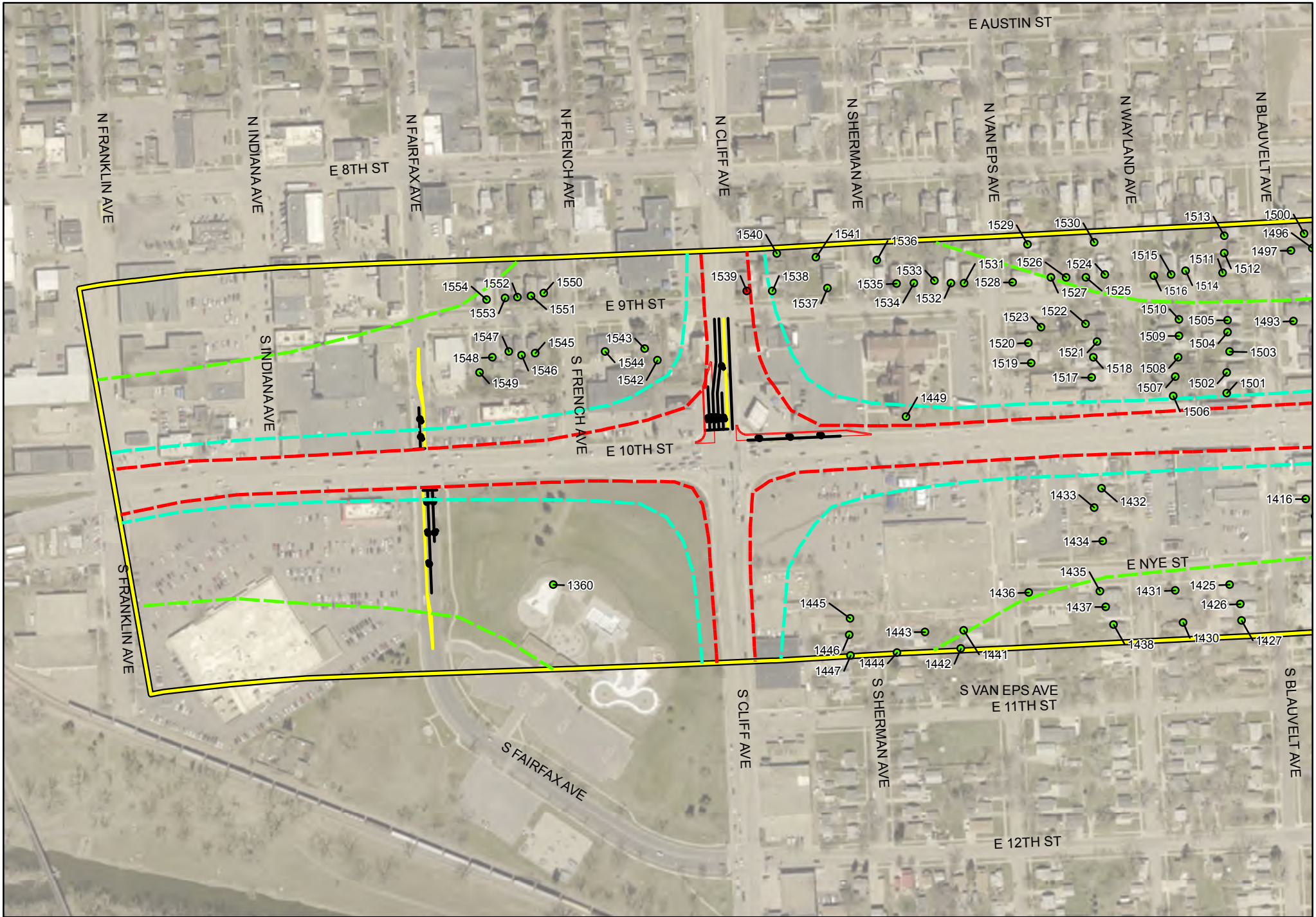


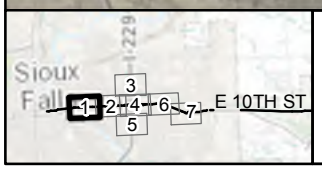


Legend

- 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 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2B

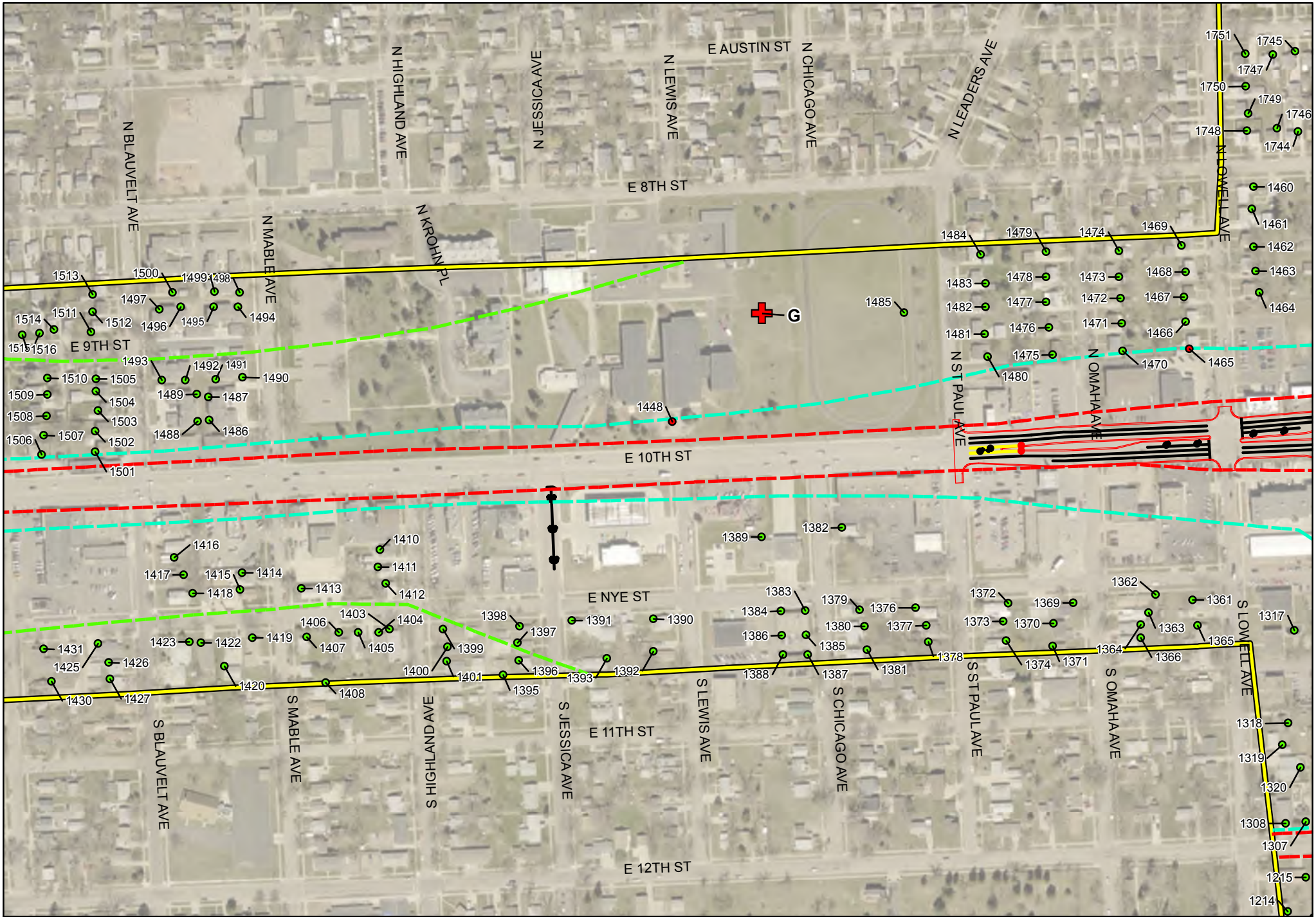


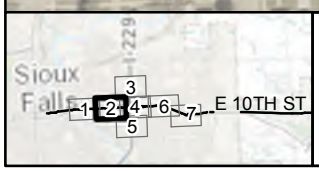


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2C

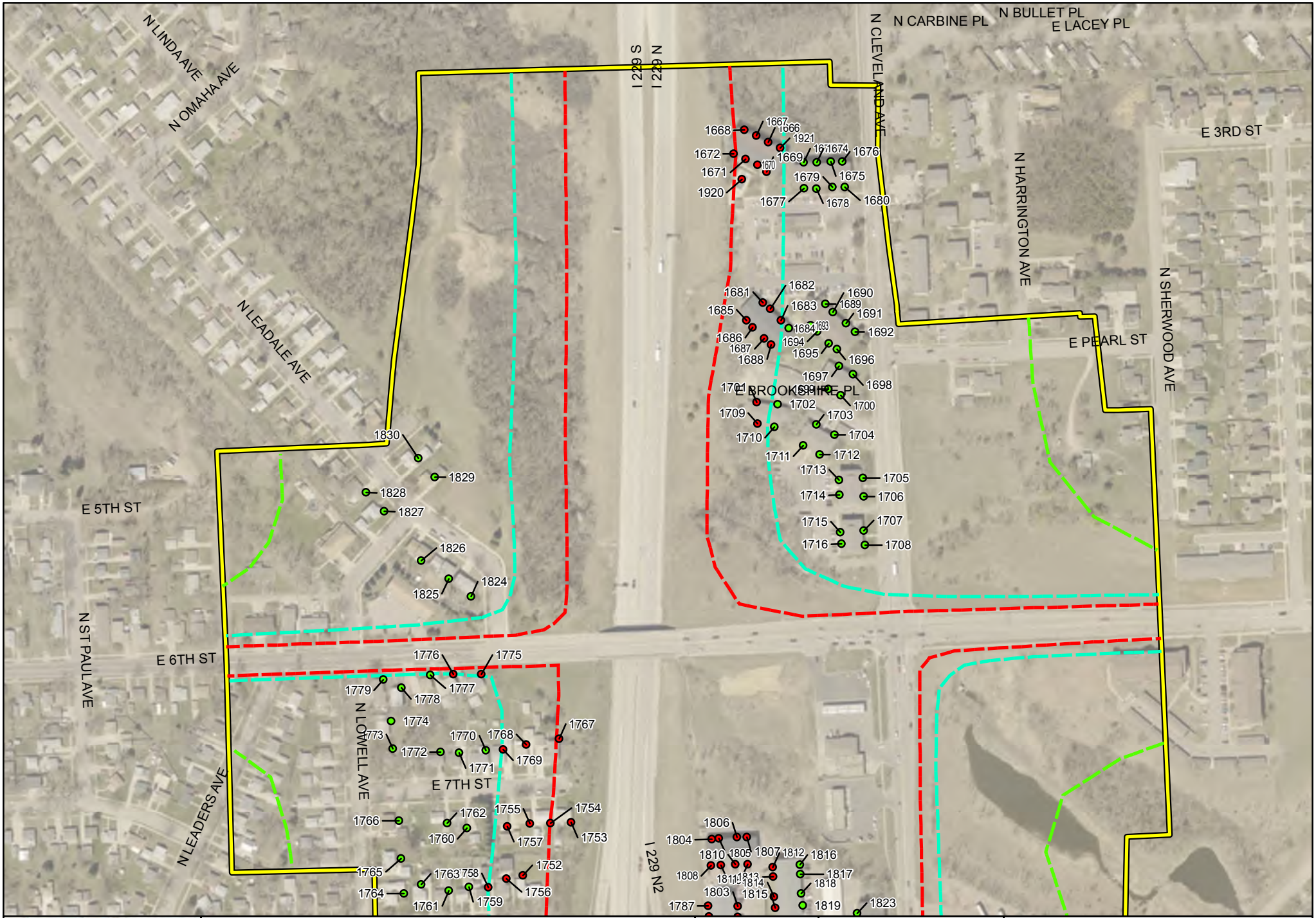


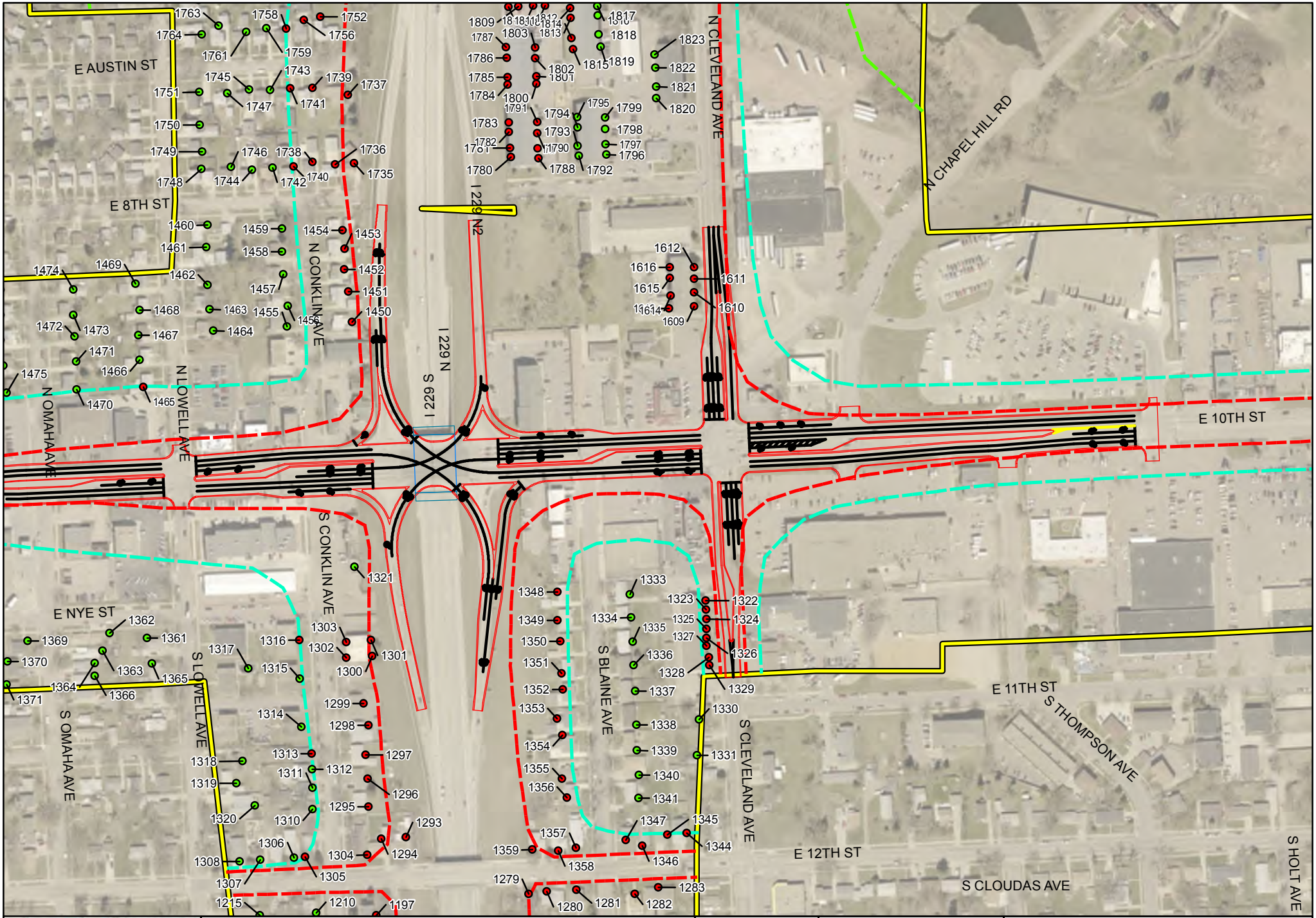


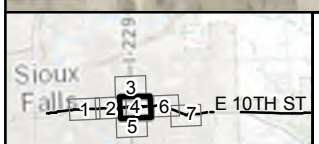
Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2C


N LINDA AVE
N OMAHA AVE
N LEADALE AVE
N LEADERS AVE
N ST PAUL AVE
N LOWELL AVE
I 229 S
I 229 N
N CLEVELAND AVE
N CARBINE PL
N BULLET PL
E LACEY PL
E 3RD ST
N HARRINGTON AVE
N SHERWOOD AVE
E PEARL ST
E BROOKSHIRE PL
E 5TH ST
E 6TH ST
E 7TH ST
E 10TH ST
1830
1829
1828
1827
1826
1825
1824
1776
1775
1779
1778
1777
1774
1773
1772
1771
1770
1769
1768
1767
1766
1762
1760
1757
1755
1754
1753
1765
1764
1763
1761
1759
1758
1756
1752
1668
1667
1666
1921
1672
1669
1671
1670
1920
1677
1679
1678
1676
1675
1674
1680
1681
1682
1685
1683
1690
1689
1691
1684
1693
1692
1686
1687
1694
1688
1695
1696
1697
1698
1701
1699
1702
1700
1709
1703
1710
1704
1711
1712
1713
1705
1714
1706
1715
1707
1716
1708
1806
1804
1810
1805
1807
1812
1816
1808
1811
1813
1814
1817
1803
1815
1818
1787
1819
1823
Sioux Falls
1
2
3
4
5
6
7
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 3 Concept Linework
10th-2C
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2C

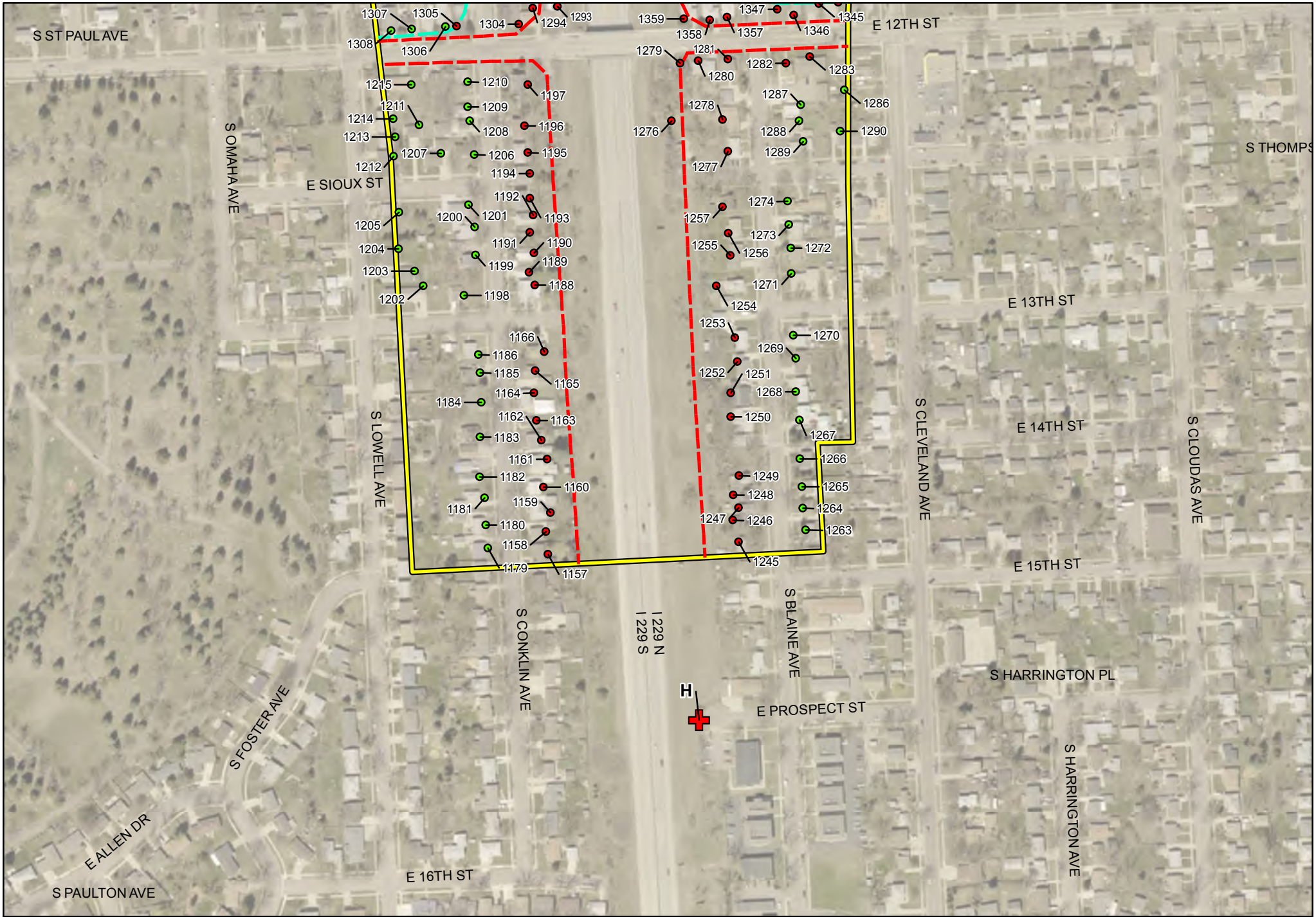


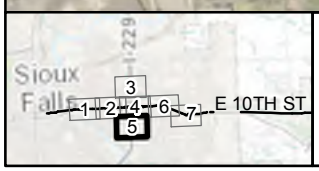


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2C

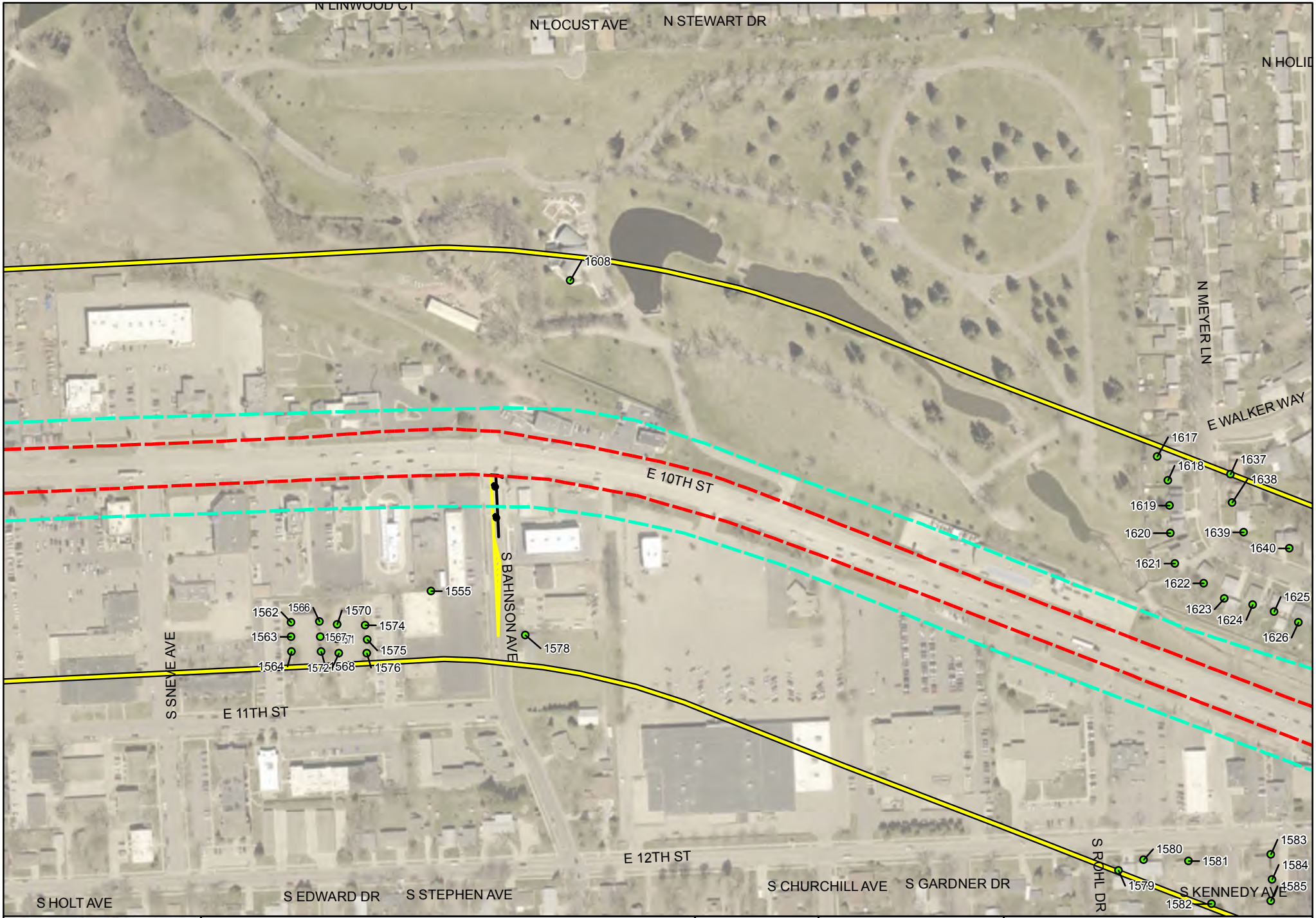




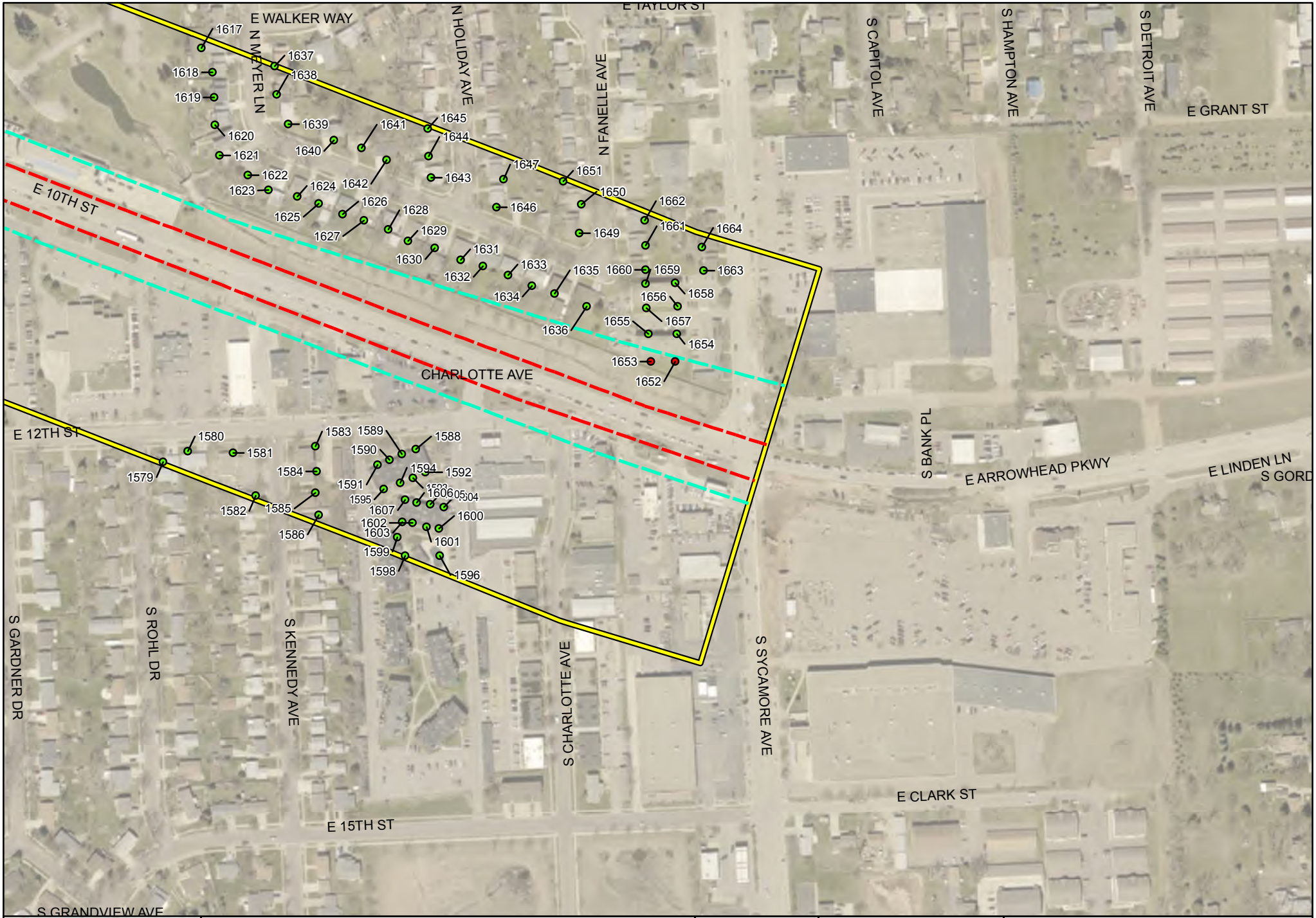
Legend

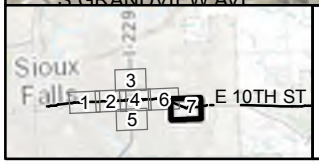
- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2C



I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2C

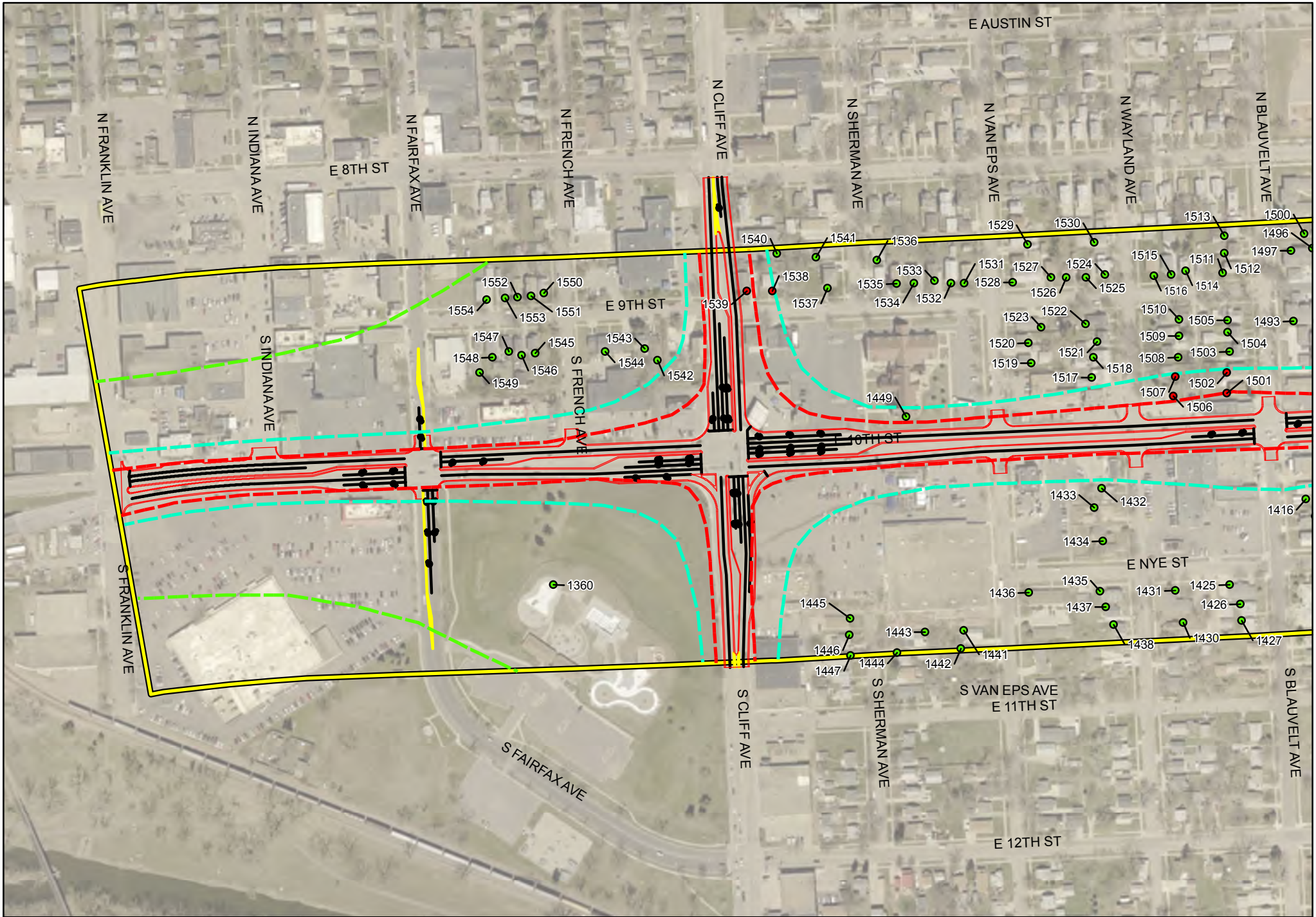


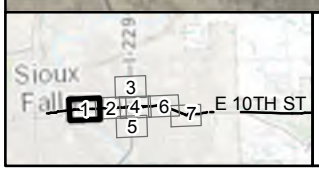


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2C

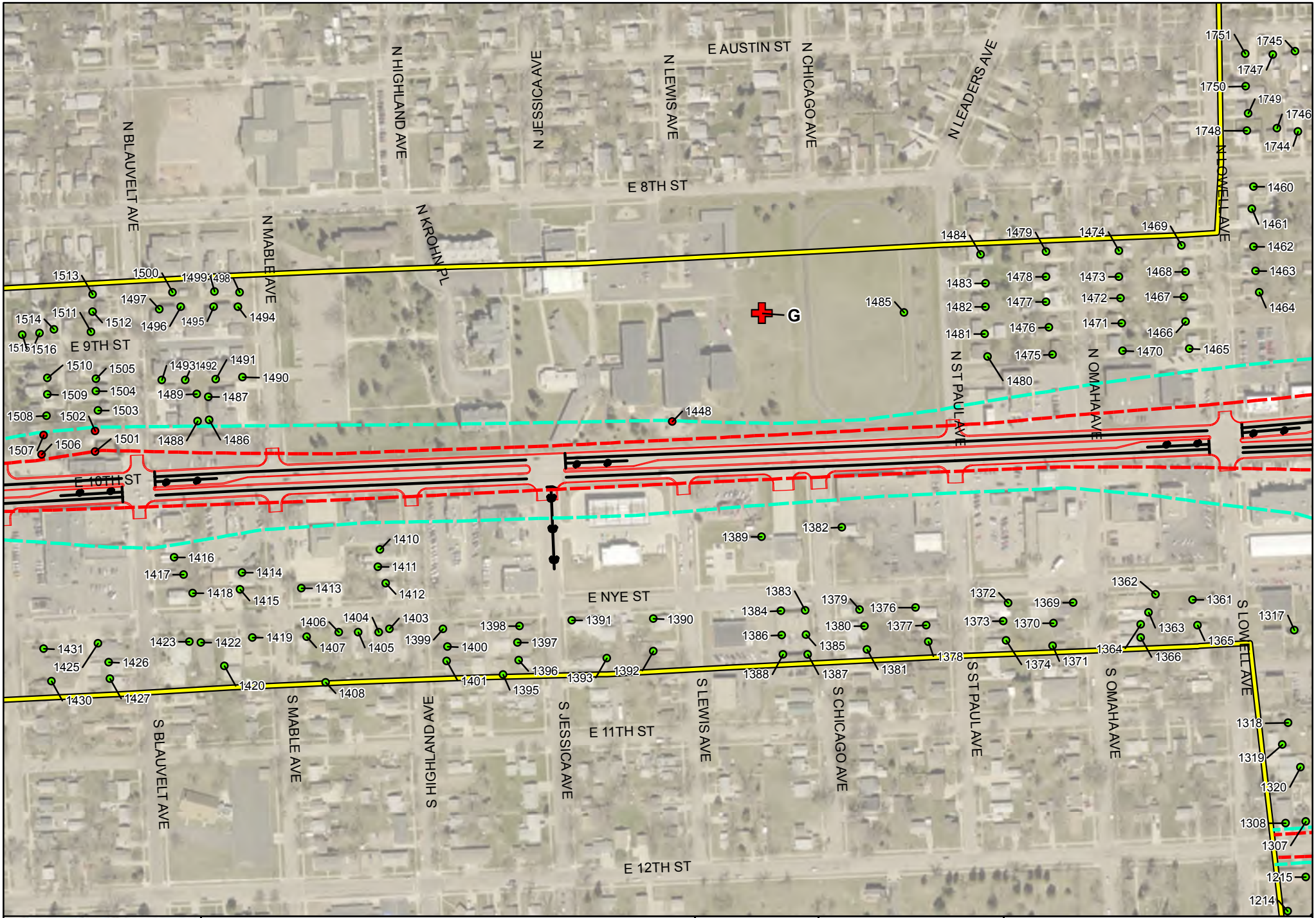


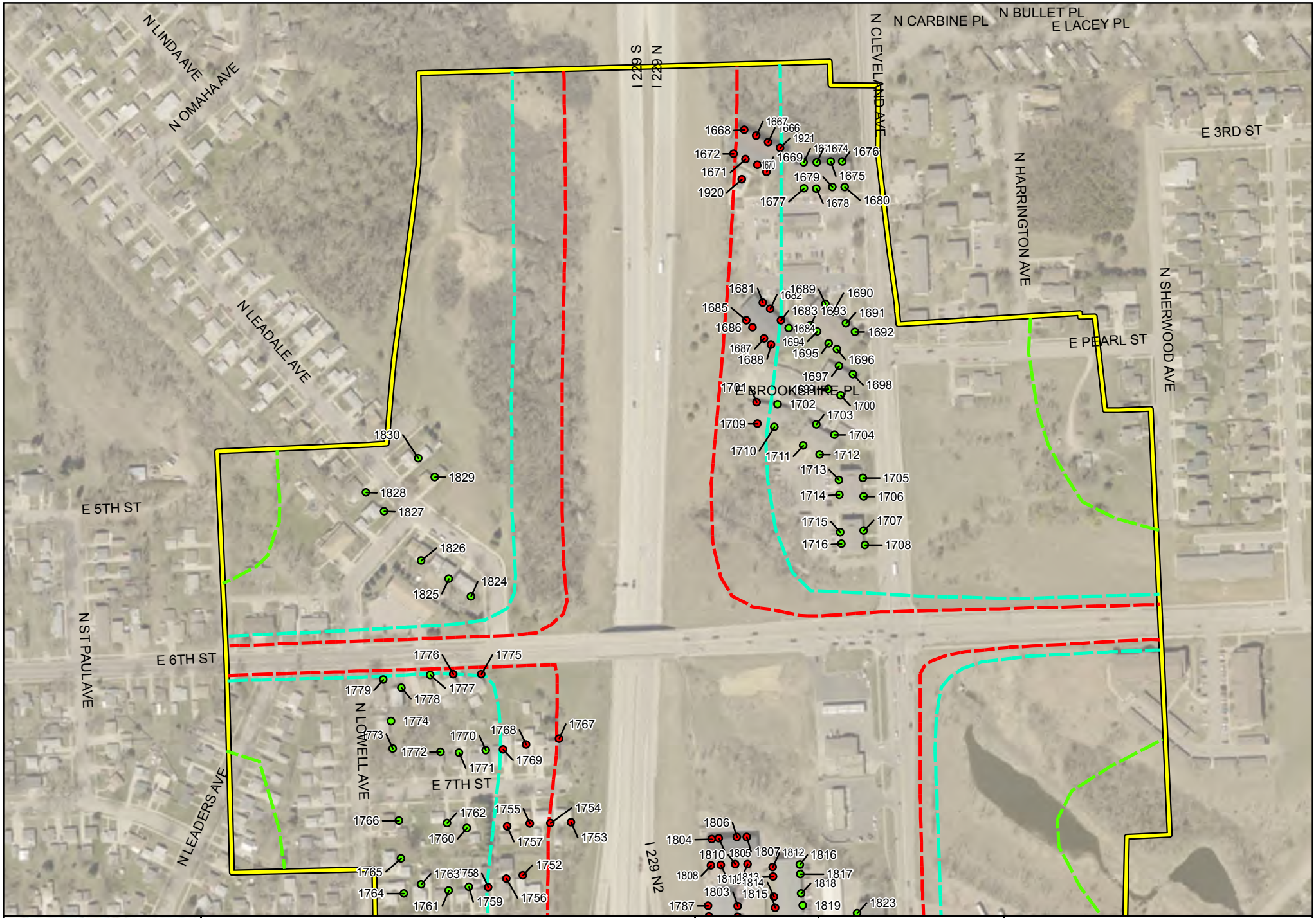


Legend

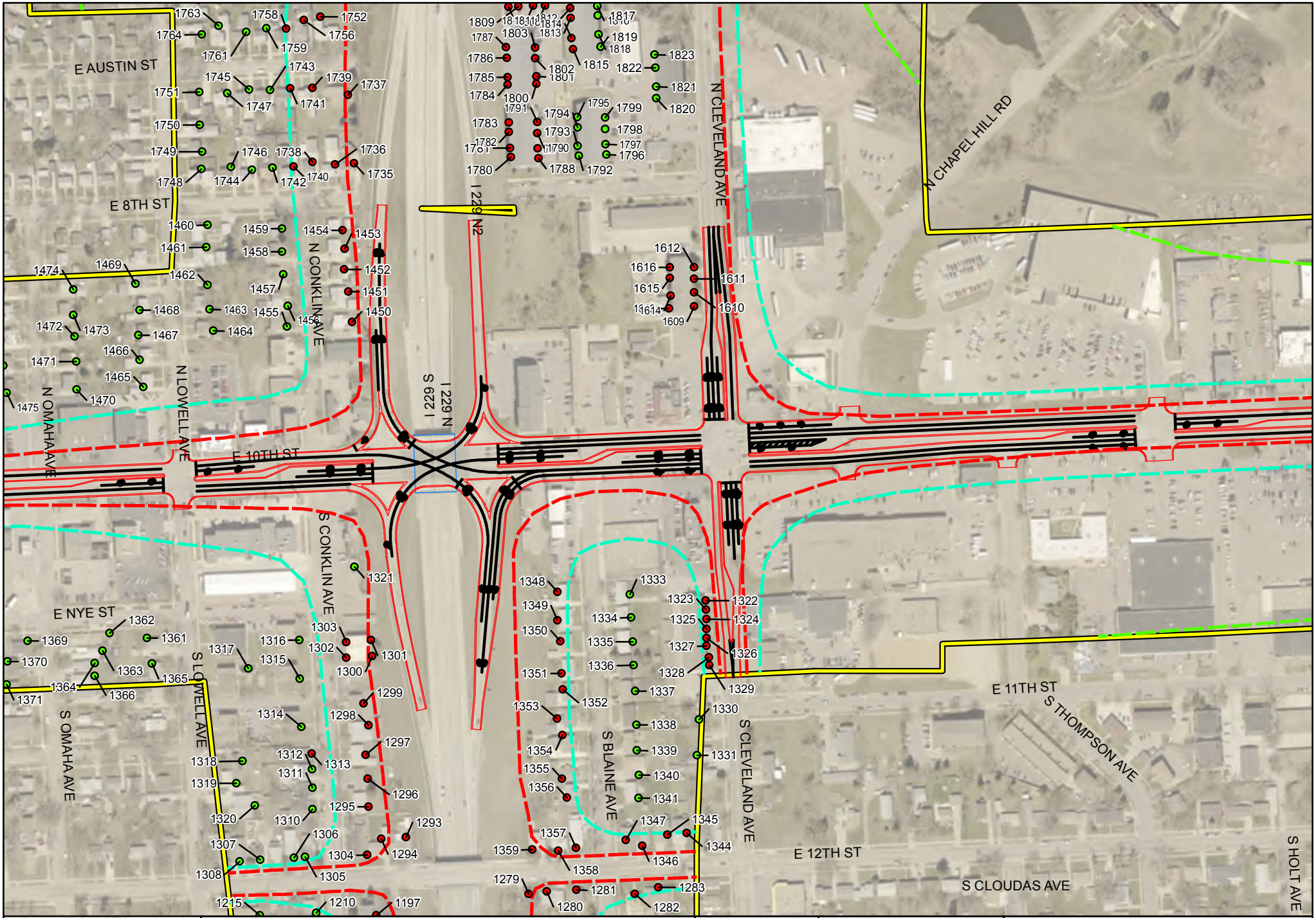
- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2D

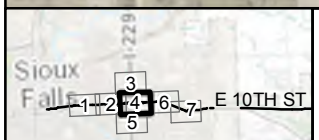
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2D


N BLAUVELT AVE
N HIGHLAND AVE
N JESSICA AVE
N LEWIS AVE
E AUSTIN ST
N CHICAGO AVE
N LEADERS AVE
N LOWELL AVE
E 8TH ST
N MABLE AVE
N KROHN PL
E 9TH ST
N ST PAUL AVE
N OMAHA AVE
E 10TH ST
E NYE ST
E 11TH ST
E 12TH ST
S BLAUVELT AVE
S MABLE AVE
S HIGHLAND AVE
S JESSICA AVE
S LEWIS AVE
S CHICAGO AVE
S ST PAUL AVE
S OMAHA AVE
S LOWELL AVE
G
1751
1745
1747
1750
1749
1746
1748
1744
1460
1461
1462
1463
1464
1484
1479
1474
1469
1483
1478
1473
1468
1482
1477
1472
1467
1485
1481
1476
1471
1466
1475
1470
1465
1480
1513
1500
1499
1498
1497
1496
1495
1494
1514
1511
1512
1515
1516
1510
1505
1493
1492
1491
1490
1509
1504
1489
1487
1508
1502
1503
1507
1506
1501
1488
1486
1448
1389
1382
1410
1416
1411
1417
1414
1413
1418
1415
1412
1383
1379
1376
1384
1380
1377
1406
1404
1403
1398
1391
1390
1423
1422
1419
1407
1405
1399
1400
1397
1386
1385
1378
1431
1426
1425
1396
1393
1392
1388
1387
1381
1420
1401
1395
1430
1427
1408
1372
1369
1362
1361
1373
1370
1363
1365
1317
1364
1374
1371
1366
1318
1319
1320
1308
1307
1215
1214
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 3 Concept Linework
10th-2D
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2D



I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2D

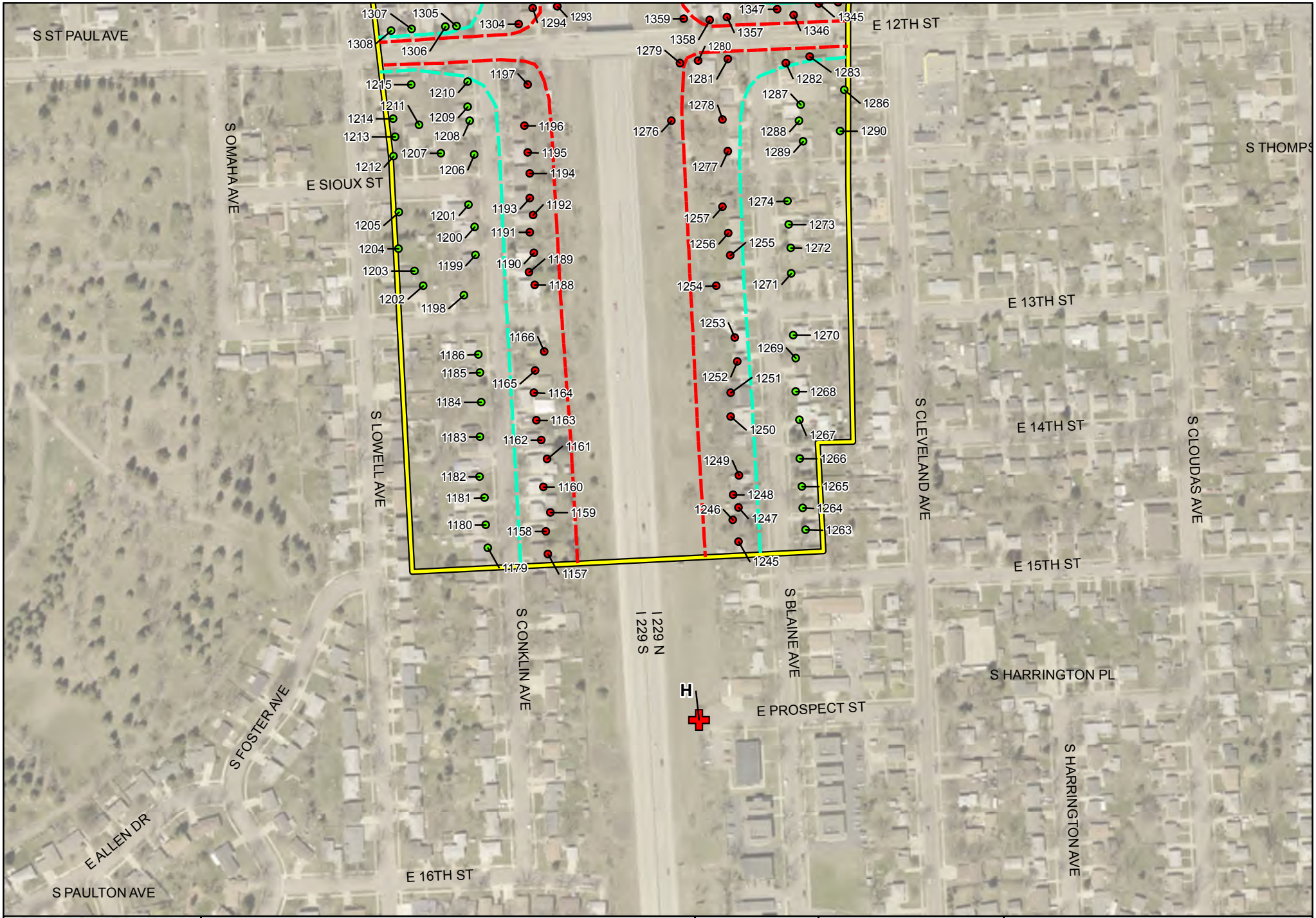




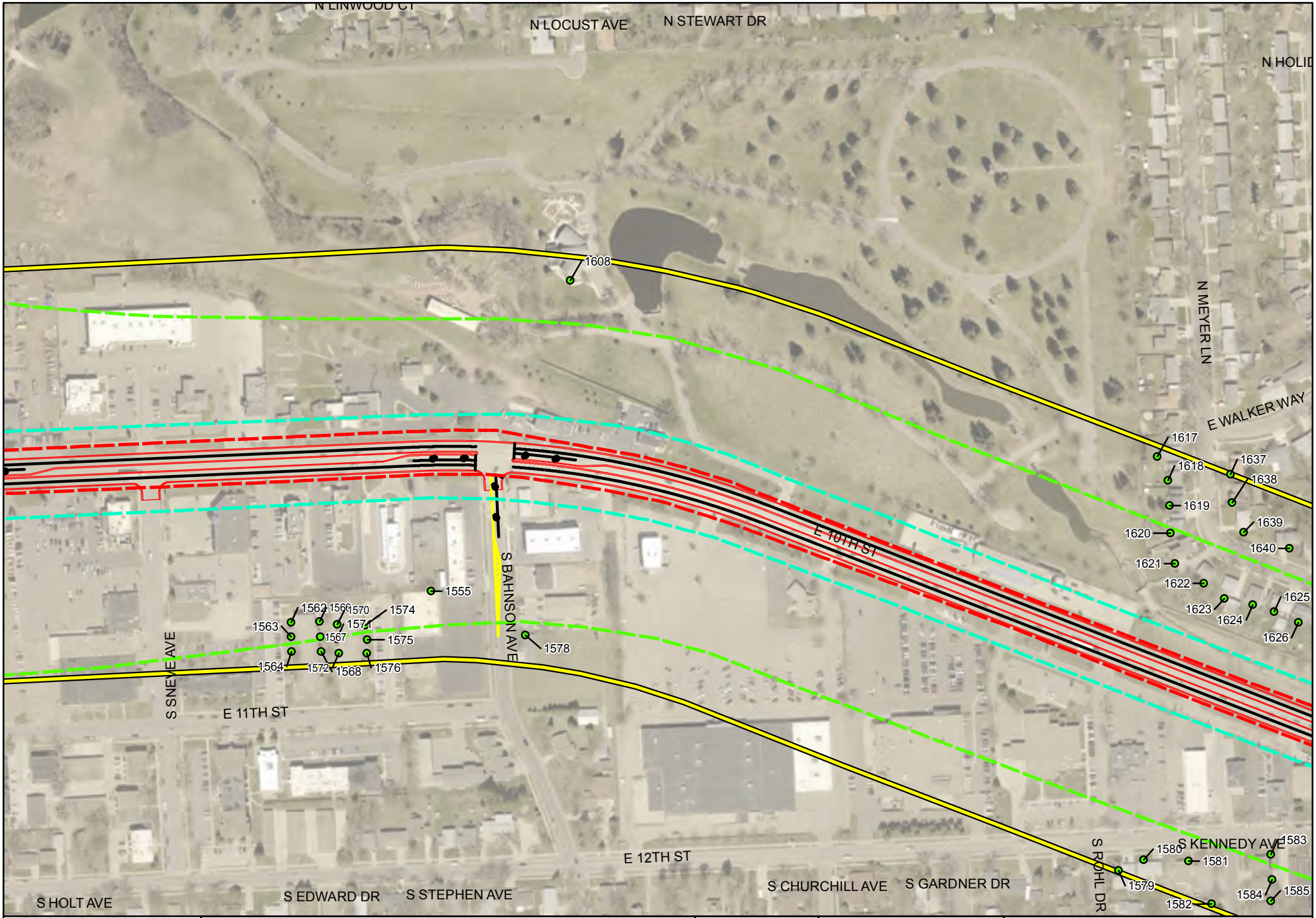
Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2D

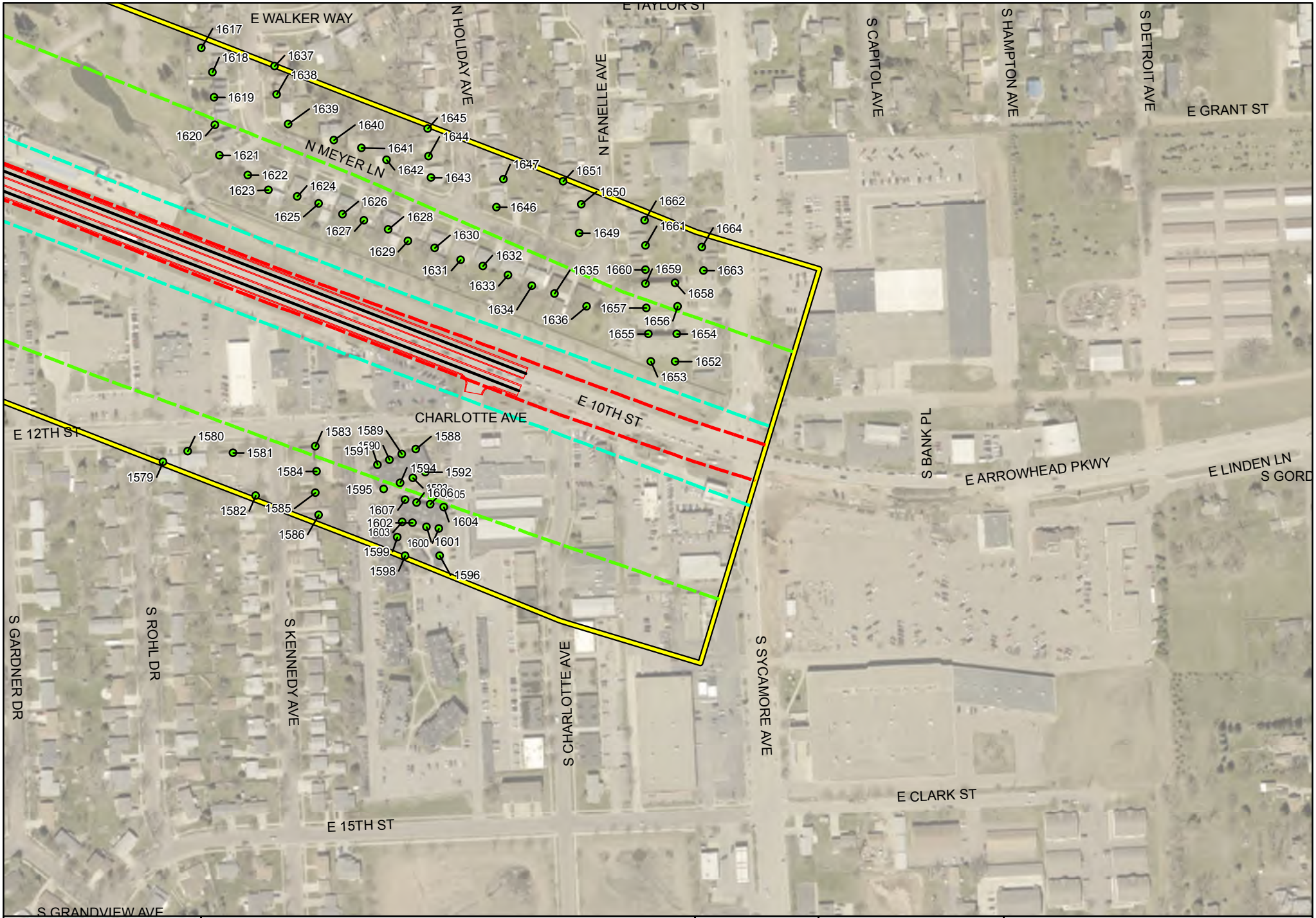
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2D

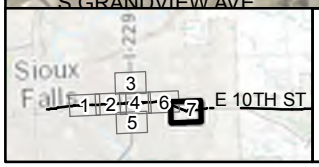


I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2D



I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2D

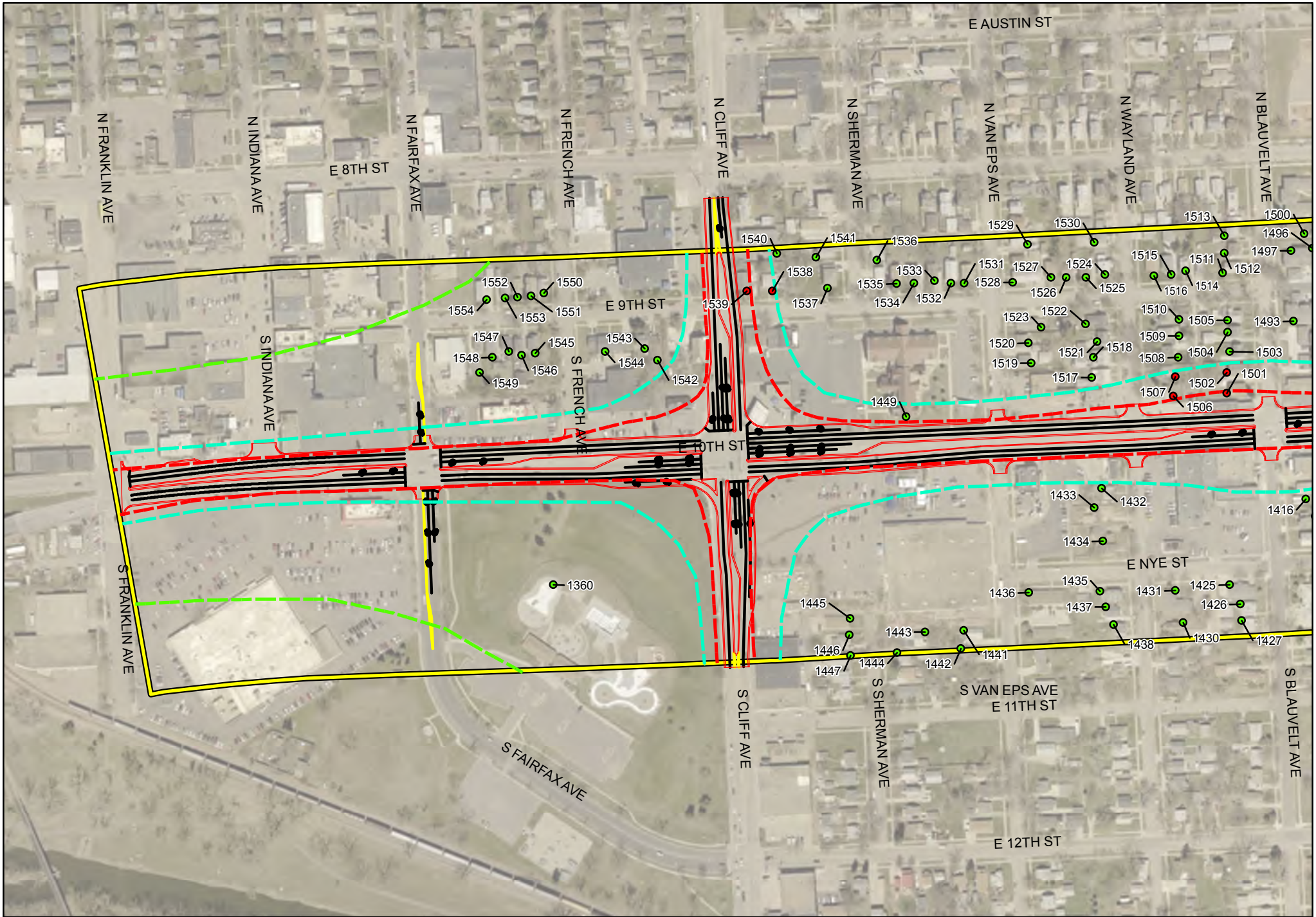


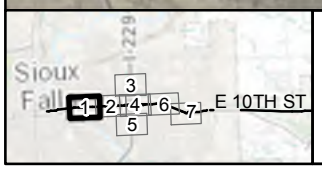


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2D

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2D

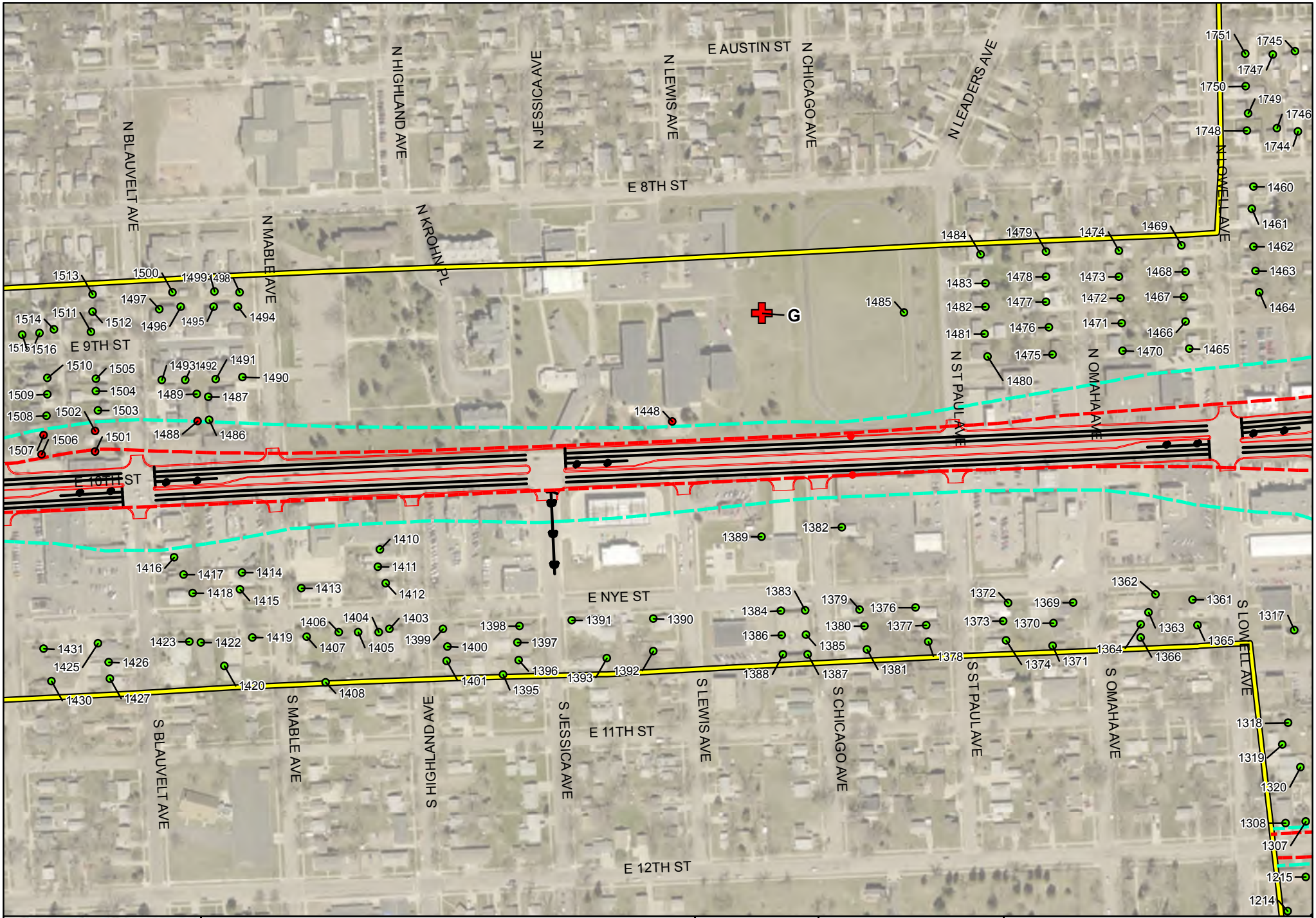


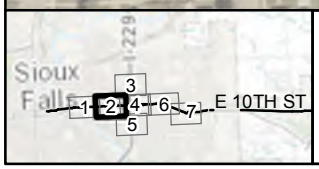


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2E

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2E

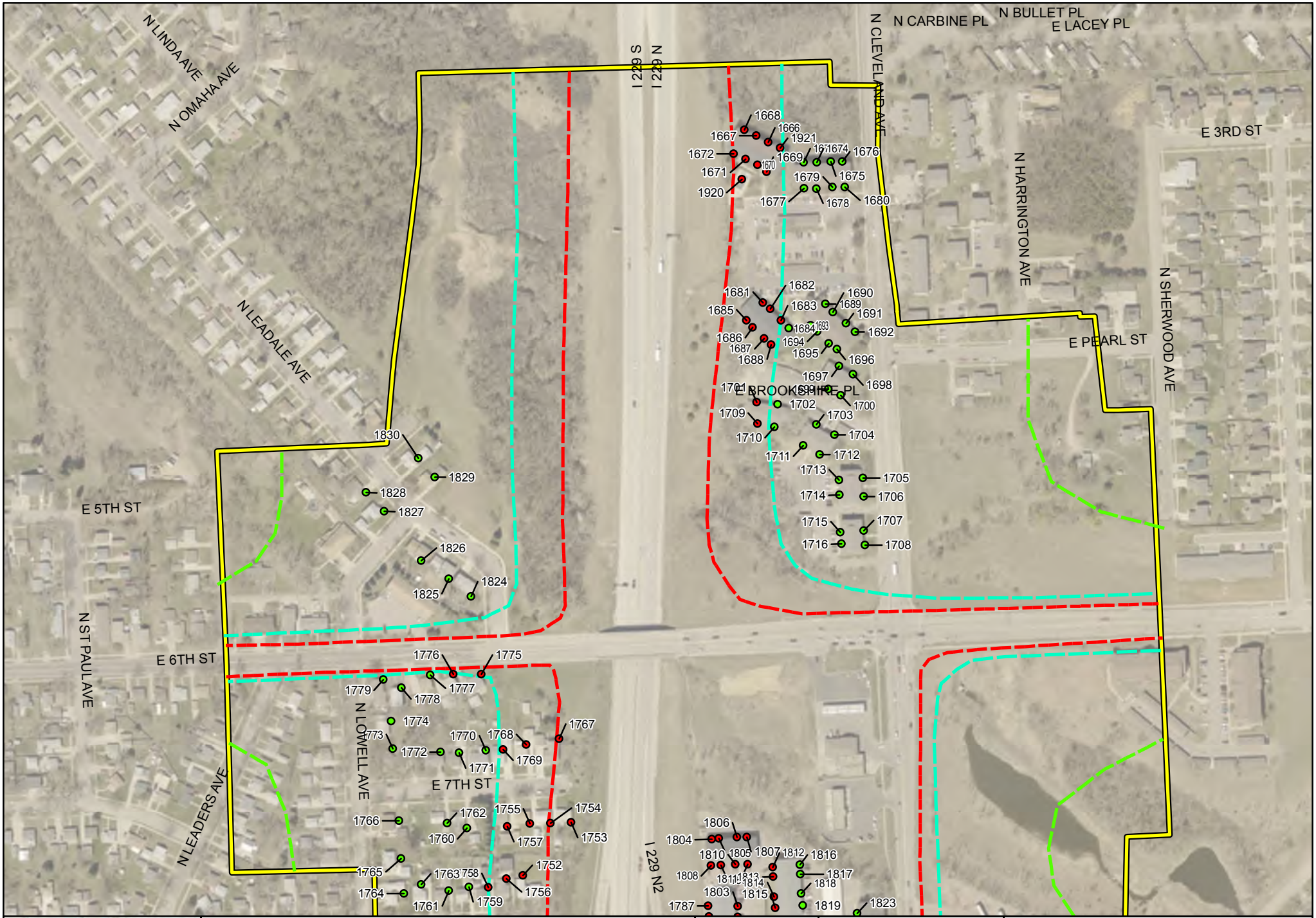


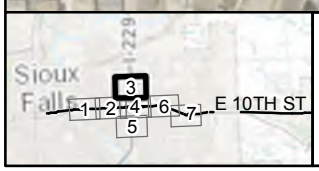


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2E

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2E

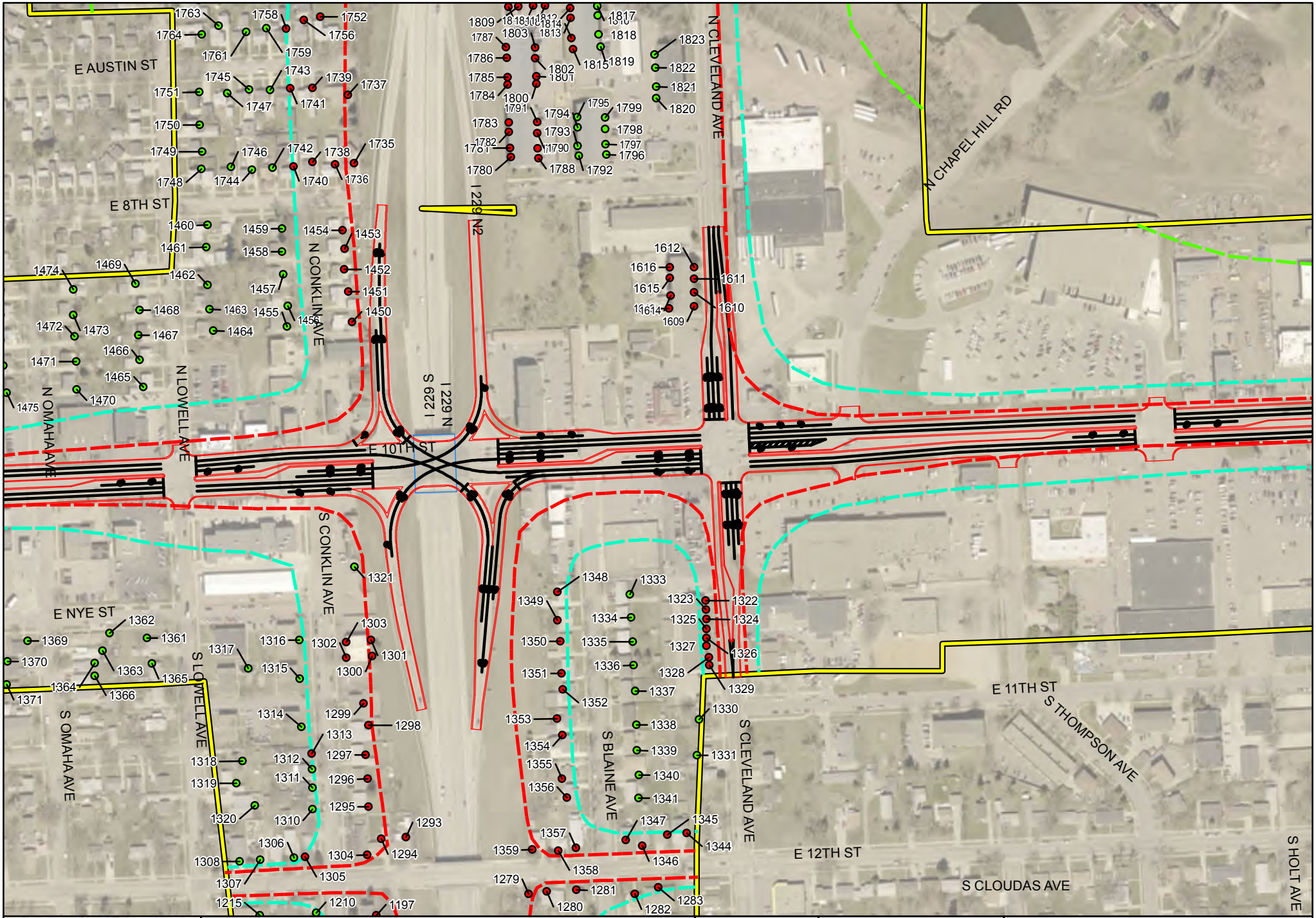


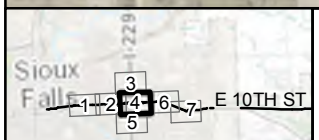


Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2E

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2E



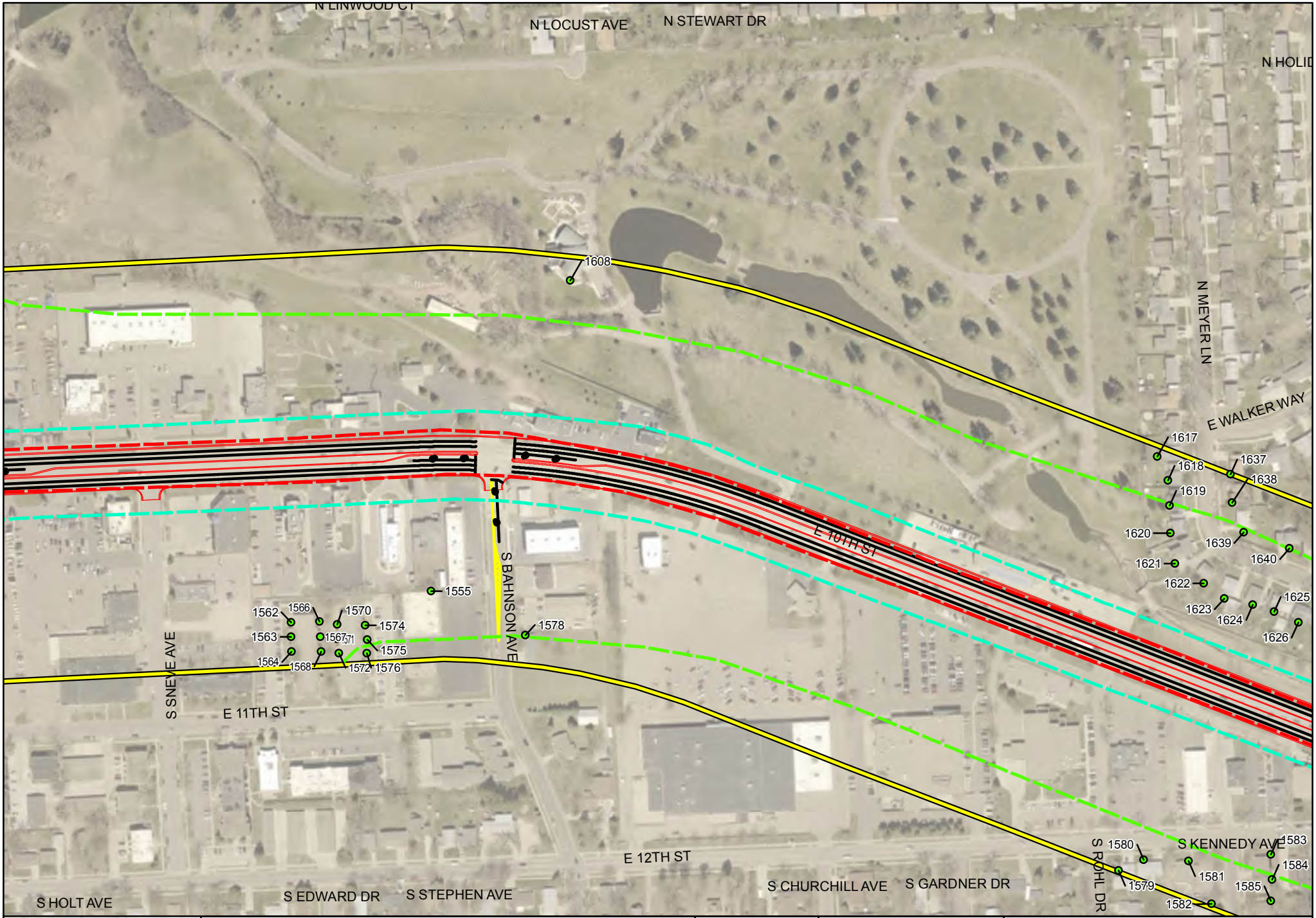


Legend

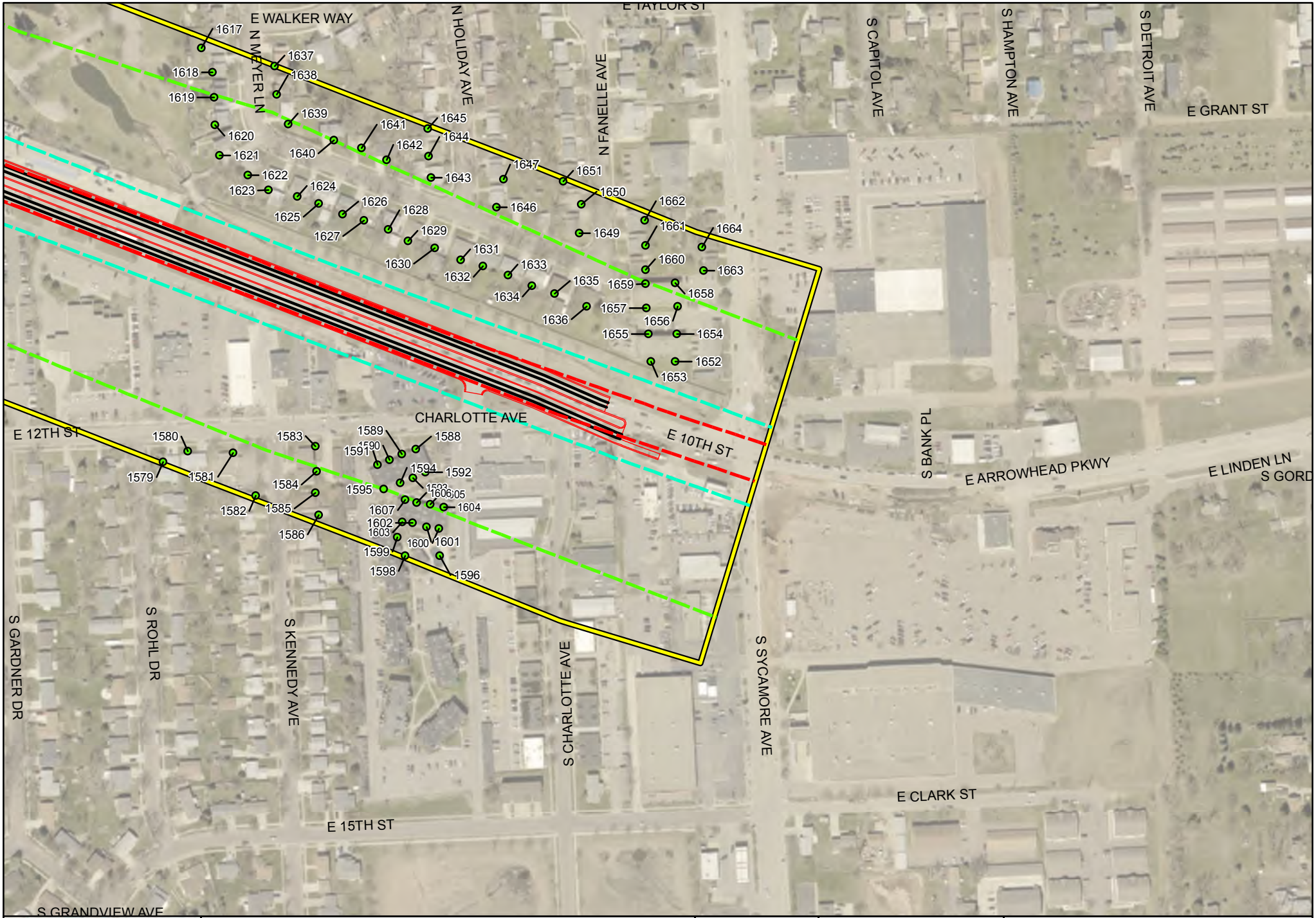
- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2E

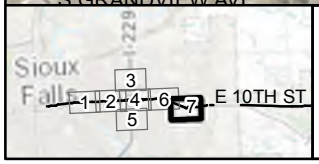
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2E


S ST PAUL AVE
S OMAHA AVE
E SIOUX ST
S LOWELL AVE
S CONKLIN AVE
I 229 N
I 229 S
S BLAINE AVE
S CLEVELAND AVE
E 12TH ST
E 13TH ST
E 14TH ST
E 15TH ST
E 16TH ST
S CLOUDAS AVE
S HARRINGTON PL
S HARRINGTON AVE
E PROSPECT ST
S FOSTER AVE
E ALLEN DR
S PAULTON AVE
S THOMPS
H
1307 1305 1304 1294 1293 1308 1306
1359 1358 1357 1347 1346 1345
1279 1281 1280 1282 1283
1215 1210 1197 1211 1209 1214 1208 1213 1207 1212 1206
1196 1195 1194 1193 1192 1201 1205 1200 1191 1204 1199 1189 1190 1203 1202 1198 1188
1287 1286 1278 1276 1288 1290 1289 1277
1274 1257 1273 1256 1255 1272 1254 1271
1253 1270 1269 1252 1251 1268 1250 1267 1266 1249 1265 1248 1246 1247 1264 1263 1245
1186 1185 1184 1183 1182 1181 1180 1179
1166 1165 1164 1163 1162 1161 1160 1159 1158 1157
Sioux Falls
I-229
E 10TH ST
1 2 3 4 5 6 7
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 3 Concept Linework 10th-2E
N
HDR
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2E



I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2E

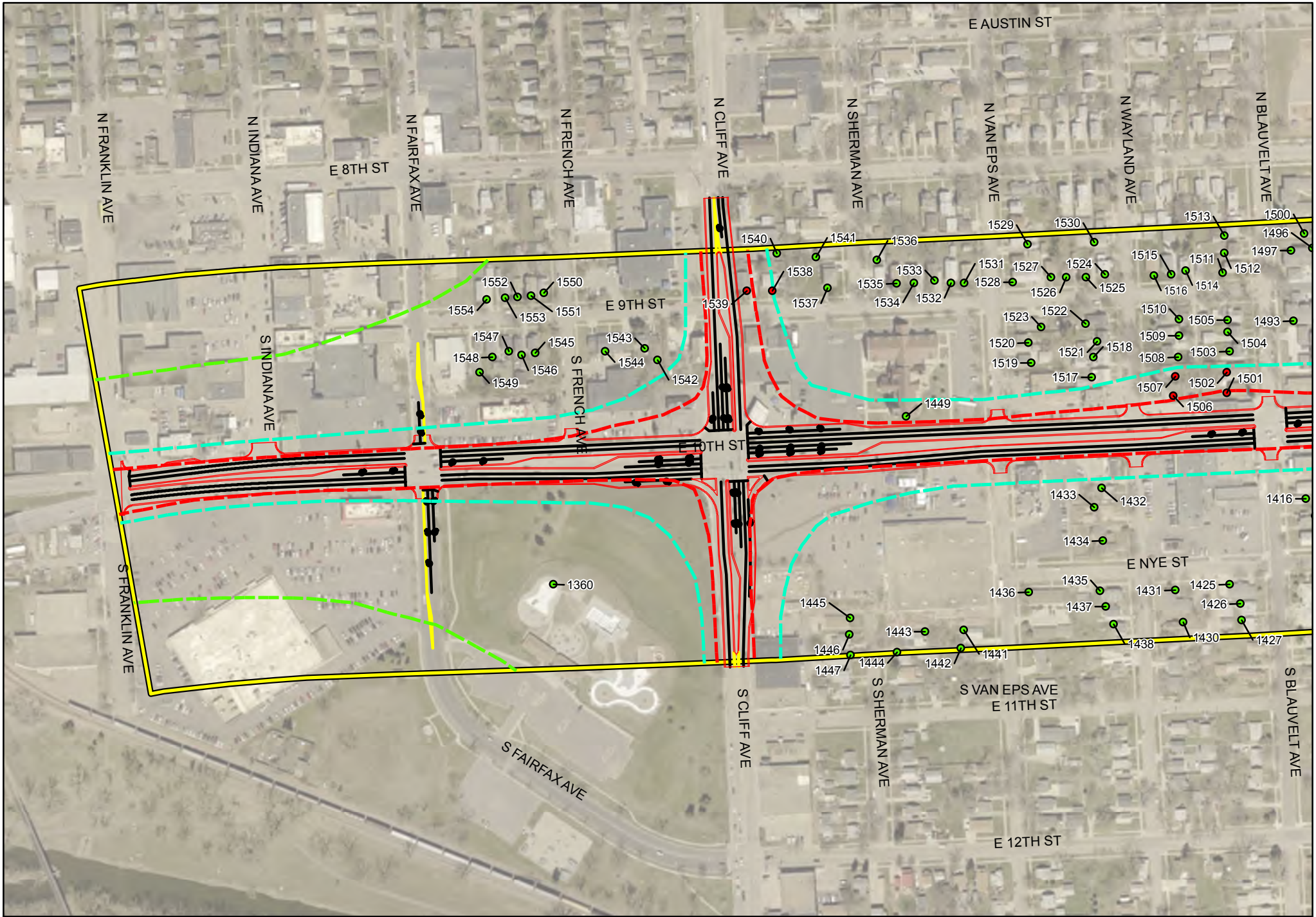




Legend

- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-2E

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 2E

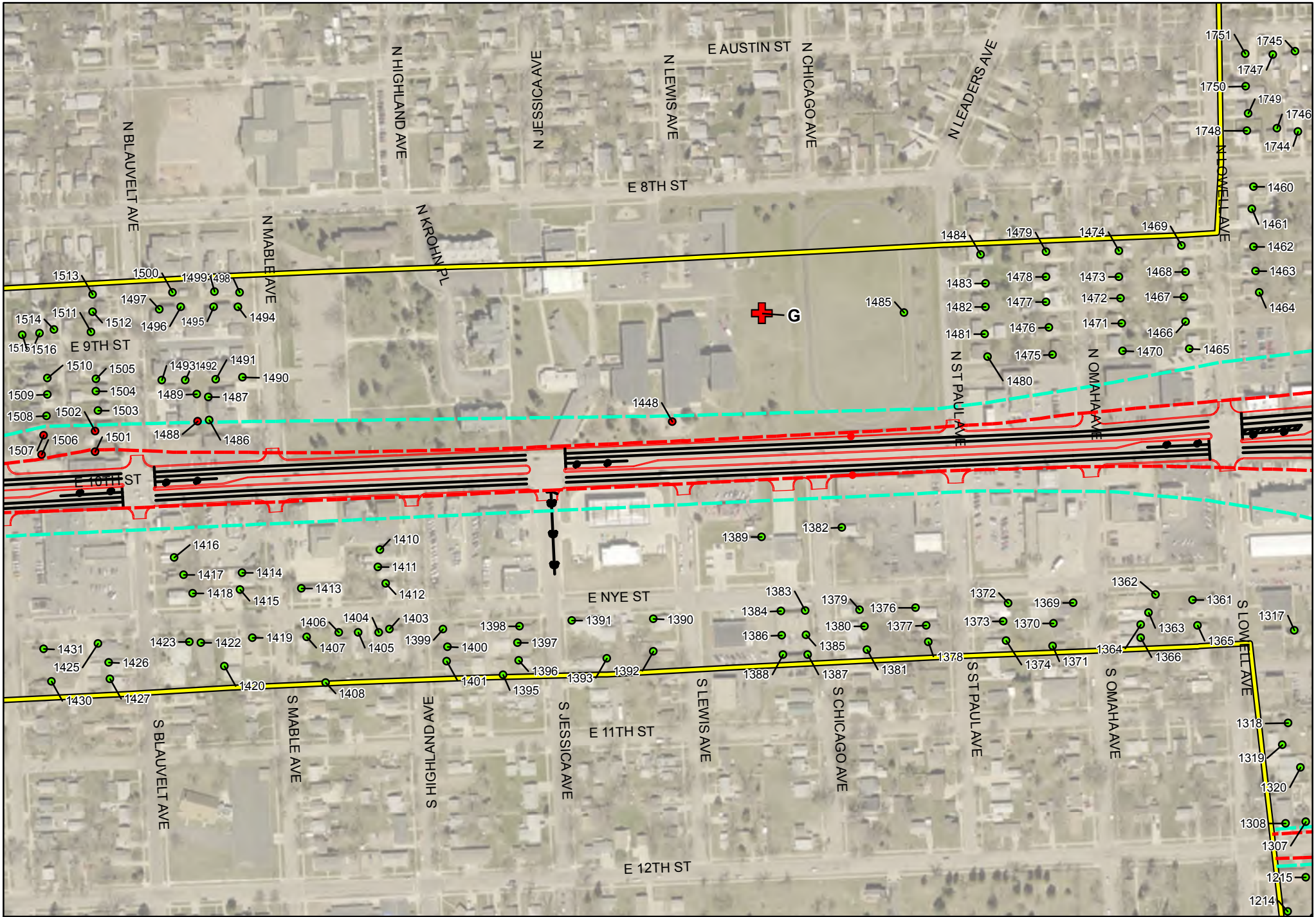


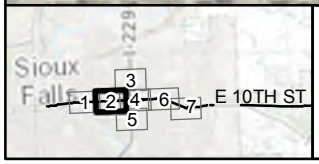
Sioux Falls I-229 E 10TH ST 1 2 3 4 5 6 7

Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-5A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5A

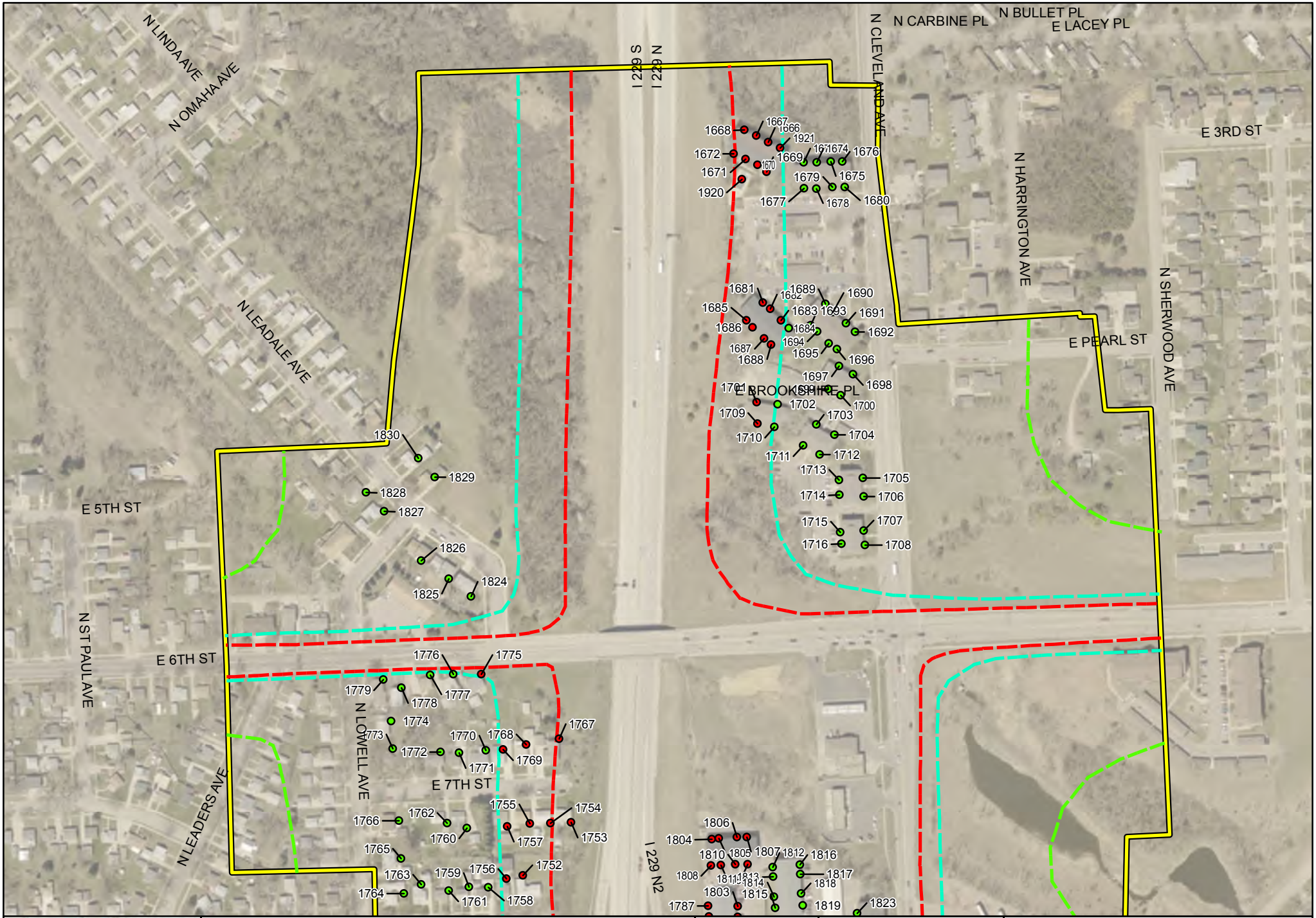




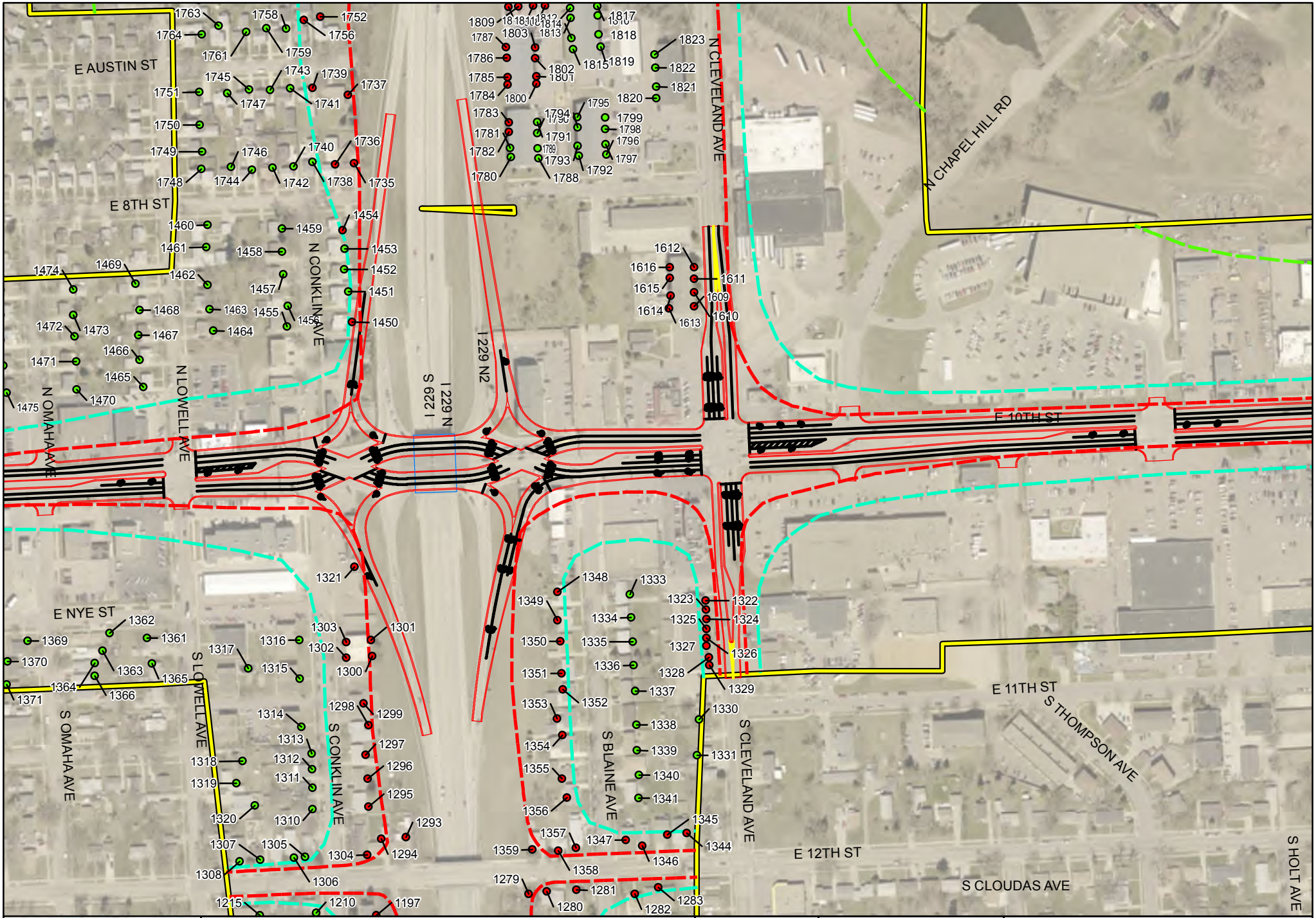
Legend

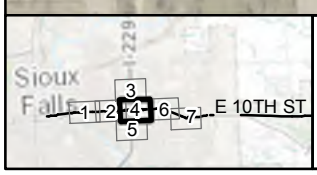
- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-5A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5A



I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5A



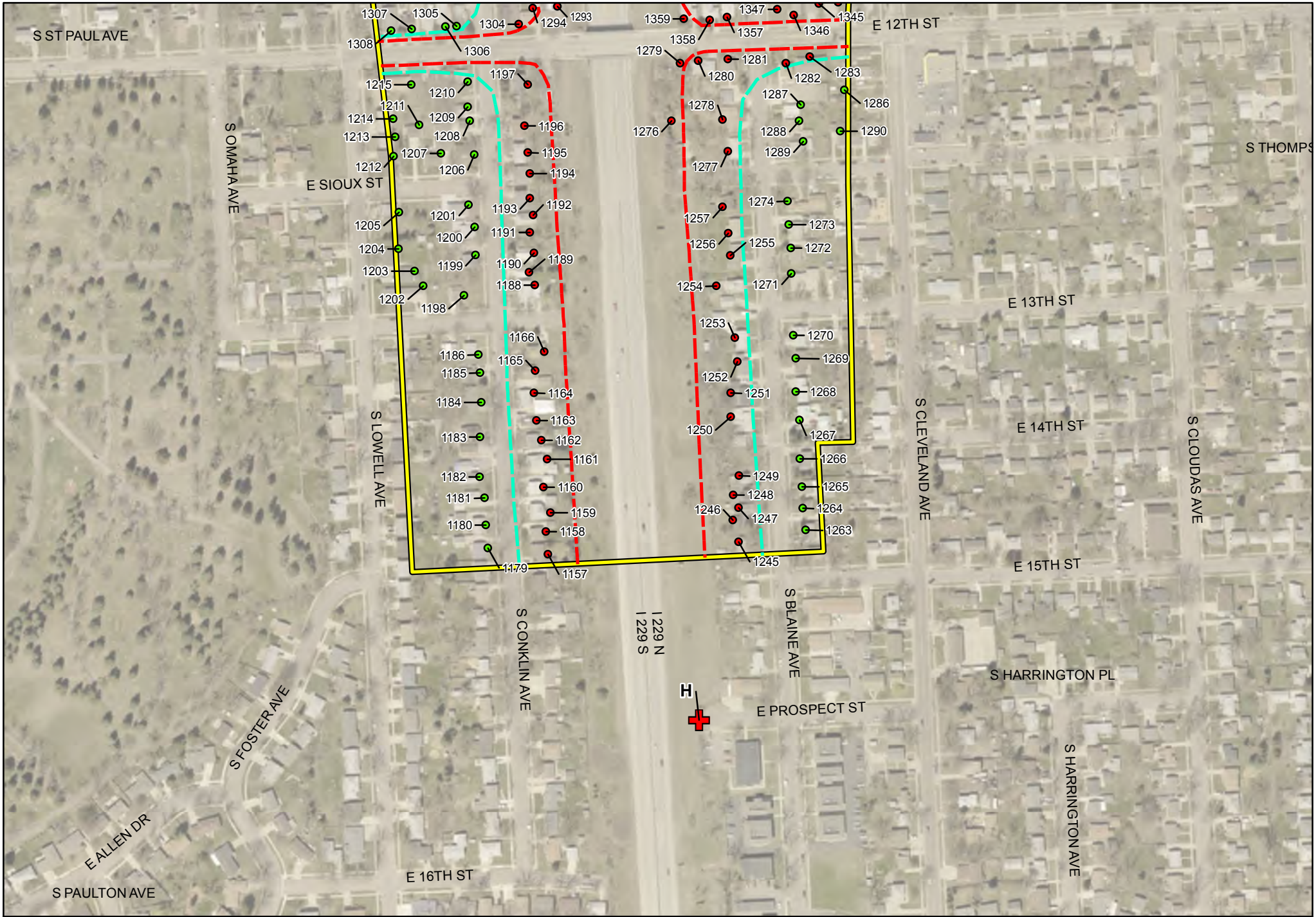


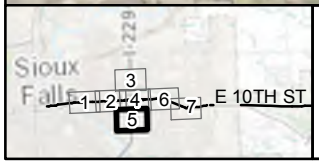
Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-5A

HDR

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5A

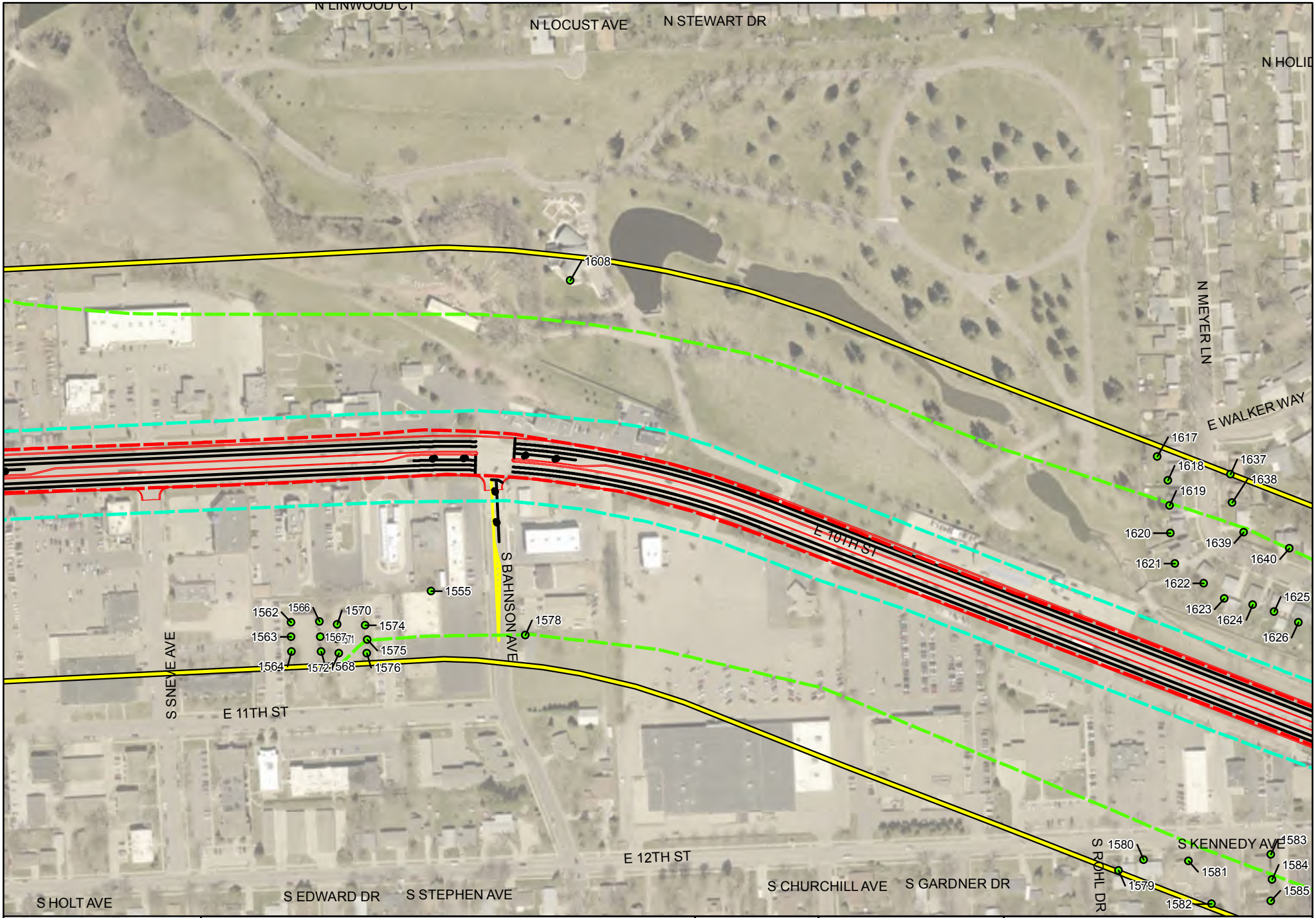




Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-5A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5A

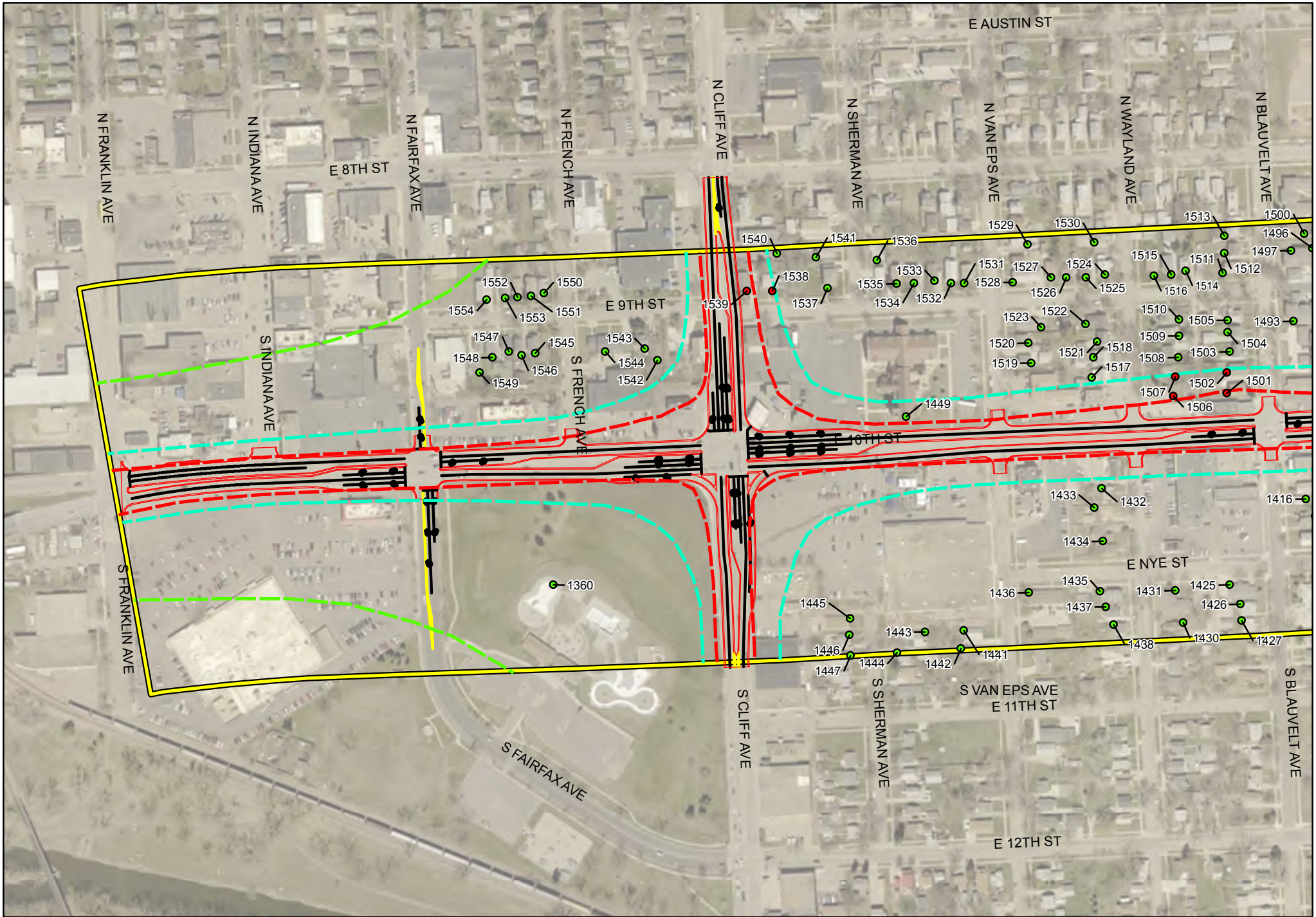

N LINWOOD CT
N LOCUST AVE
N STEWART DR
N HOLID
N MEYER LN
E WALKER WAY
E 10TH ST
S BAHNSON AVE
S SNEVE AVE
E 11TH ST
E 12TH ST
S HOLT AVE
S EDWARD DR
S STEPHEN AVE
S CHURCHILL AVE
S GARDNER DR
S ROHL DR
S KENNEDY AVE
1608
1617
1618
1619
1620
1621
1622
1623
1624
1625
1626
1637
1638
1639
1640
1555
1562
1566
1570
1574
1563
1567
1571
1575
1564
1572
1568
1576
1578
1580
1581
1579
1582
1583
1584
1585
Sioux Falls
I-229
E 10TH ST
1
2
3
4
5
6
7
Legend
Non-Impacted Receptors
Impacted Receptors
Noise Monitoring Location
56 dBA Contour Line
66 dBA Contour Line
71 dBA Contour Line
Noise Study
Sub-Study 3 Concept Linework 10th-5A
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5A

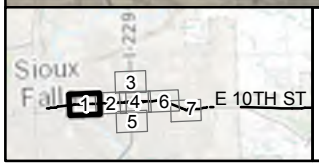


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study
- Sub-Study 3 Concept Linework 10th-5A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5A

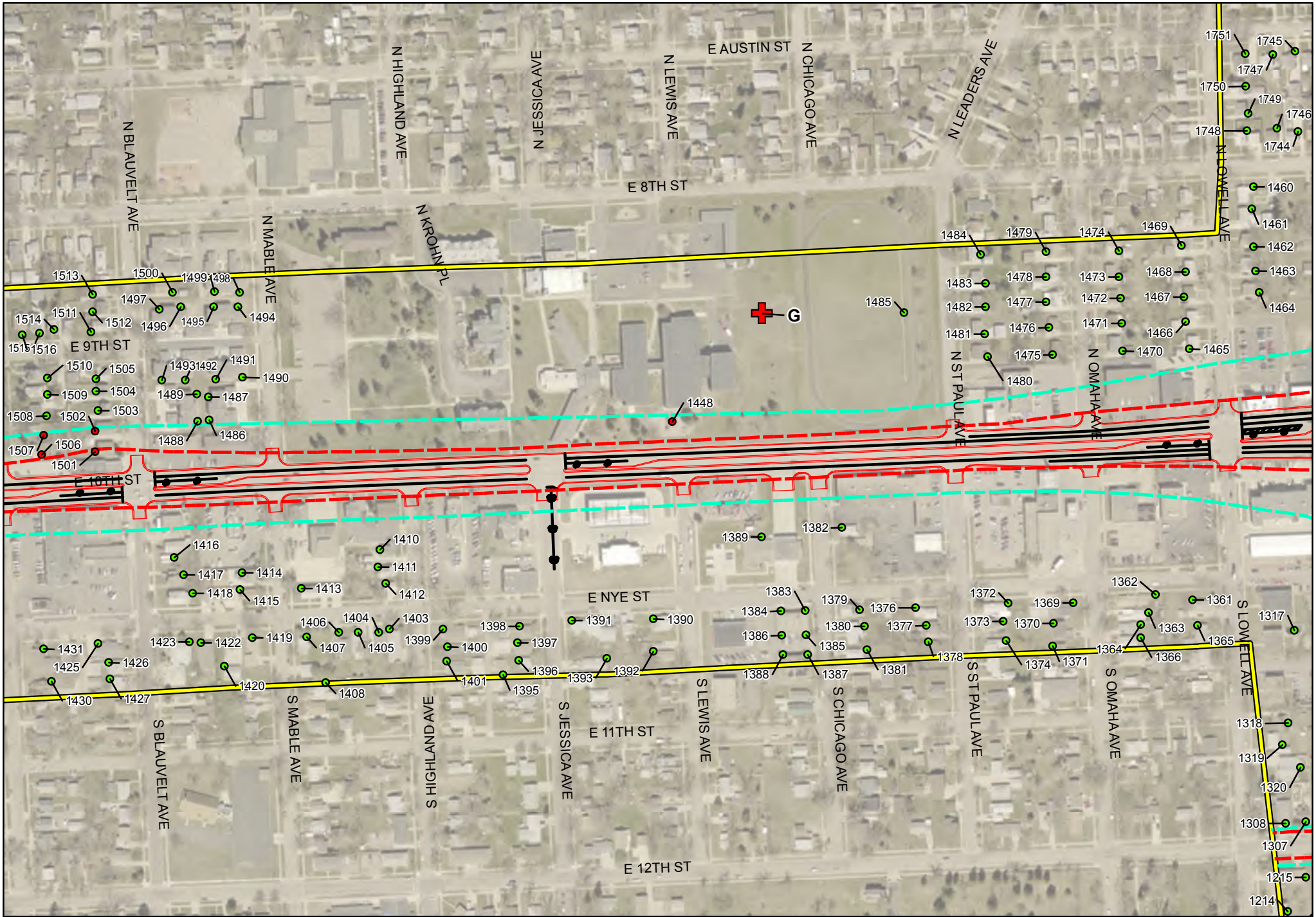


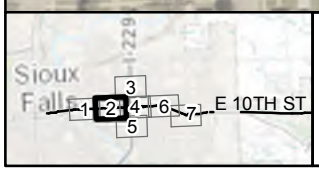


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5B

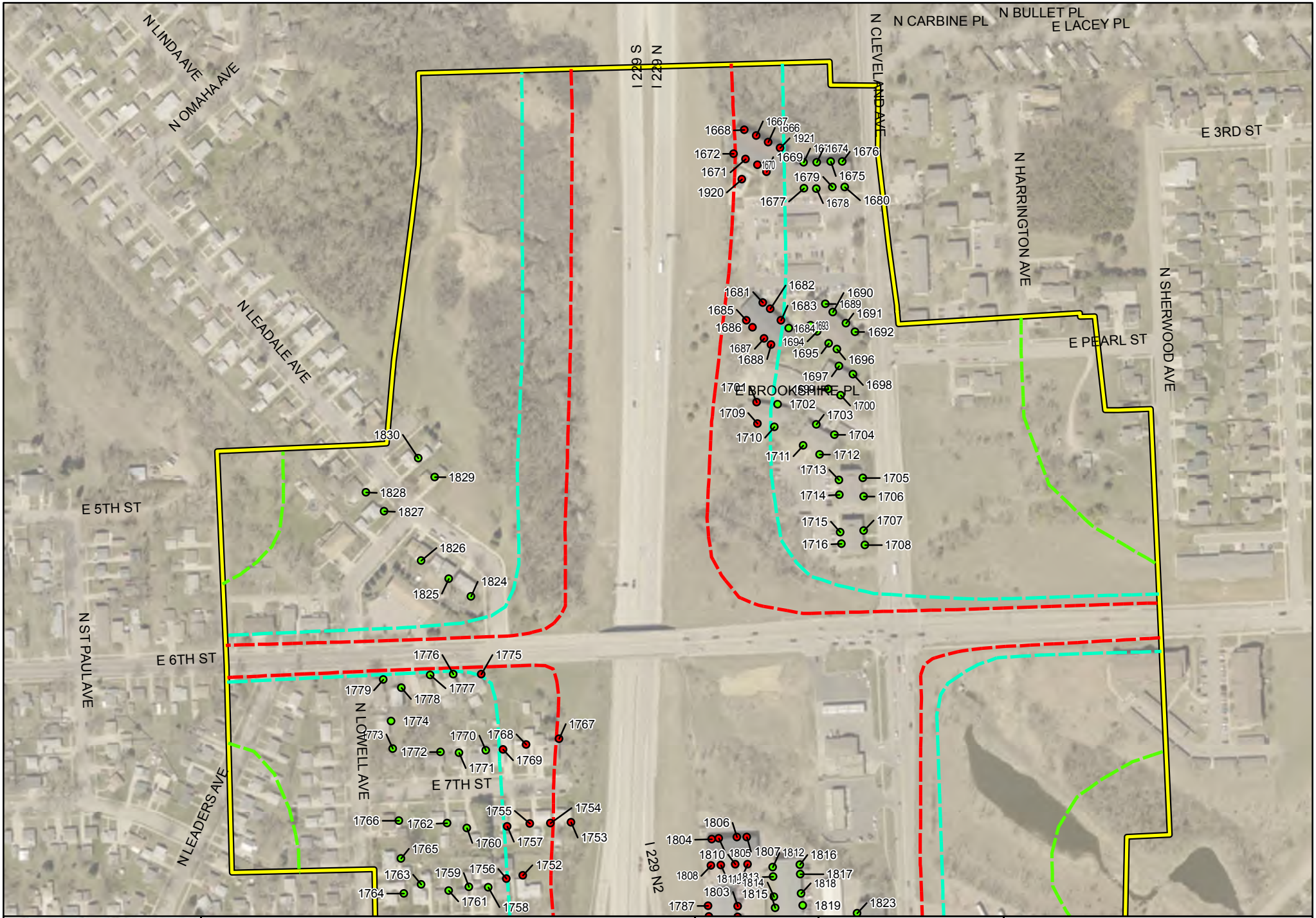


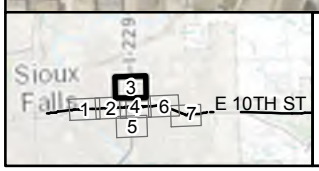


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5B

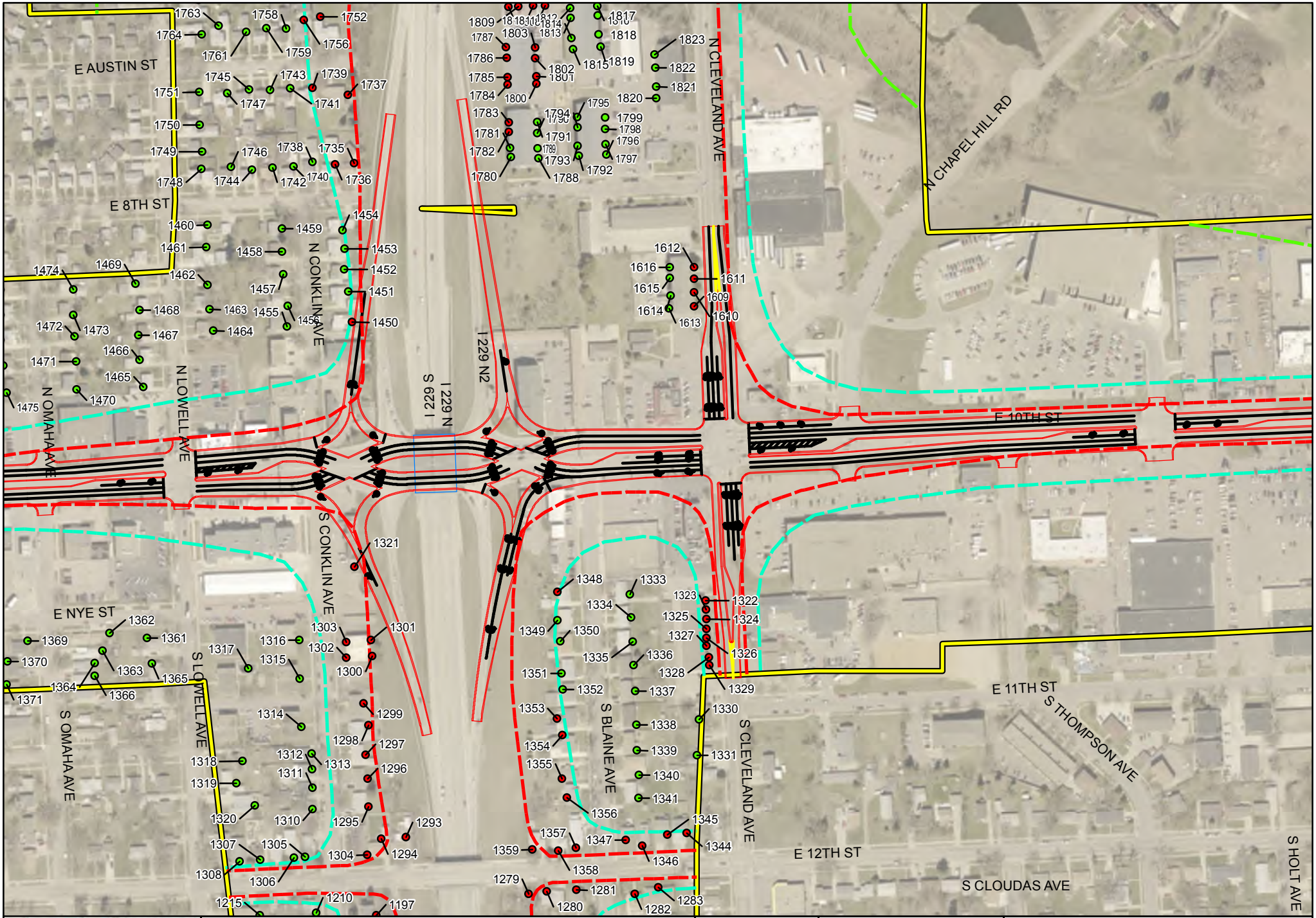


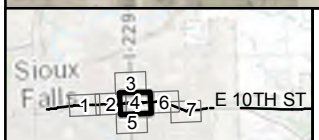


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5B

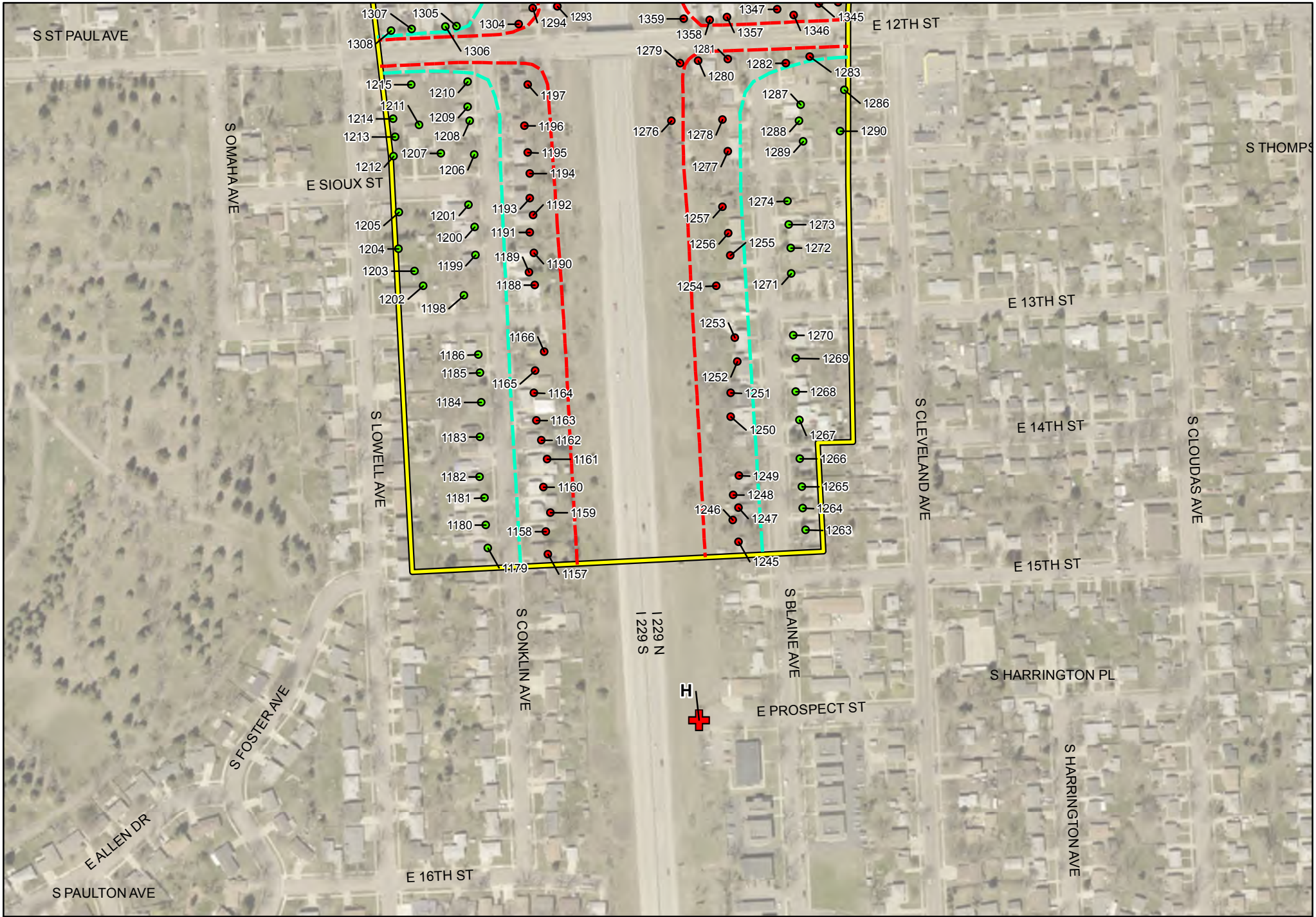


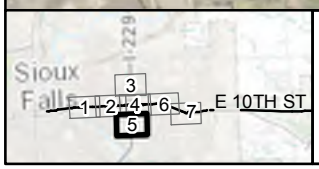


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5B

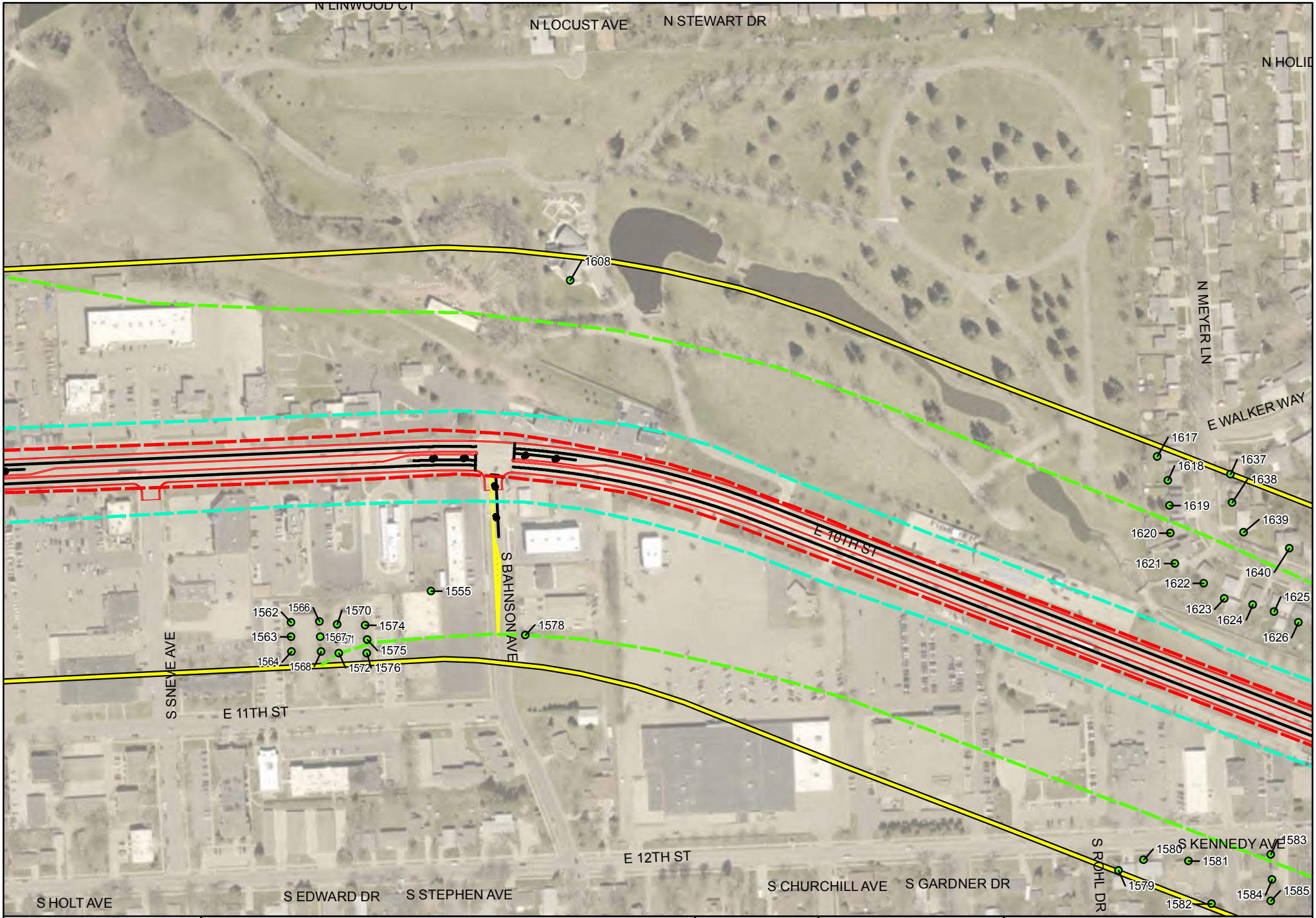




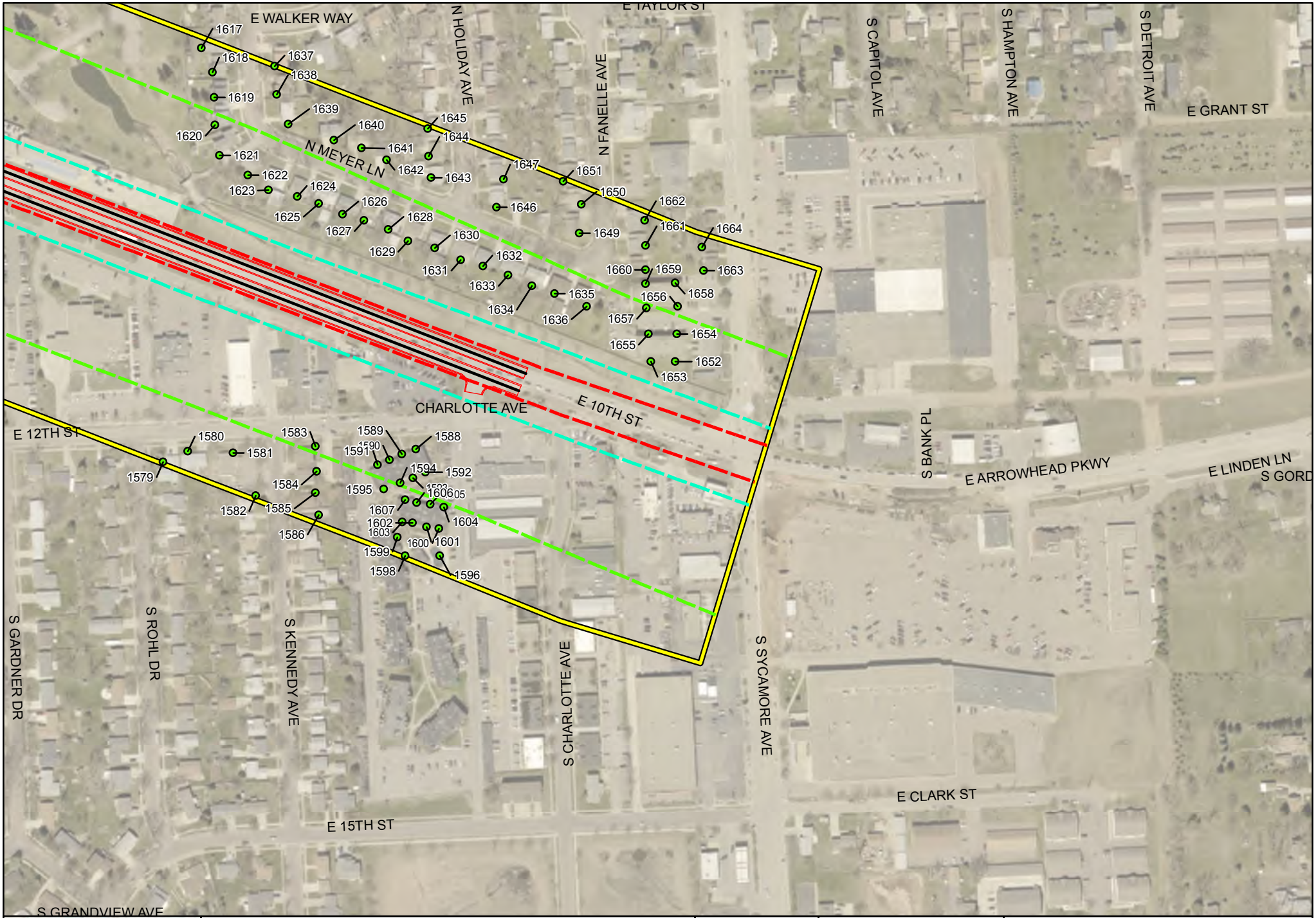
Legend

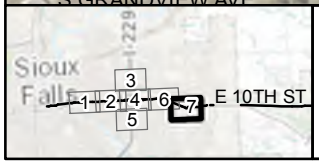
- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5B



I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5B

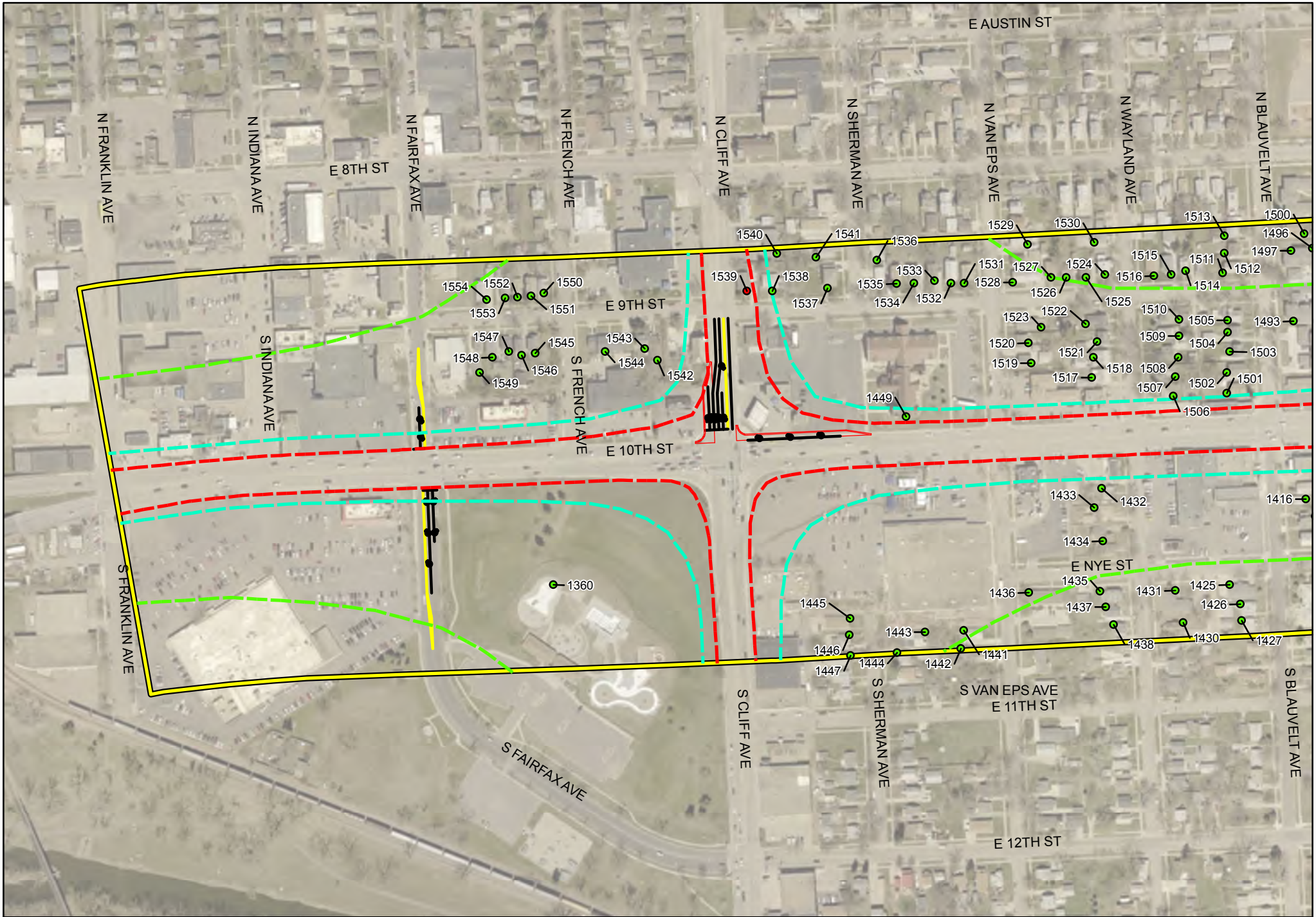


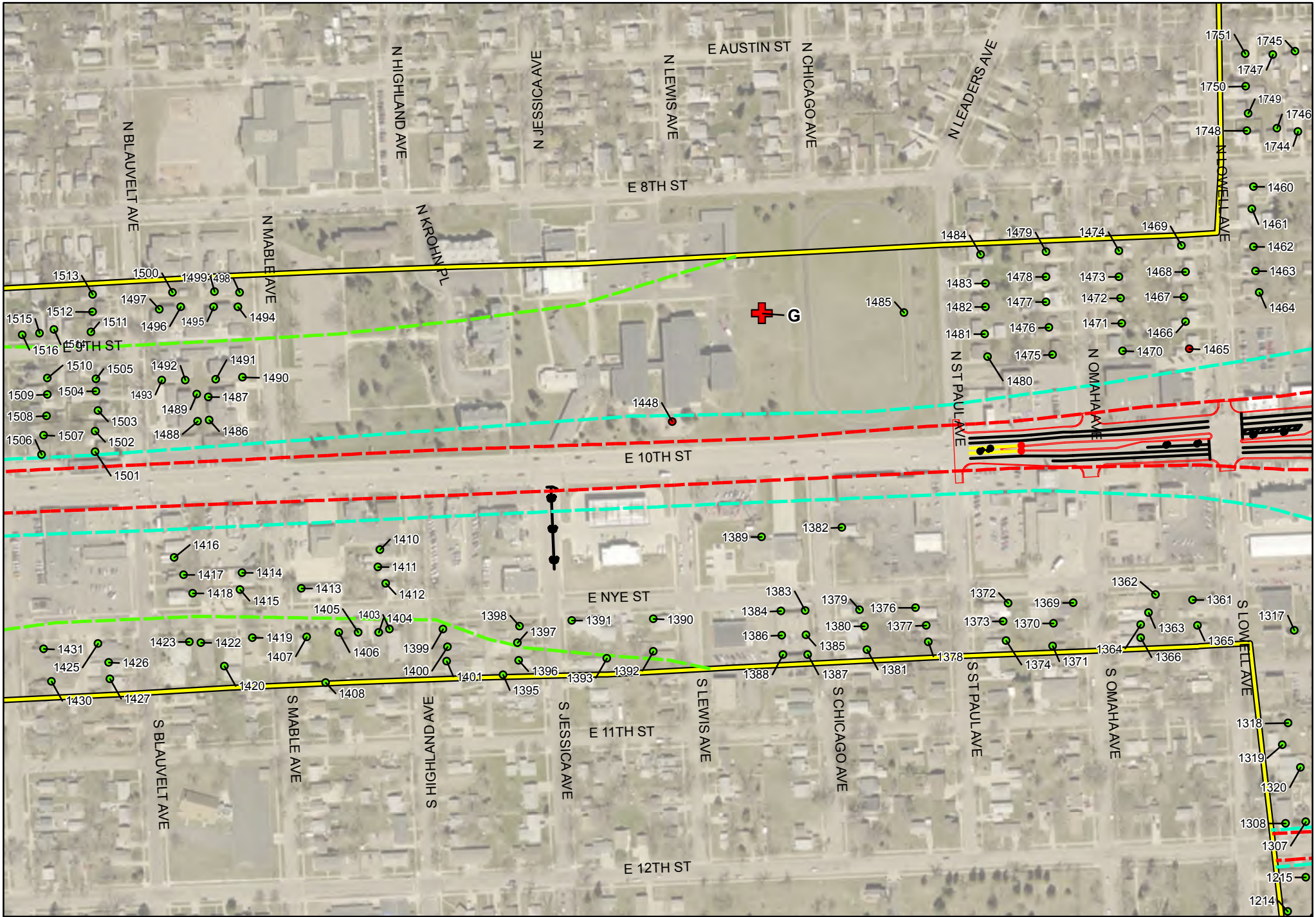


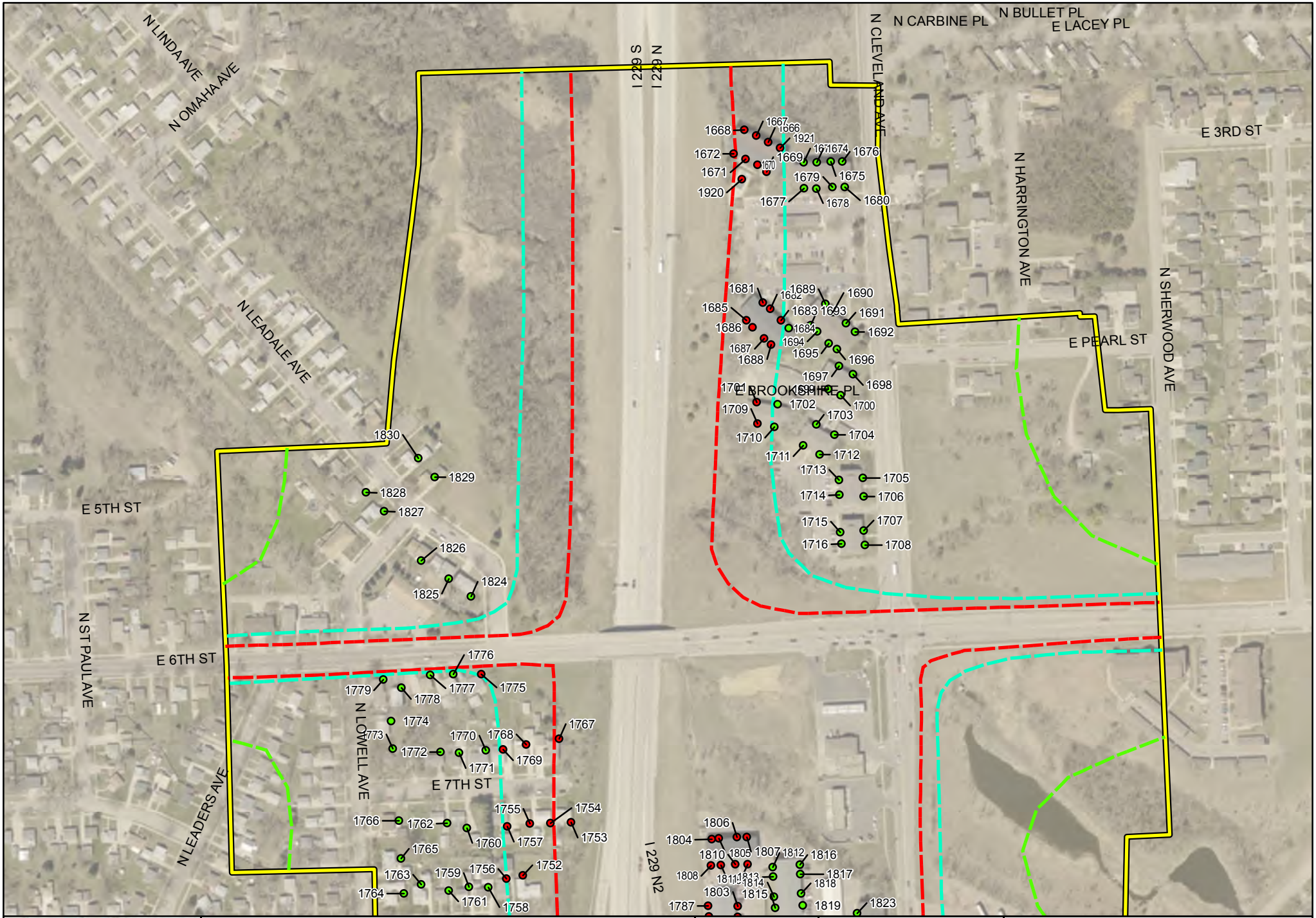
Legend

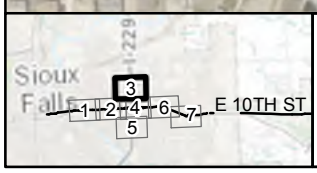
- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-5B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5B


E AUSTIN ST
N FRANKLIN AVE
N INDIANA AVE
E 8TH ST
N FAIRFAX AVE
N FRENCH AVE
N CLIFF AVE
N SHERMAN AVE
N VAN EPS AVE
N WAYLAND AVE
N BLAUVELT AVE
E 9TH ST
S INDIANA AVE
S FRENCH AVE
E 10TH ST
S FRANKLIN AVE
E NYE ST
S FAIRFAX AVE
S CLIFF AVE
S SHERMAN AVE
S VAN EPS AVE
E 11TH ST
S BLAUVELT AVE
E 12TH ST
1360
1449
1493
1496
1497
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1416
1425
1426
1427
1430
1431
1432
1433
1434
1435
1436
1437
1438
1441
1442
1443
1444
1445
1446
1447
Sioux Falls
I-229
E 10TH ST
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 3 Concept Linework 10th-5C
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5C


N BLAUVELT AVE
N HIGHLAND AVE
N JESSICA AVE
N LEWIS AVE
E AUSTIN ST
N CHICAGO AVE
N LEADERS AVE
N LOWELL AVE
N MABLE AVE
N KROHN PL
E 8TH ST
E 9TH ST
E 10TH ST
N ST PAUL AVE
N OMAHA AVE
E NYE ST
E 11TH ST
E 12TH ST
S BLAUVELT AVE
S MABLE AVE
S HIGHLAND AVE
S JESSICA AVE
S LEWIS AVE
S CHICAGO AVE
S ST PAUL AVE
S OMAHA AVE
S LOWELL AVE
G
1751 1745 1747 1750 1749 1746 1748 1744 1460 1461 1462 1463 1464 1465 1466 1467 1468 1469 1470 1471 1472 1473 1474 1475 1476 1477 1478 1479 1480 1481 1482 1483 1484 1485 1513 1500 1499 1498 1497 1496 1495 1494 1512 1511 1515 1516 1504 1510 1505 1492 1491 1490 1493 1489 1487 1509 1504 1508 1503 1488 1486 1506 1507 1502 1501 1448 1382 1389 1410 1416 1411 1417 1414 1412 1418 1415 1413 1405 1403 1404 1398 1391 1390 1397 1423 1422 1419 1407 1406 1399 1400 1401 1396 1393 1392 1395 1431 1425 1426 1420 1408 1430 1427 1383 1384 1379 1376 1380 1377 1386 1385 1388 1387 1381 1378 1372 1369 1373 1370 1374 1371 1362 1361 1363 1365 1364 1366 1317 1318 1319 1320 1308 1307 1215 1214
Sioux Falls
I-229
E 10TH ST
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 3 Concept Linework
10th-5C
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5C



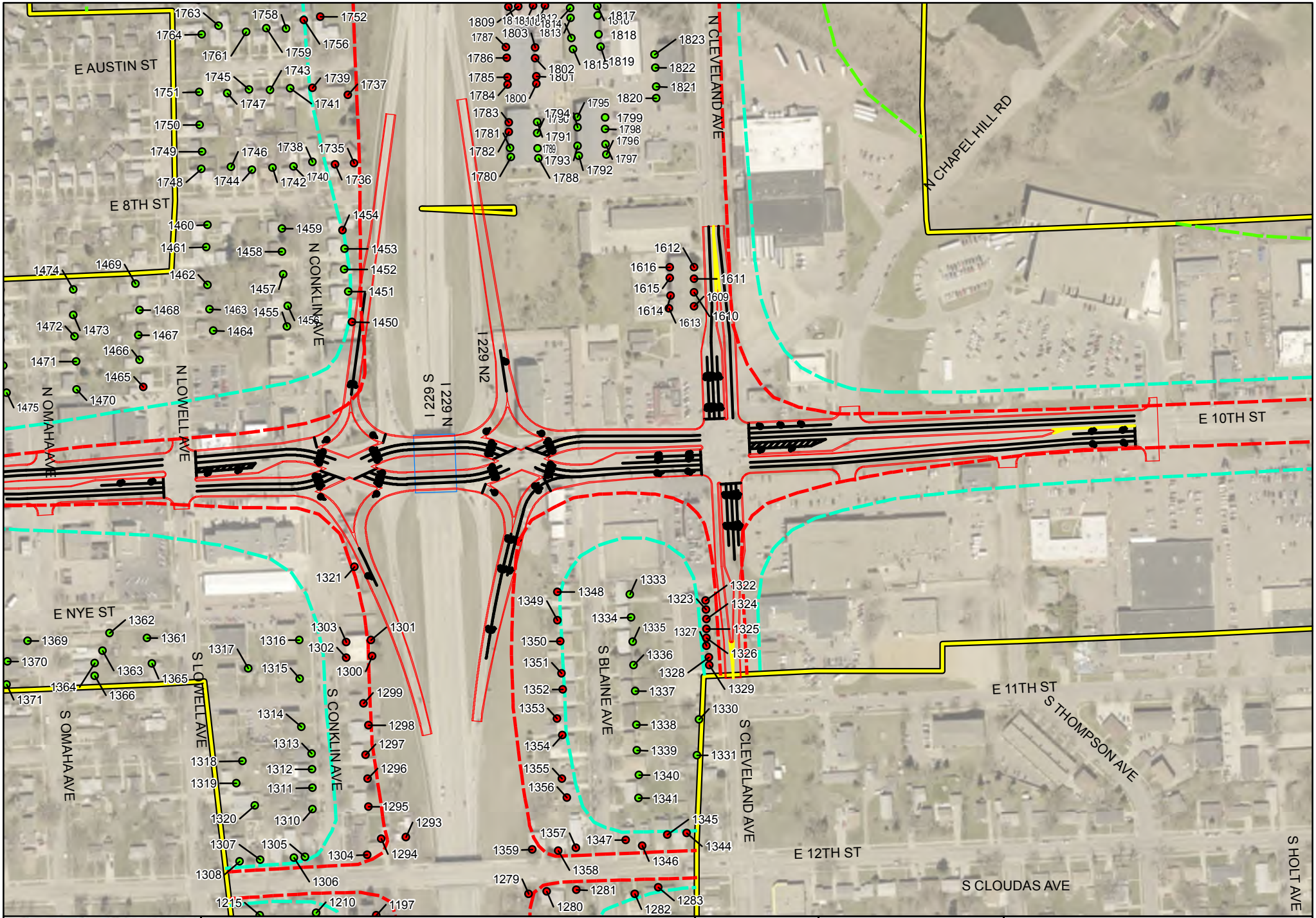


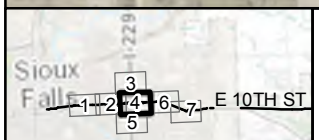
Legend

- 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 3 Concept Linework 10th-5C

HDR

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5C

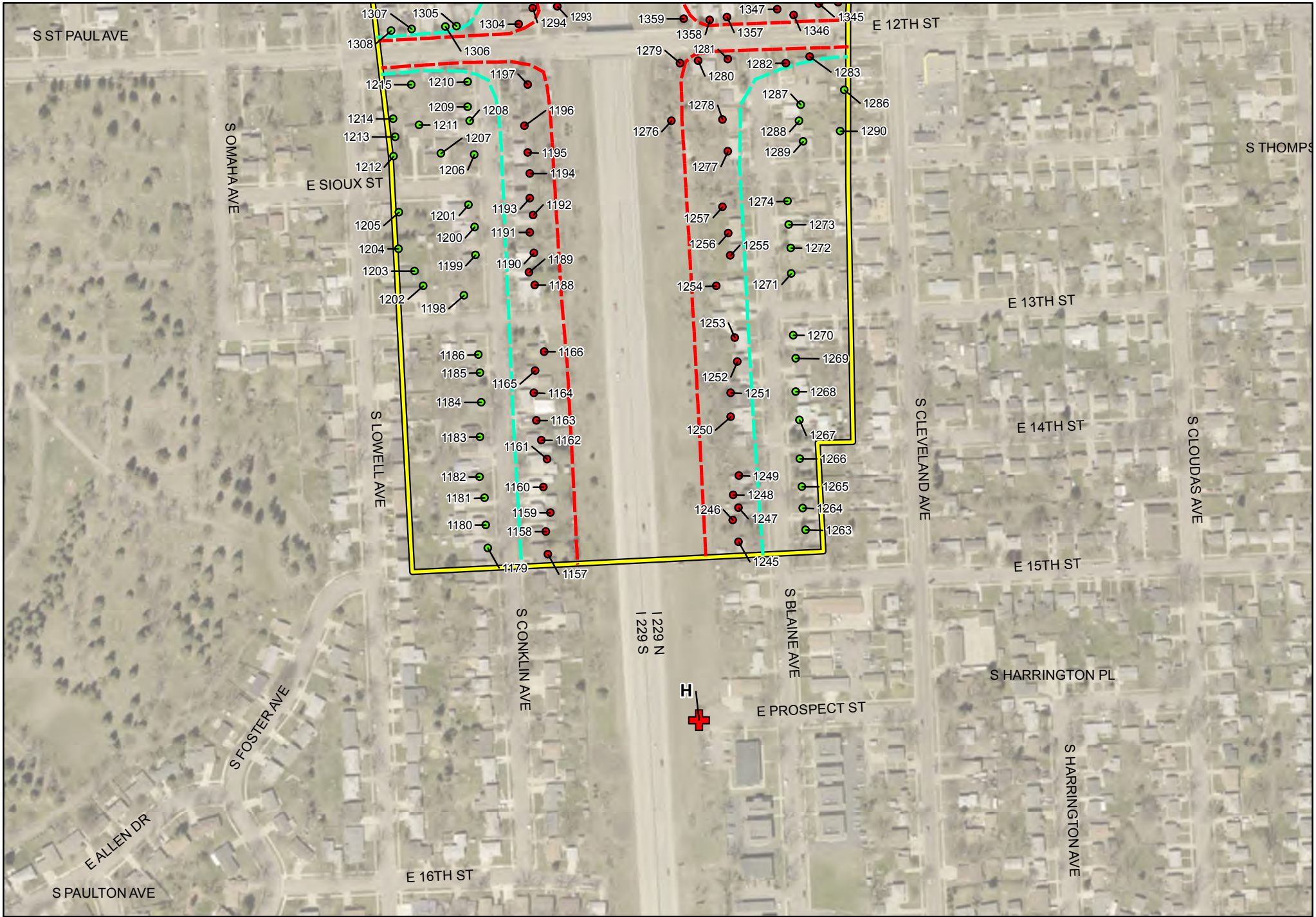


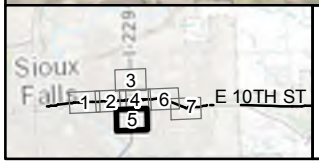


Legend

- 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 3 Concept Linework 10th-5C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5C

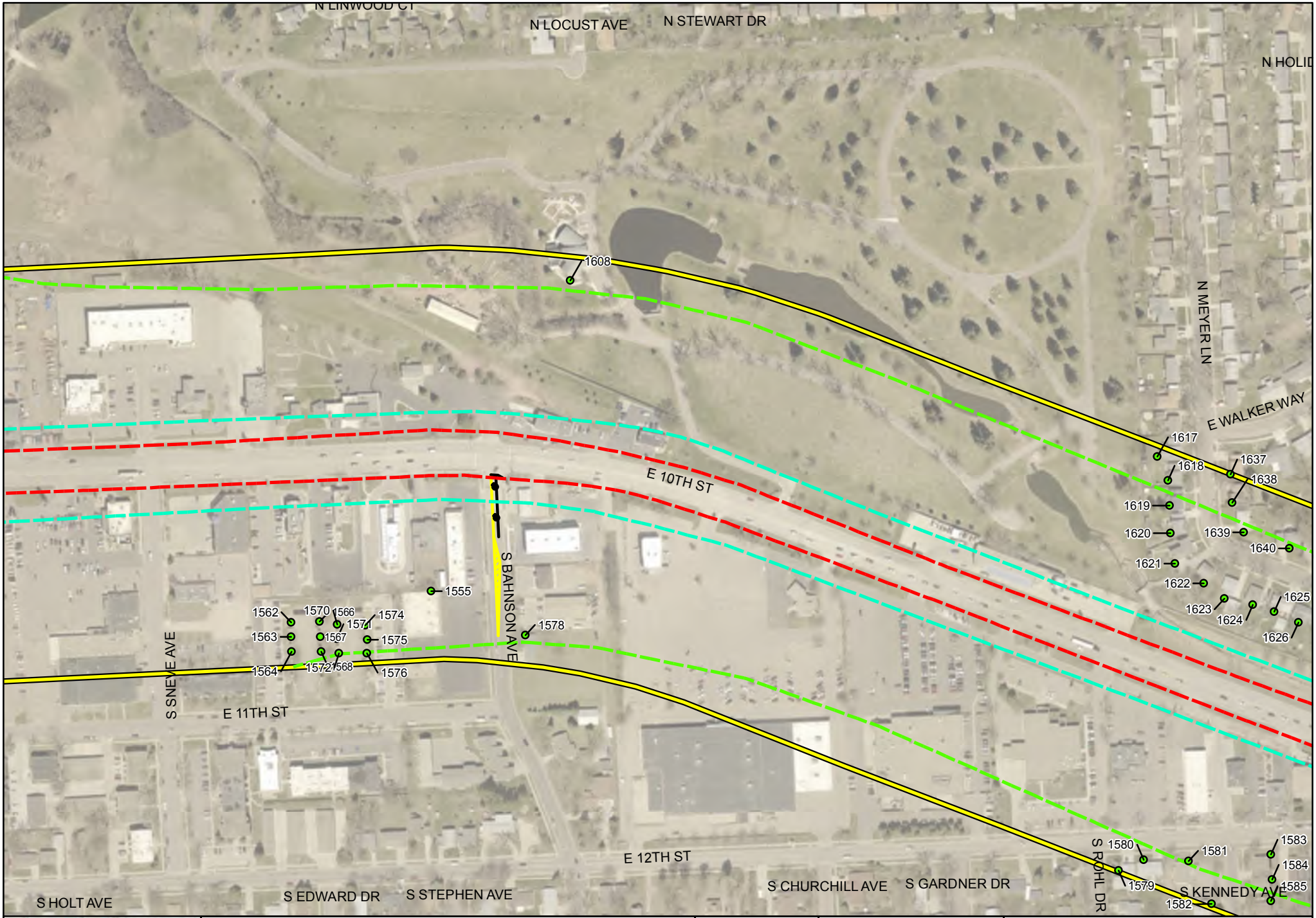


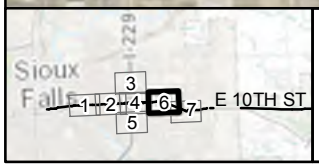


Legend

- 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 3 Concept Linework 10th-5C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5C

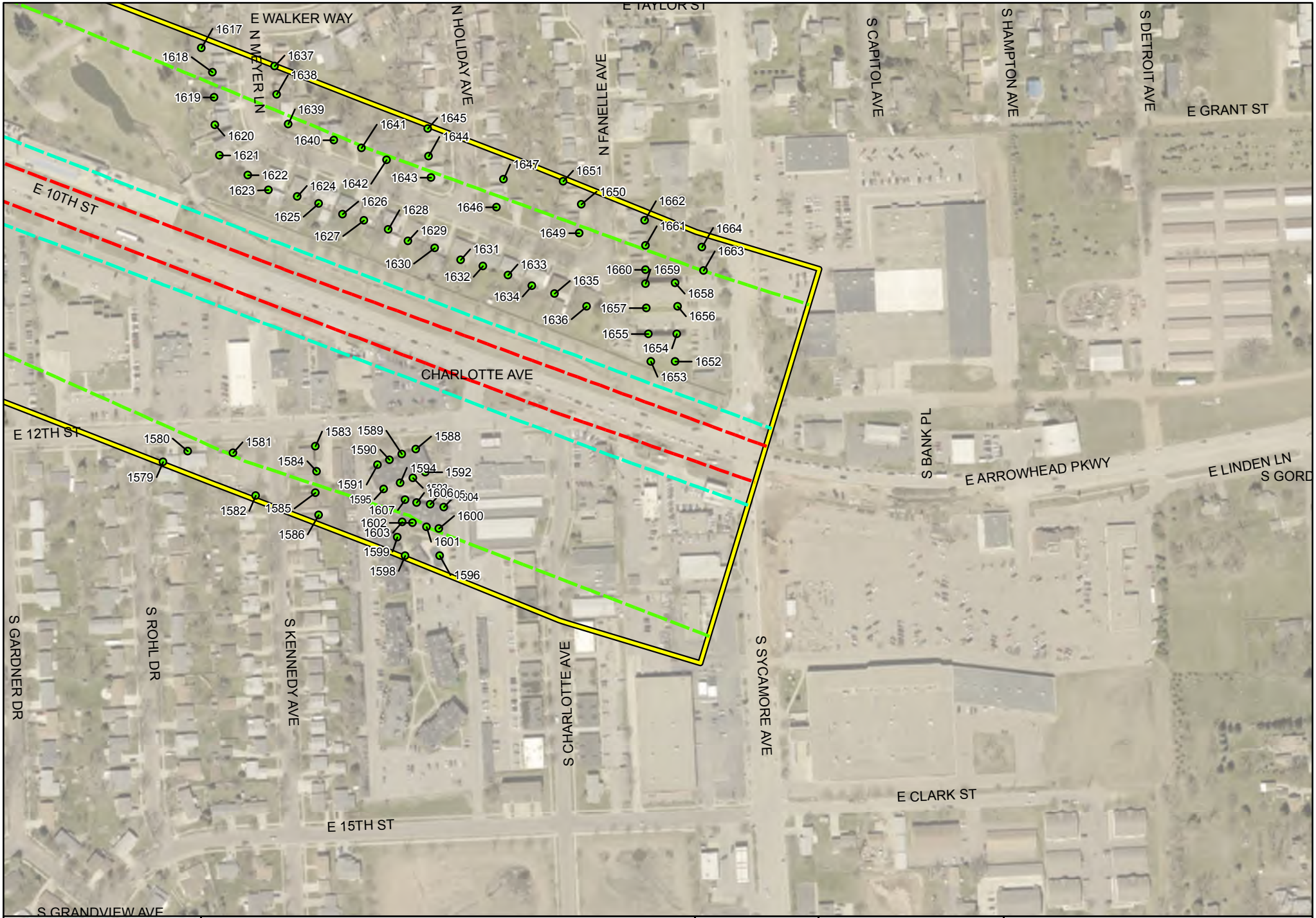


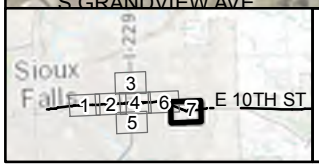


Legend

- 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 3 Concept Linework 10th-5C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5C

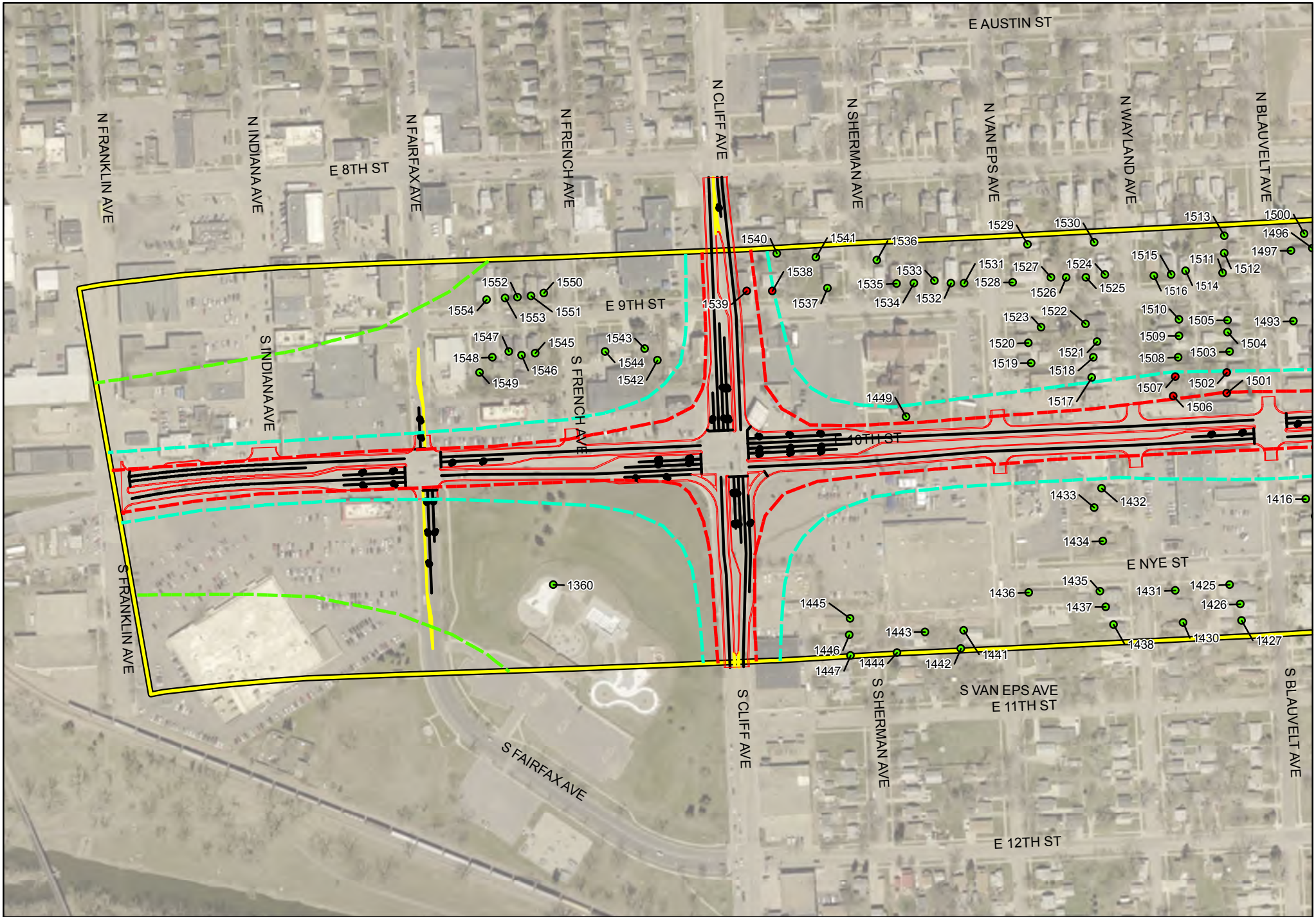


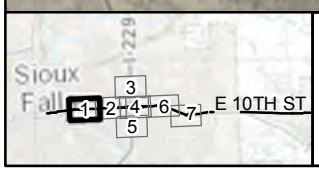


Legend

- 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 3 Concept Linework 10th-5C

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 5C

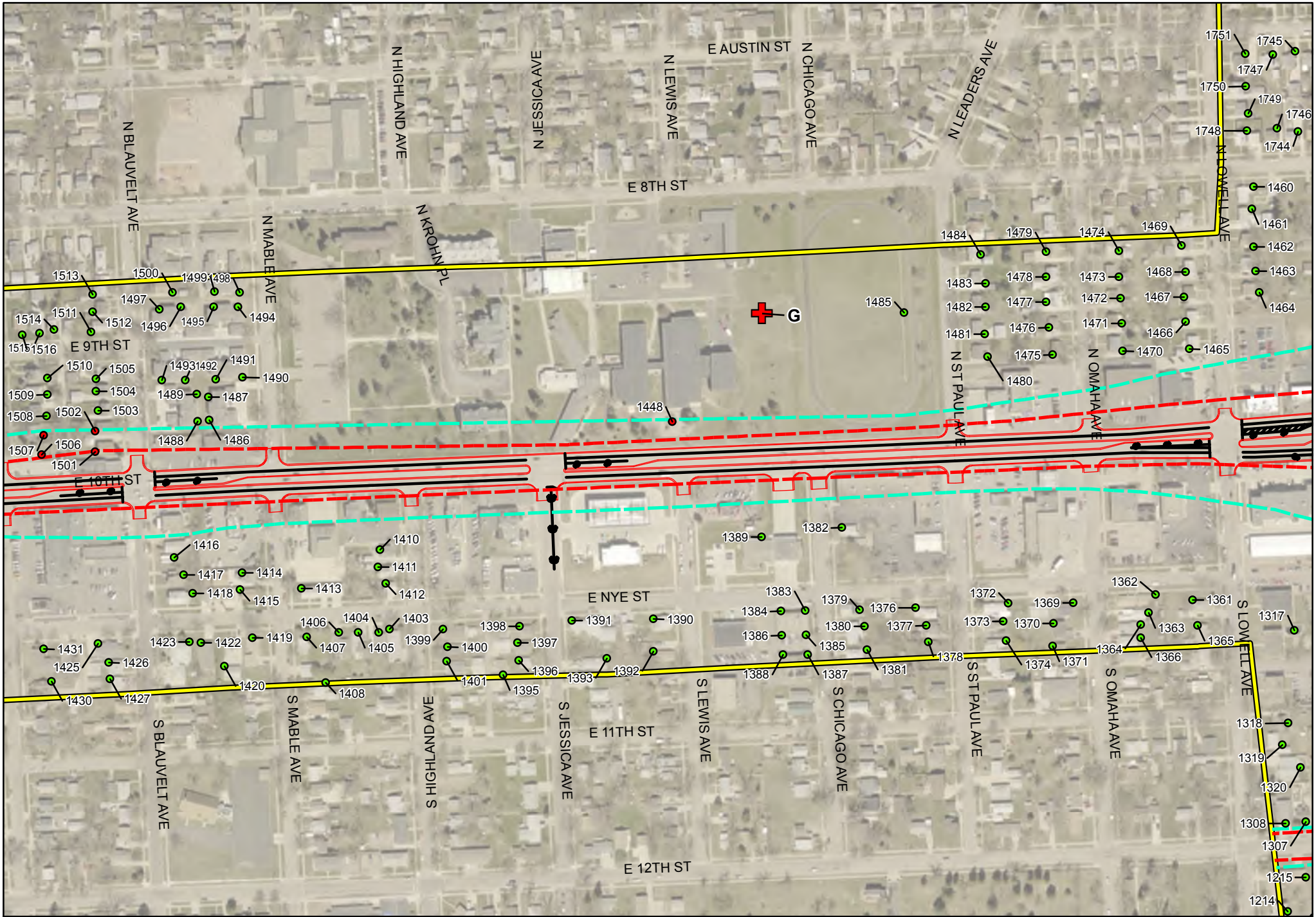


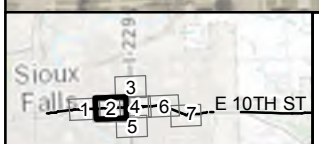


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-9A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9A

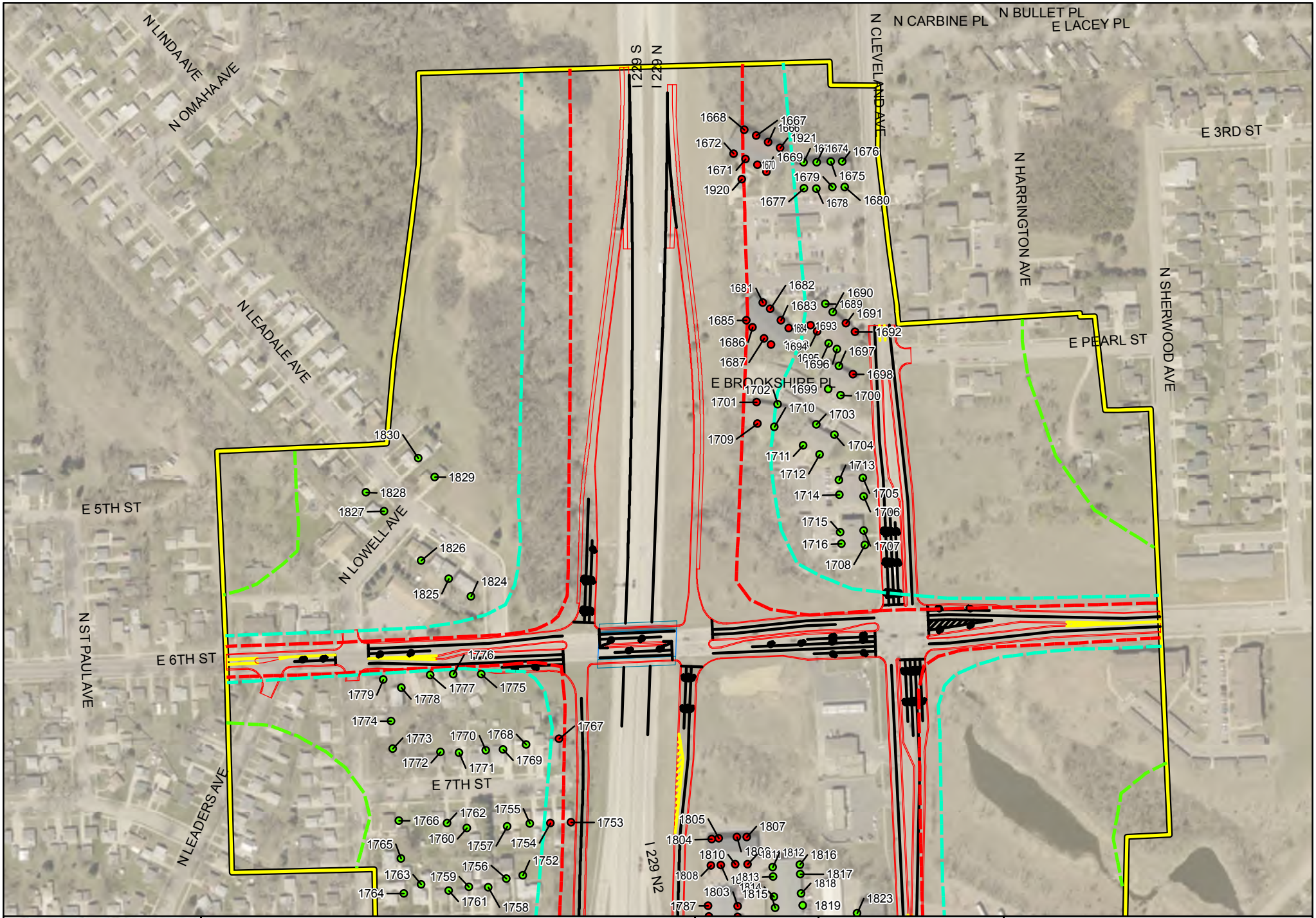


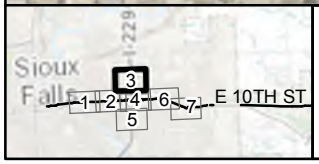


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-9A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9A

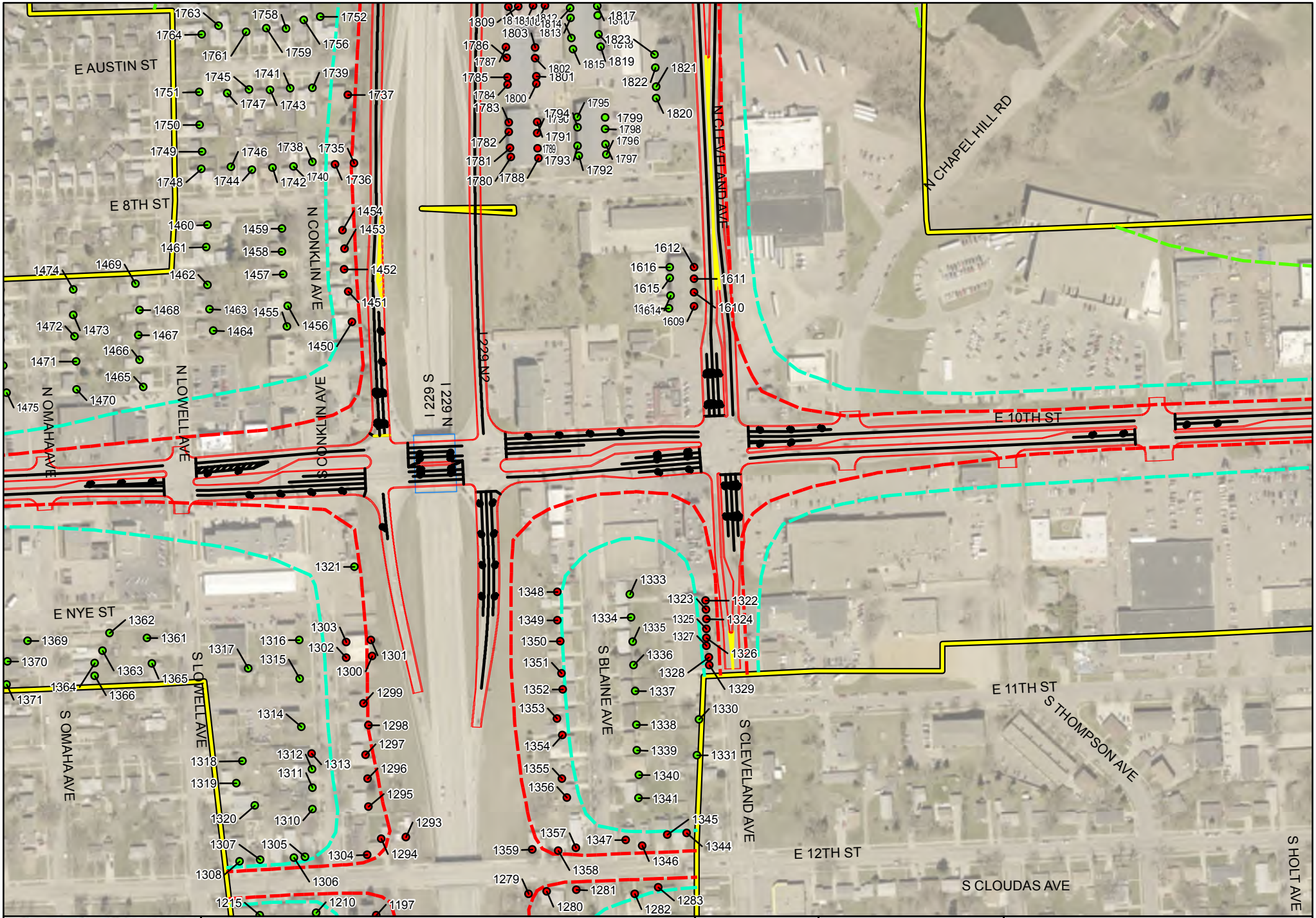


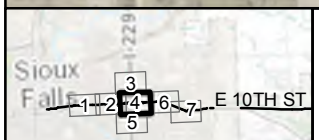


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-9A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9A

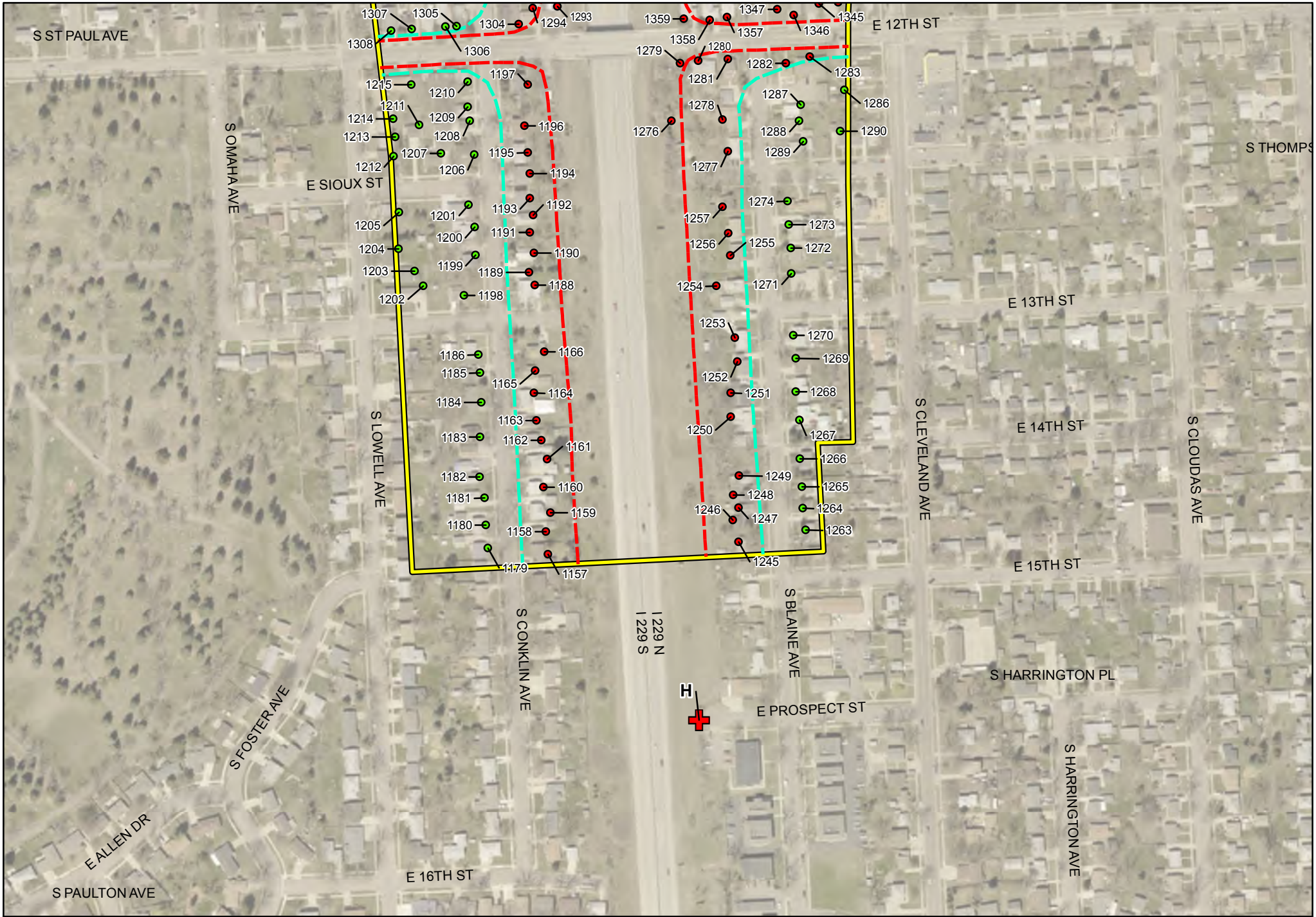


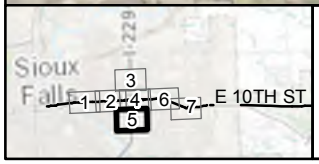


Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-9A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9A

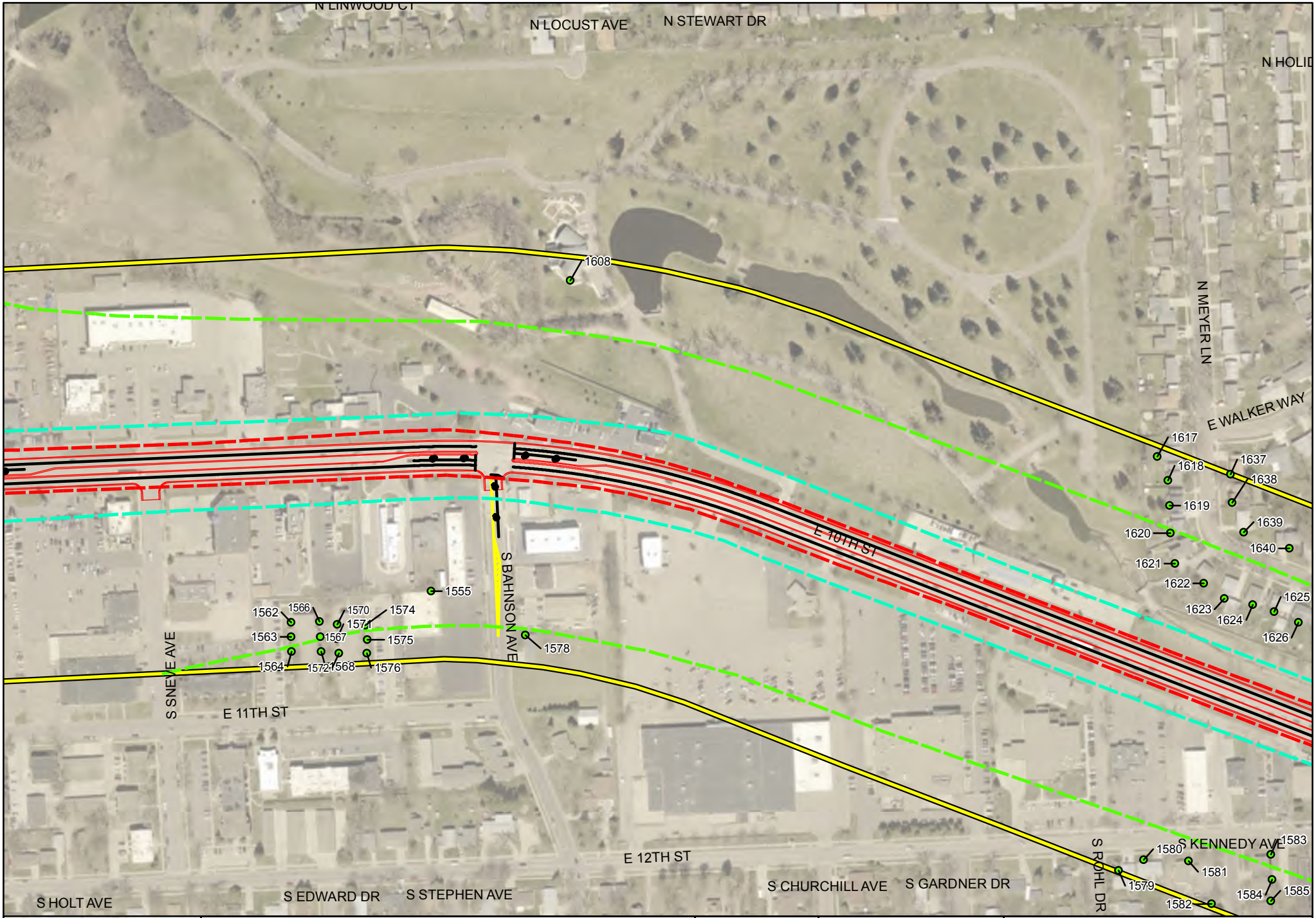


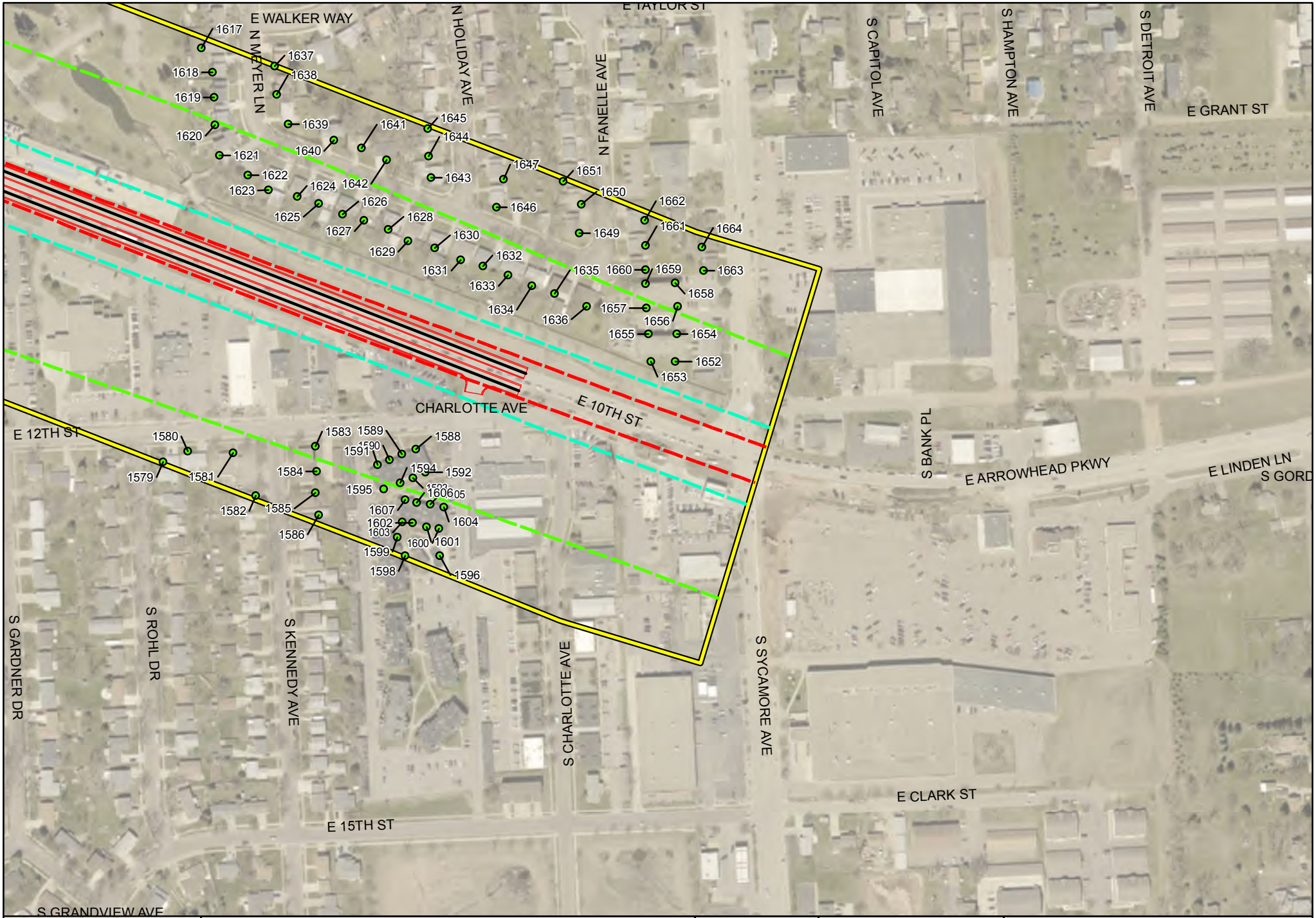


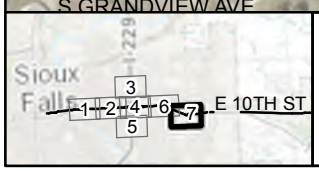
Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-9A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9A


N LINWOOD CT
N LOCUST AVE
N STEWART DR
N HOLID
N MEYER LN
E WALKER WAY
1608
1617
1618
1637
1638
1619
1639
1620
1640
1621
1622
1623
1624
1625
1626
E 10TH ST
S BAHNSON AVE
1555
1562
1566
1570
1574
1563
1567
1571
1575
1578
1564
1572
1568
1576
S SNEVE AVE
E 11TH ST
E 12TH ST
S KENNEDY AVE
1583
1580
1581
1579
1584
1585
1582
S ROHL DR
S CHURCHILL AVE
S GARDNER DR
S HOLT AVE
S EDWARD DR
S STEPHEN AVE
Sioux Falls
I-229
1
2
3
4
5
6
7
E 10TH ST
Legend
Non-Impacted Receptors
Impacted Receptors
Noise Monitoring Location
56 dBA Contour Line
66 dBA Contour Line
71 dBA Contour Line
Noise Study Area
Sub-Study 3 Concept Linework
10th-9A
HDR
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9A

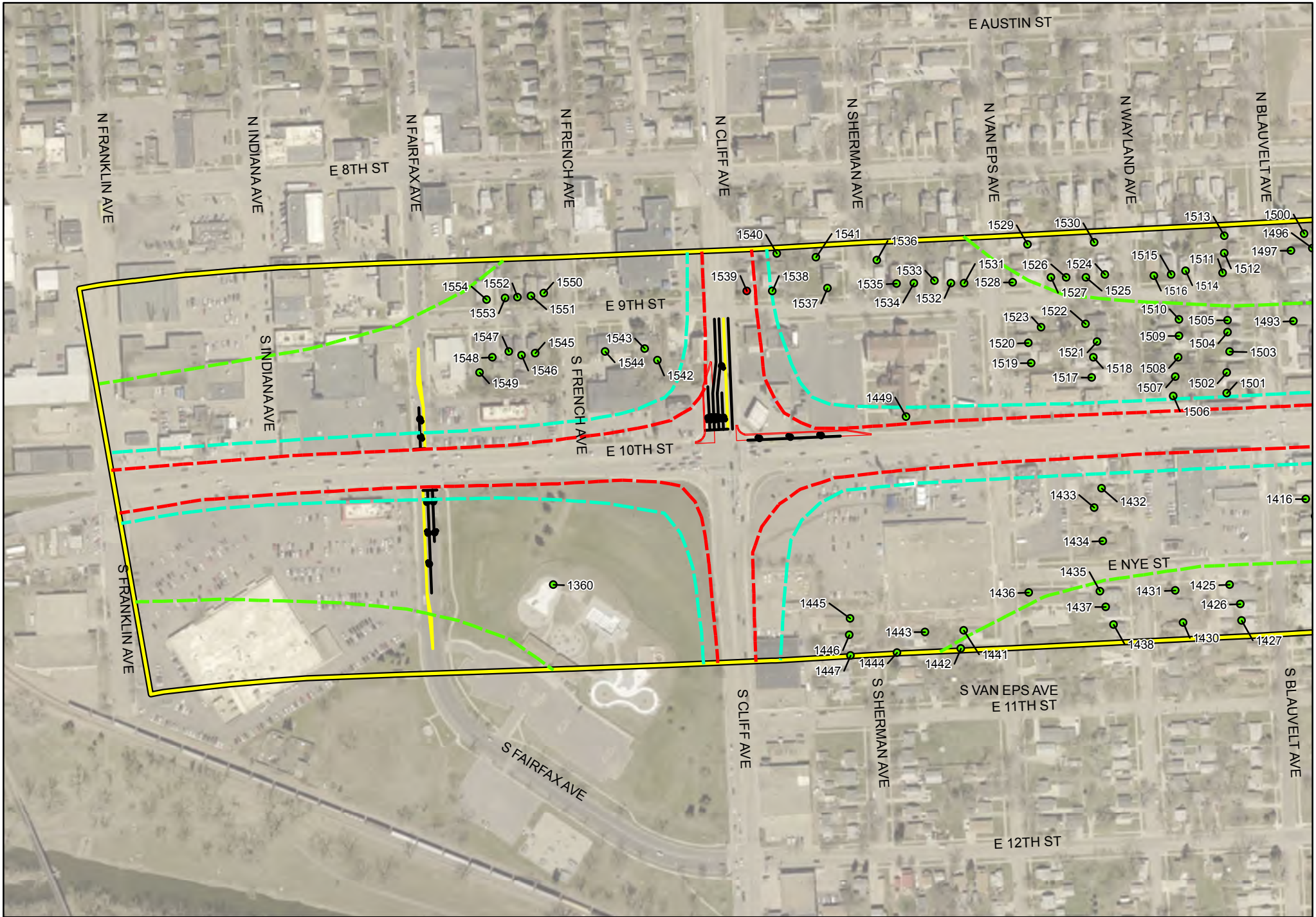


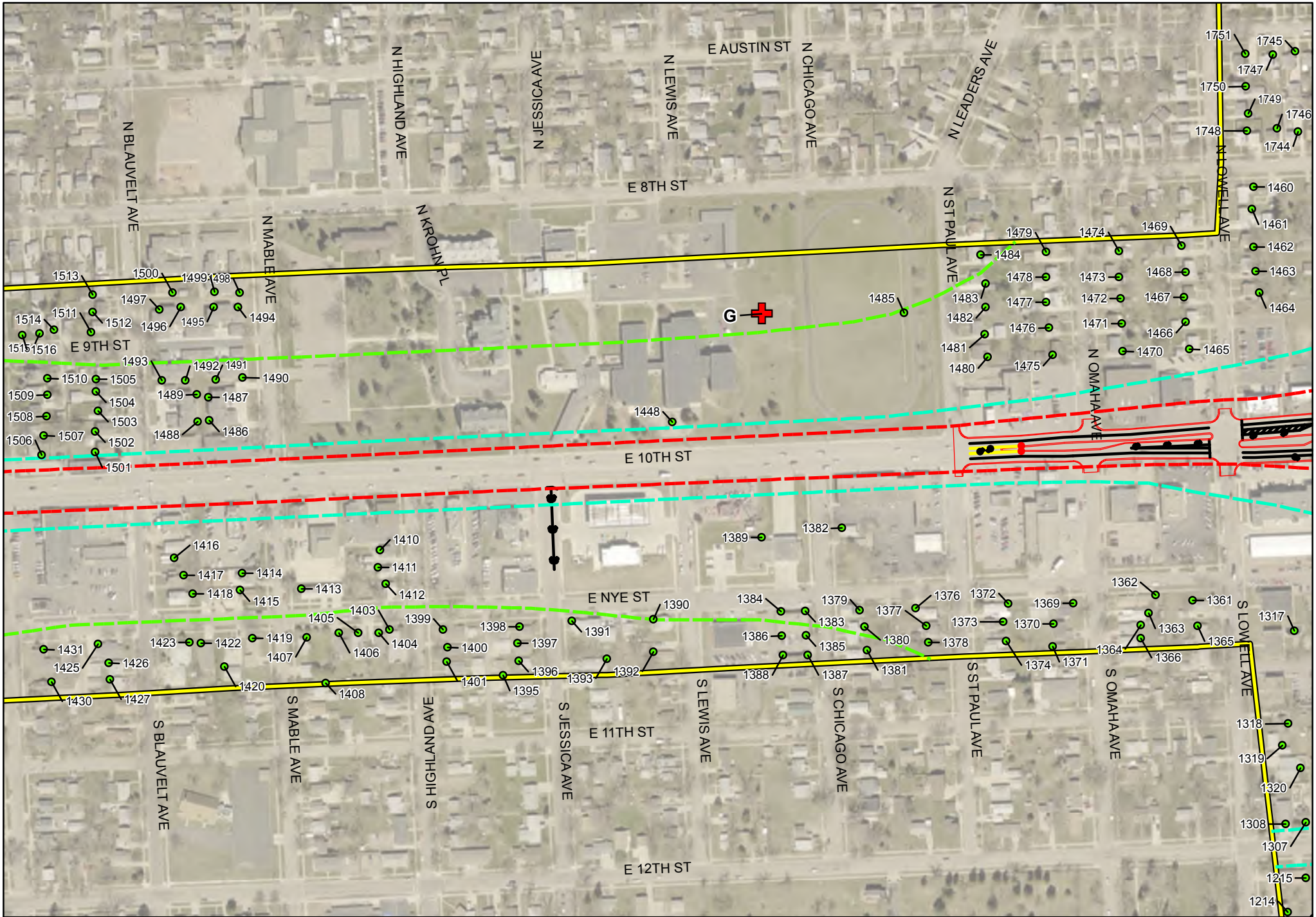


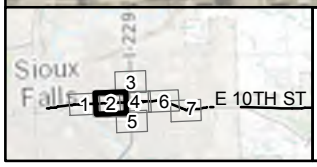
Legend

- Non-Impacted Receptors
- Impacted Receptors
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-9A

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9A


E AUSTIN ST
N FRANKLIN AVE
N INDIANA AVE
E 8TH ST
N FAIRFAX AVE
N FRENCH AVE
N CLIFF AVE
N SHERMAN AVE
N VAN EPS AVE
N WAYLAND AVE
N BLAUVELT AVE
E 9TH ST
S INDIANA AVE
S FRENCH AVE
E 10TH ST
S FRANKLIN AVE
E NYE ST
S FAIRFAX AVE
S CLIFF AVE
S SHERMAN AVE
S VAN EPS AVE
E 11TH ST
S BLAUVELT AVE
E 12TH ST
1360
1449
1493
1496
1497
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1416
1425
1426
1427
1430
1431
1432
1433
1434
1435
1436
1437
1438
1441
1442
1443
1444
1445
1446
1447
Sioux Falls
I-229
E 10TH ST
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 3 Concept Linework 10th-9B
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9B

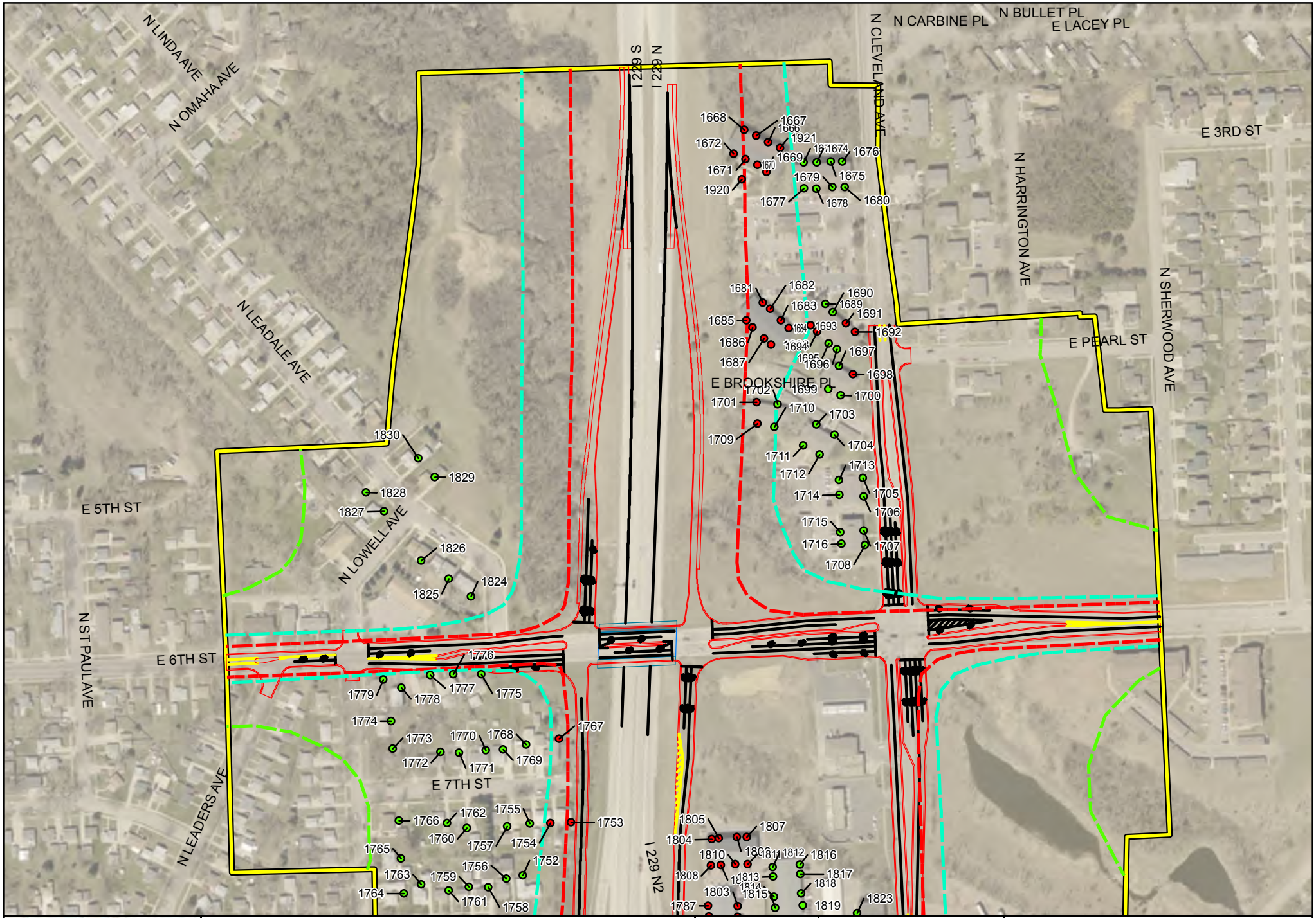


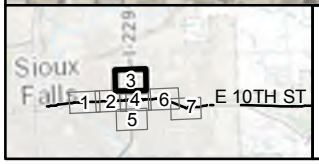


Legend

- 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 3 Concept Linework 10th-9B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9B

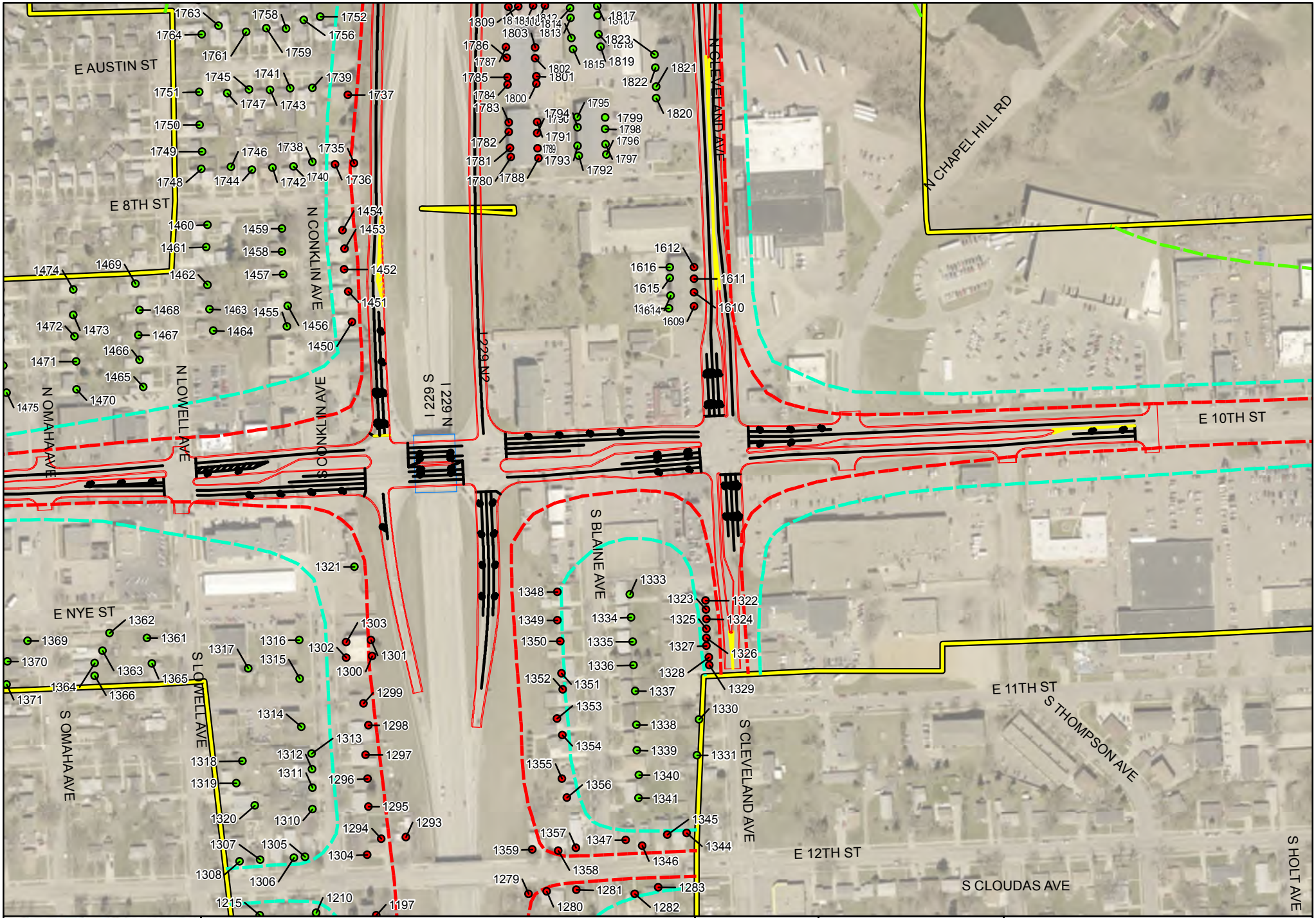


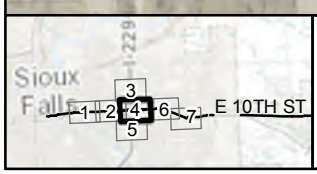


Legend

- 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 3 Concept Linework 10th-9B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9B



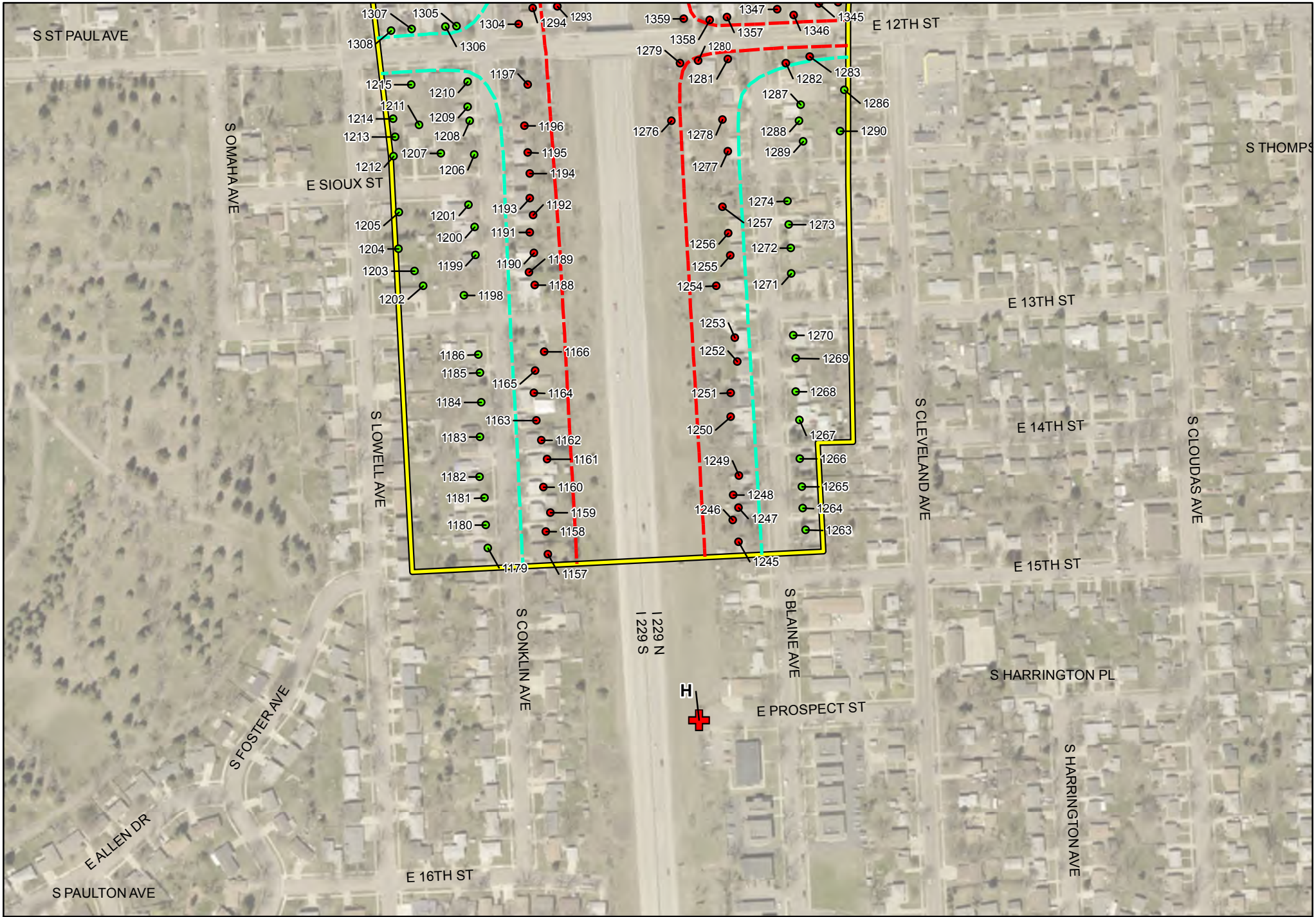


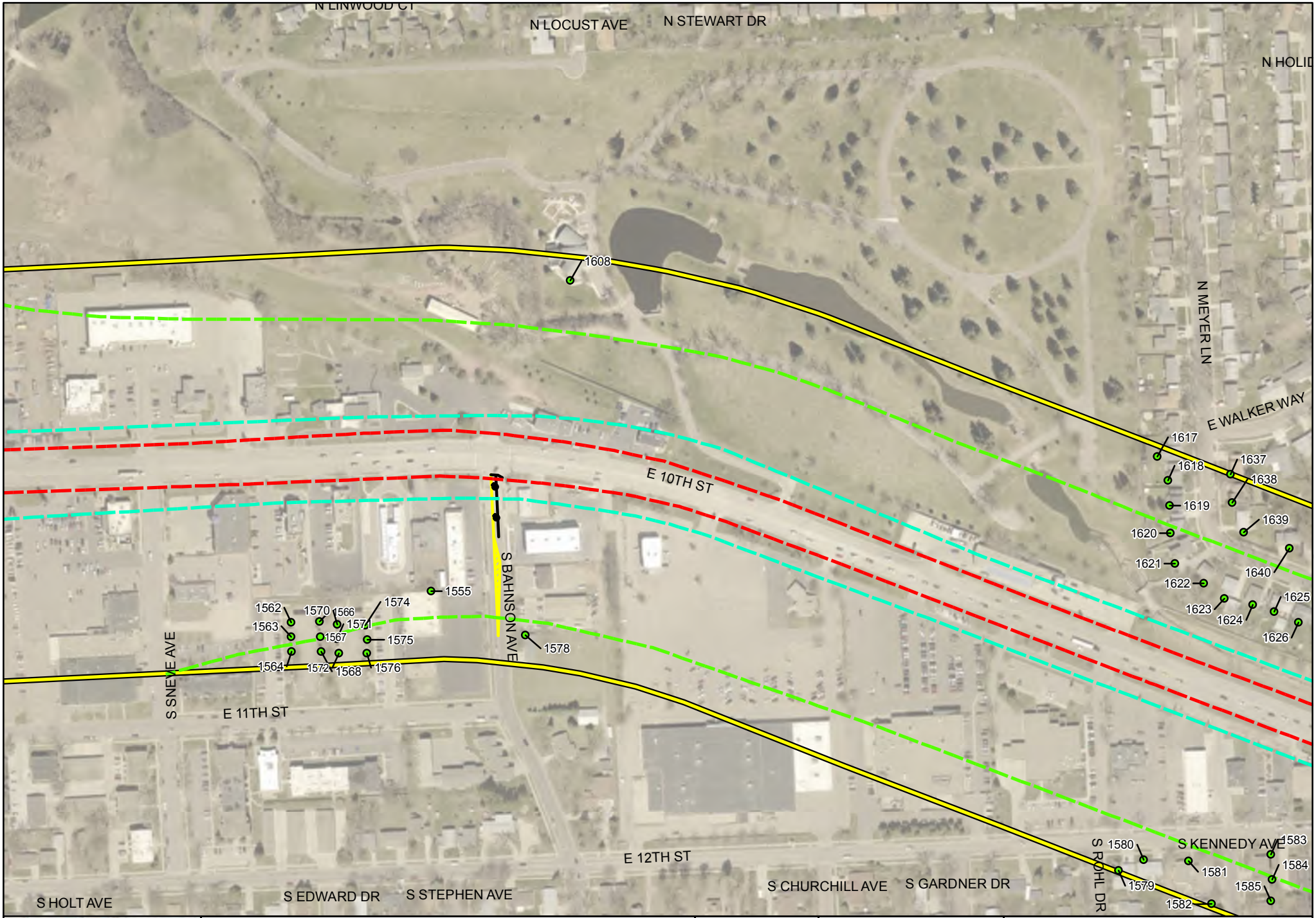
Legend

- 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 3 Concept Linework 10th-9B

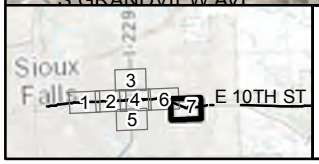
HDR

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9B


S ST PAUL AVE
S OMAHA AVE
E SIOUX ST
S LOWELL AVE
S CONKLIN AVE
I 229 N
I 229 S
S BLAINE AVE
S CLEVELAND AVE
E 12TH ST
E 13TH ST
E 14TH ST
E 15TH ST
E 16TH ST
S CLOUDAS AVE
S HARRINGTON PL
S HARRINGTON AVE
E PROSPECT ST
S FOSTER AVE
E ALLEN DR
S PAULTON AVE
S THOMPS
H
1307 1305 1304 1294 1293 1359 1347 1345
1308 1306 1358 1357 1346
1279 1280
1281 1282 1283
1287 1286
1276 1278 1288 1290
1289
1277
1274
1257 1273
1256 1272
1255
1254 1271
1253 1270
1252 1269
1251 1268
1250 1267
1249 1266
1265
1248
1246 1247 1264
1263
1245
1215 1210 1197
1211 1209 1196
1214 1208
1213 1207 1195
1212 1206 1194
1205 1201 1193 1192
1204 1200 1191
1203 1199 1190 1189
1202 1198 1188
1186 1166
1185 1165
1184 1164
1163
1183 1162
1161
1182 1160
1181 1159
1180 1158
1179 1157
Sioux Falls
1 2 3 4 5 6 7
E 10TH ST
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 3 Concept Linework 10th-9B
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9B


N LINWOOD CT
N LOCUST AVE
N STEWART DR
N HOLID
N MEYER LN
E WALKER WAY
E 10TH ST
S BAHNSON AVE
S SNEVE AVE
E 11TH ST
E 12TH ST
S HOLT AVE
S EDWARD DR
S STEPHEN AVE
S CHURCHILL AVE
S GARDNER DR
S ROHL DR
S KENNEDY AVE
1608
1555
1562
1563
1564
1570
1566
1574
1571
1567
1575
1572
1568
1576
1578
1617
1618
1619
1620
1621
1622
1623
1624
1637
1638
1639
1640
1625
1626
1580
1581
1579
1582
1583
1584
1585
Sioux Falls
I-229
E 10TH ST
1
2
3
4
5
6
7
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 3 Concept Linework 10th-9B
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9B

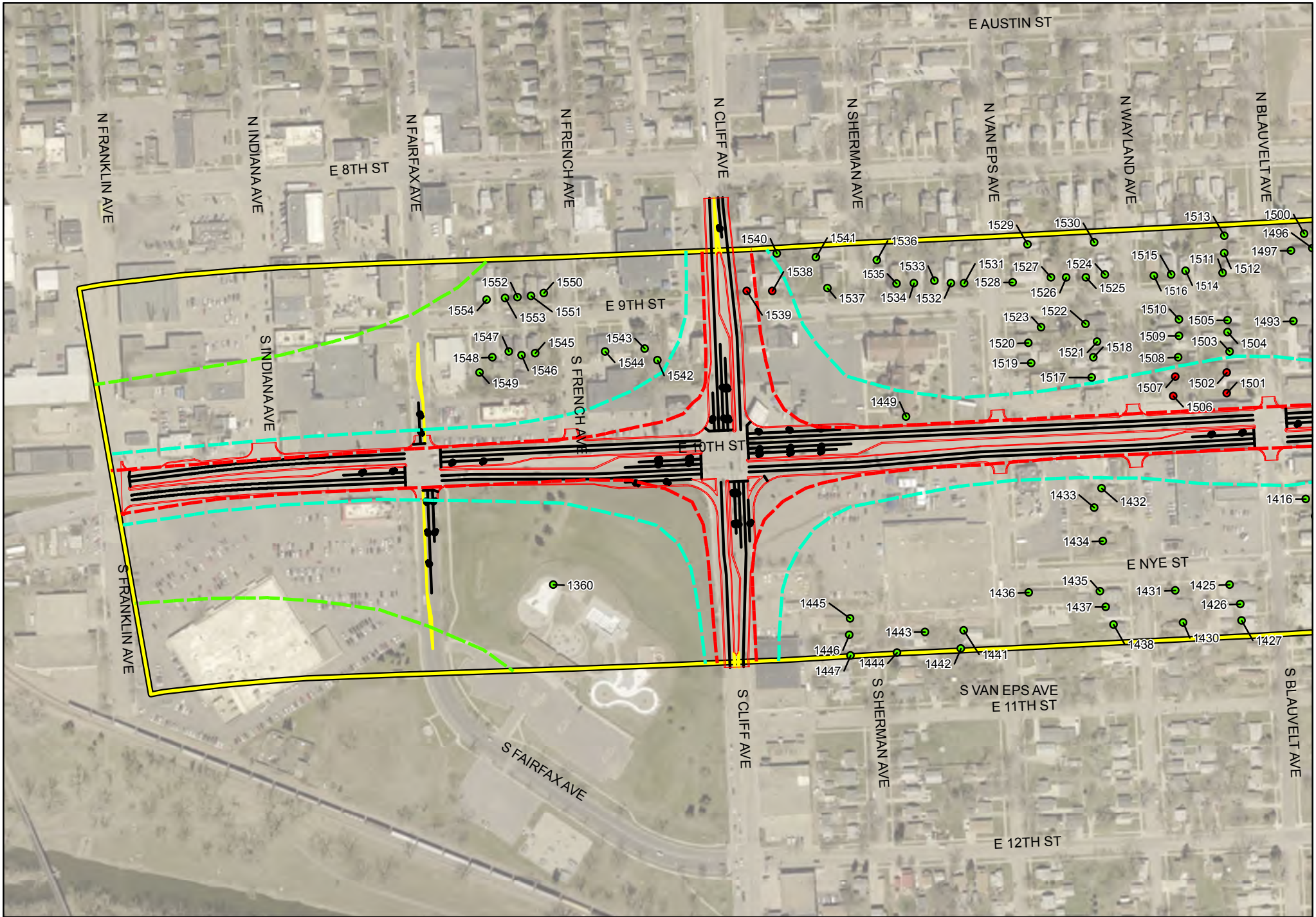


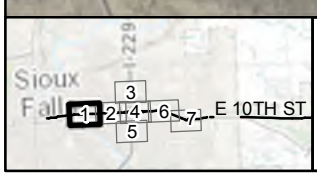


Legend

- 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 3 Concept Linework 10th-9B

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative 9B

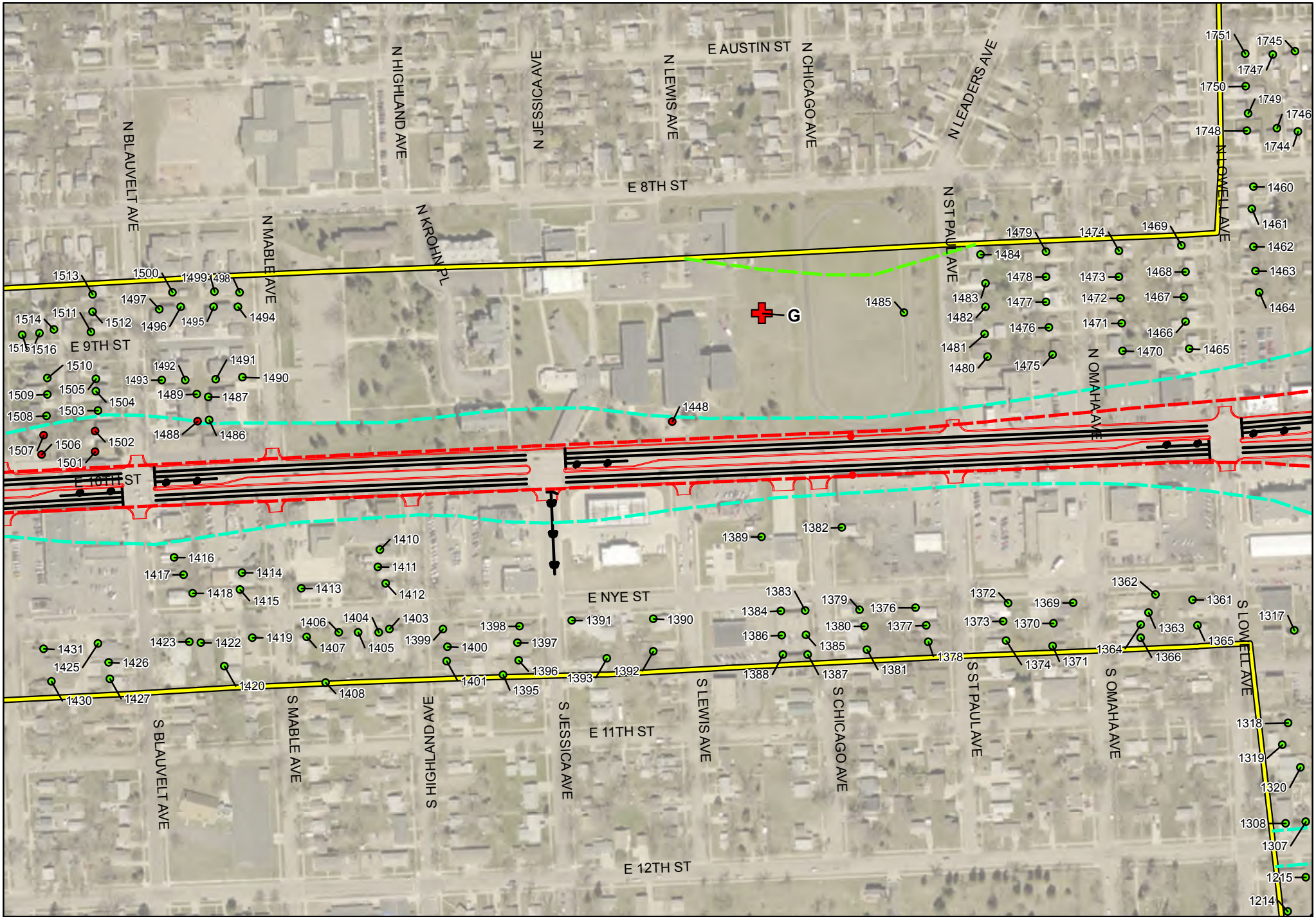


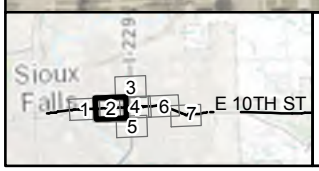


Legend

- 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 3 Concept Linework 10th-Var

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative VAR

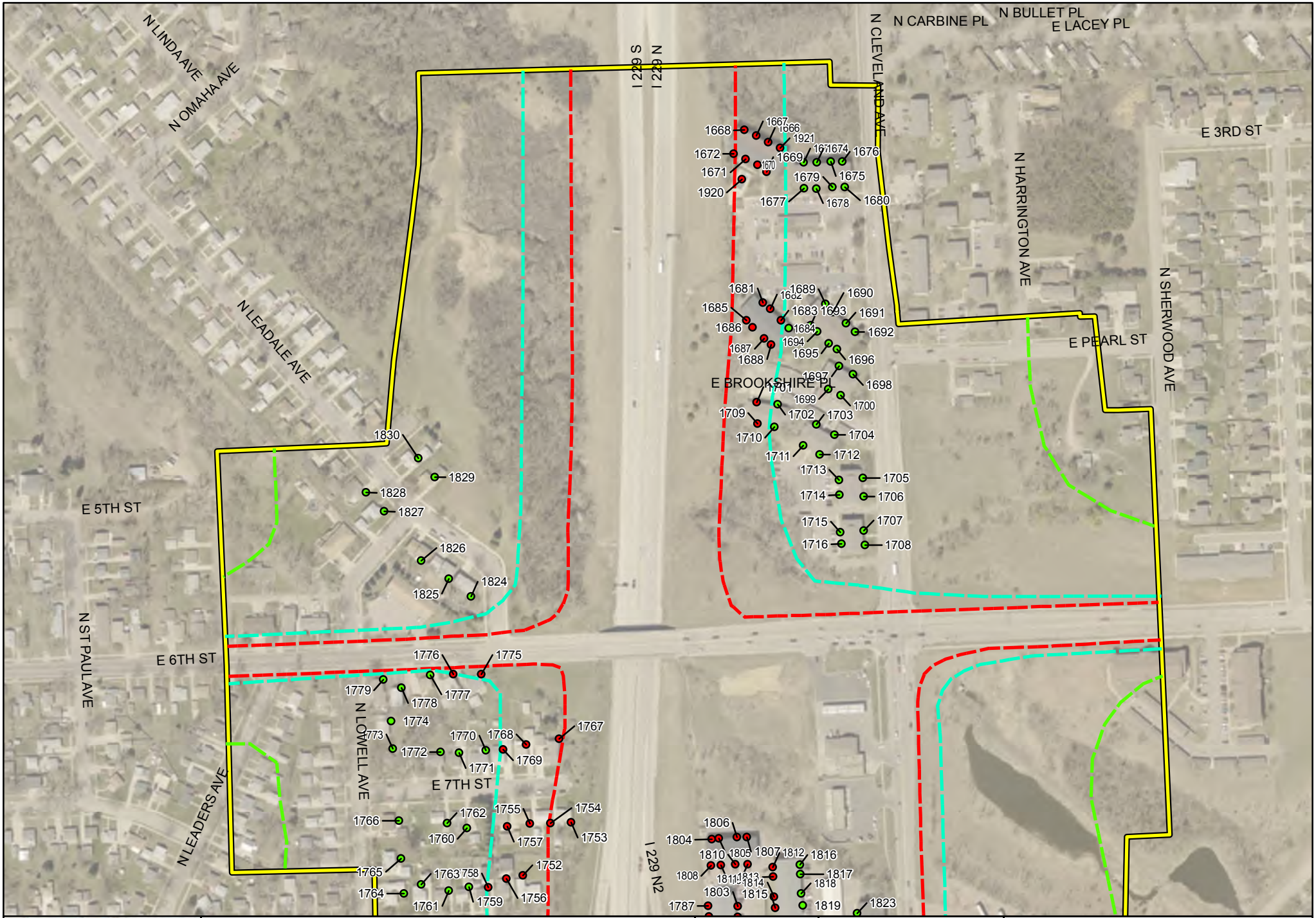




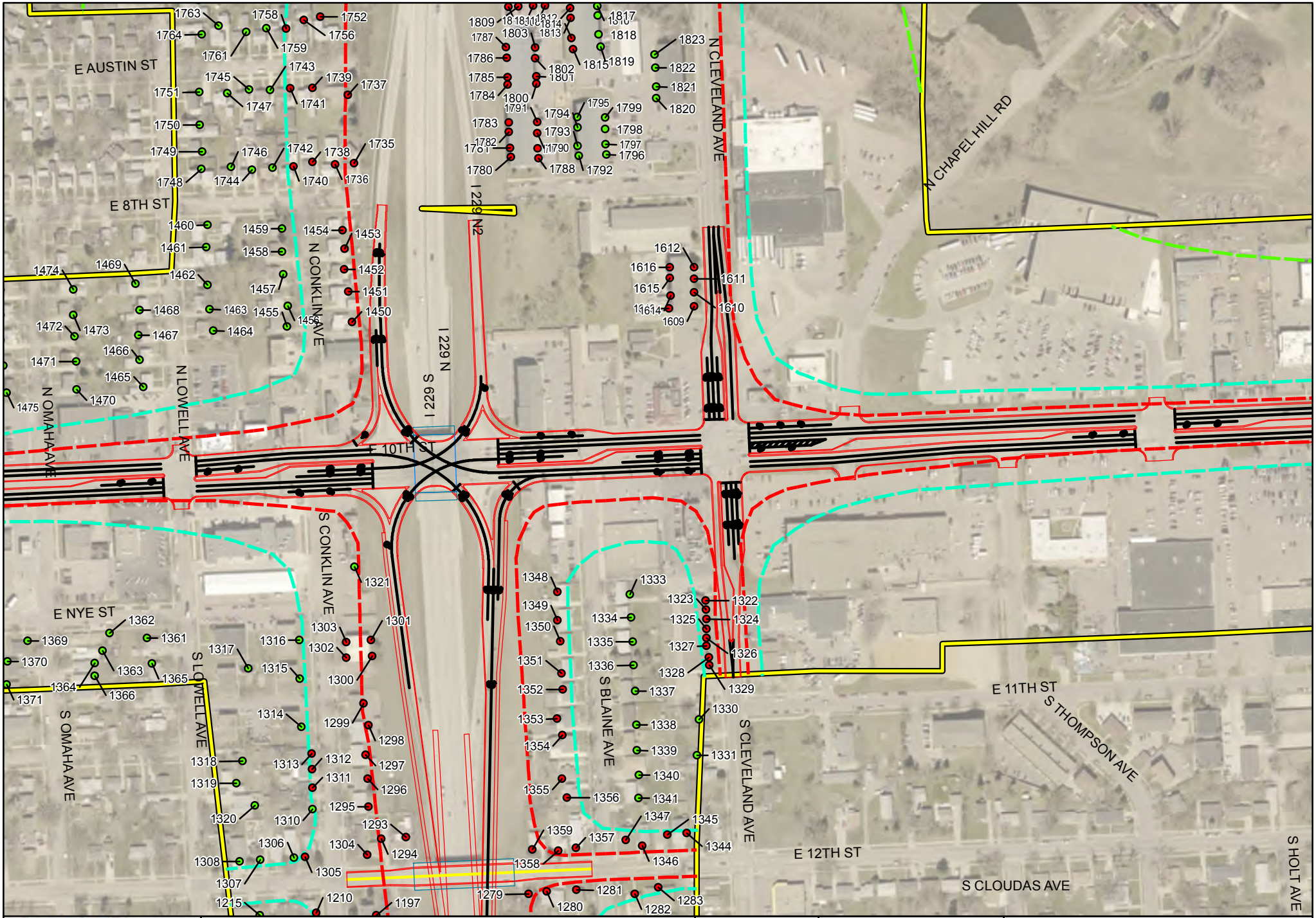
Legend

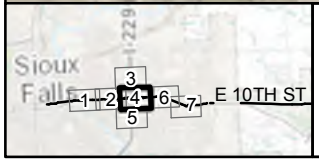
- Non-Impacted Receptor
- Impacted Receptor
- Noise Monitoring Location
- 56 dBA Contour Line
- 66 dBA Contour Line
- 71 dBA Contour Line
- Noise Study Area
- Sub-Study 3 Concept Linework 10th-Var

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative VAR



I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative VAR

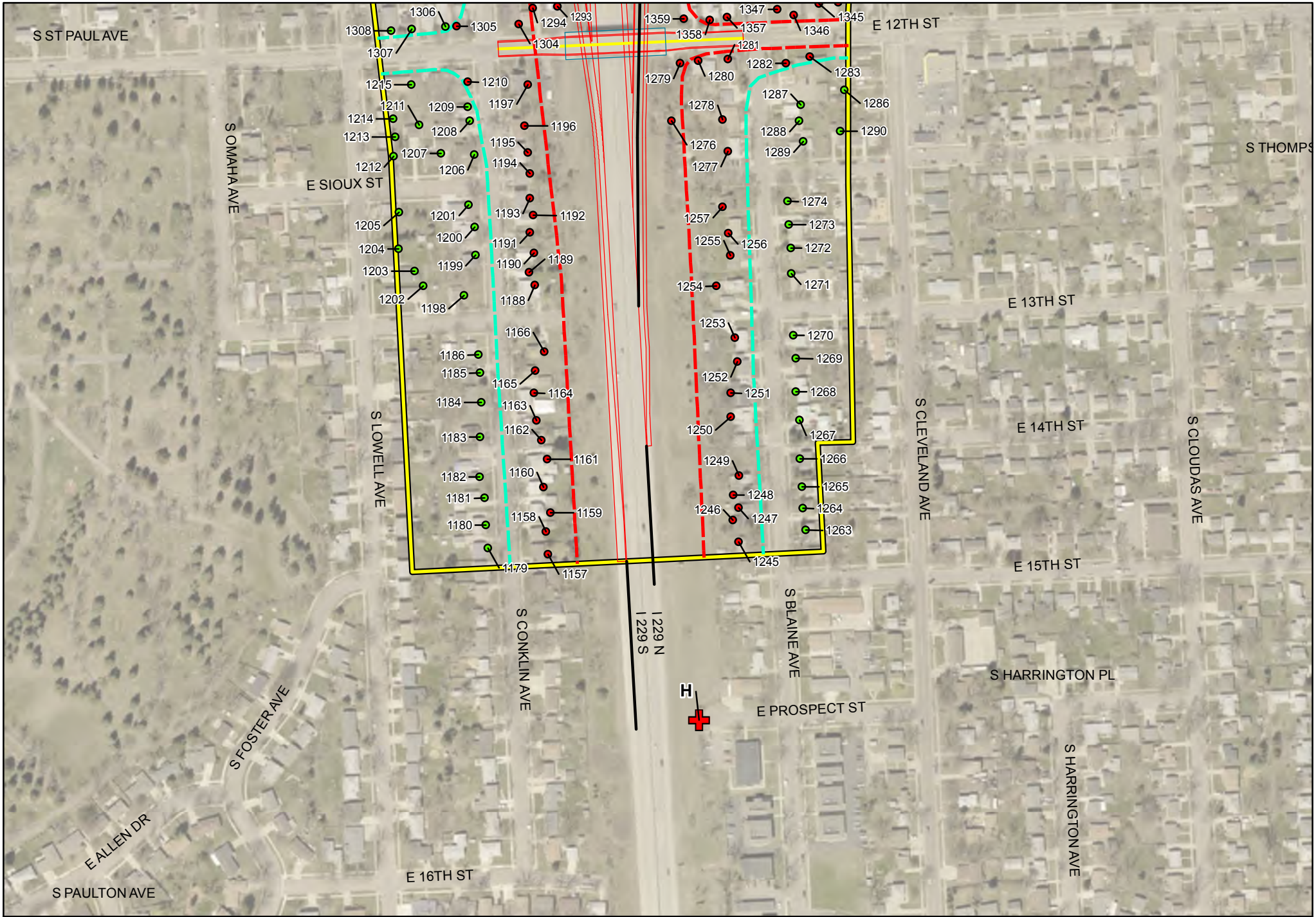


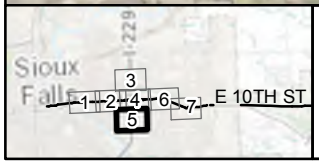


Legend

- 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 3 Concept Linework 10th-Var

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative VAR

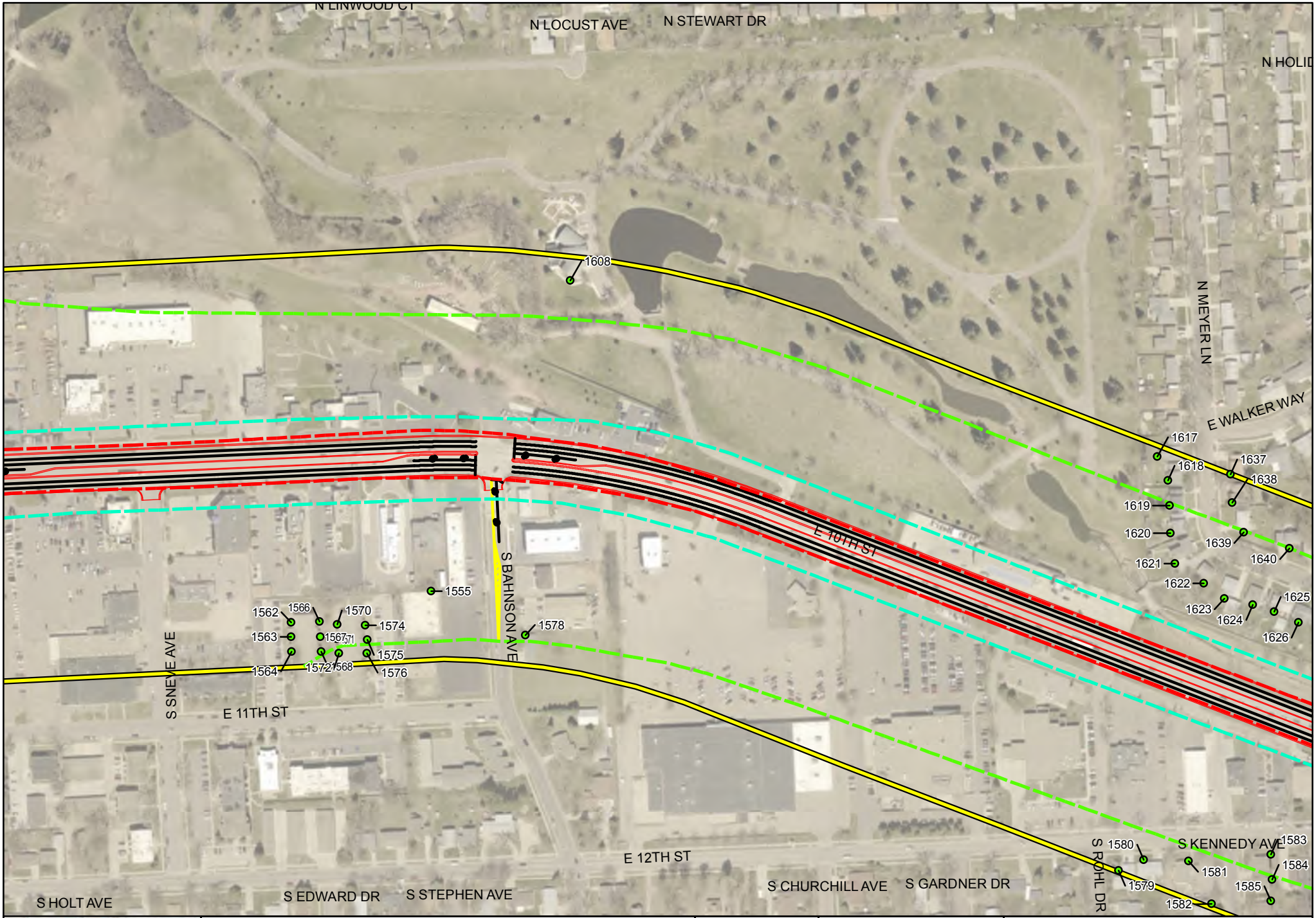


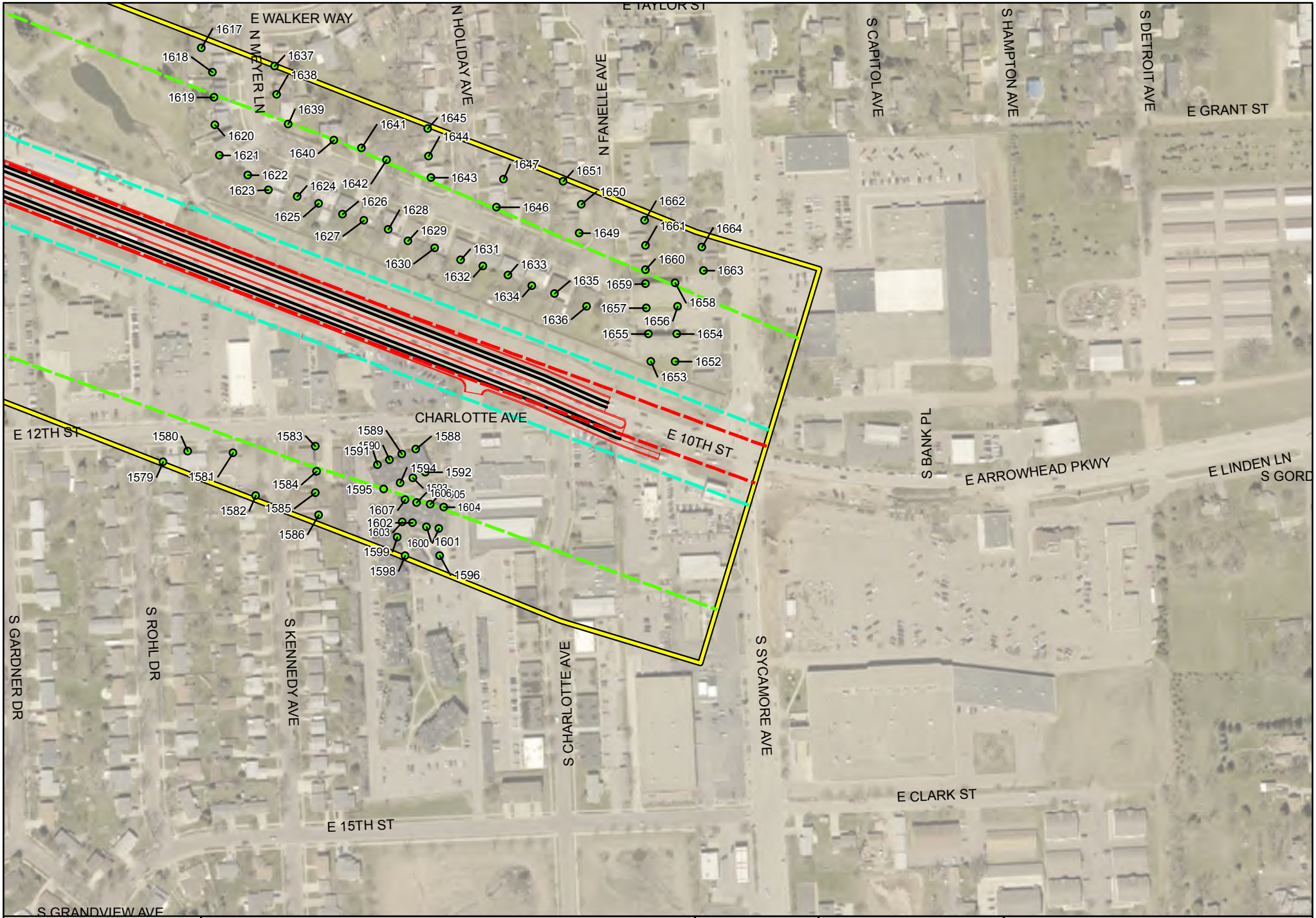


Legend

- 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 3 Concept Linework 10th-Var

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative VAR


N LINWOOD CT
N LOCUST AVE
N STEWART DR
N HOLID
N MEYER LN
E WALKER WAY
1608
1617
1618
1637
1638
1619
1620
1639
1640
1621
1622
1623
1624
1625
1626
E 10TH ST
S BAHNSON AVE
1555
1562
1566
1570
1574
1563
1567
1571
1578
1564
1572
1568
1575
1576
S SNEVE AVE
E 11TH ST
E 12TH ST
1580
S KENNEDY AVE
1583
1581
1584
1579
1585
1582
S ROHL DR
S CHURCHILL AVE
S GARDNER DR
S HOLT AVE
S EDWARD DR
S STEPHEN AVE
Sioux Falls
I-229
E 10TH ST
1
2
3
4
5
6
7
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 3 Concept Linework
10th-Var
HDR
I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative VAR



Sioux Falls I-229 E 10TH ST 1 2 3 4 5 6 7

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 3 Concept Linework 10th-Var

I-229 Major Investment Corridor Study
Sub-Study #3
Noise Contour Figures
Proposed Alternative VAR

Appendix H. 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	barbmanny78@gmail.com
3	Nick Mentele		770-8856	nickmentele@yahoo.com
4	Jim Entenman			
5	Stacy DuChene		221-2667	sduchene@hrgreen.com
6	Trent Swanson	100 N Phillips #901 SF-S.D 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	117120 85th SF	605-368-2114	
9	Jack Mallek	4705 Yellowstone	335-5596	
10	Gail Buson	6500 TALLGRASS	357 4780	
11	Craig Lloyd	6904 S Westfield St	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				
16				
17				
18				
19				

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	Rich Schwanke VFW	3601 S Minnesota SF		Imbliss628@aol.com
2	Butch Haugen VFW	3601 S. Minn. SFSD	605-553-5518	bhaugen@gmail.com
3	Mike Behn SDDOT	700 E Broadway Pierre SD	605 773 4423	Michael.Behn@state.sd.us
4	Brad Remmich SDDOT	" "	605-773-3073	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	7505 S. Kiwanis, # 2444 SF, SD 57106	605-338-0966	akscrib@yahoo.com
10	Brad Hicks	609 S. Conklin SF SD 57103		
11	Bill Cool Kollis	3217 W. Zephyr Pl SF SD.		
12	Larry Karsten	2504 E. 19th	338-4760	
13	Chris Parsley	7001 W 66th	219-384-1507	CMPARSLEY@Gmail.com
14	Brent Hamilton	1301 S. Minnesota Ave	605-953-3618	
15	Jerry Jackie Nash	3105 Tricia Lane	605-338-1870	
16	Julie Christianson	1105 S Riverdale	605-338-3260	bigkahuna@sioux falls.net
17	Robert Leonhardt	2001 S Carolina Dr	605-321-5074	
18	Mark Miller	3908 S Dolly SF 57103		
19	Mark Haines	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 SFSD 57104	605-367-5390	amber@secog.org
5	Mike Holm	1309 E North Star		mHolm@cidinc.net
6	JOAN STORER	3900 W Avera Dr	605 323-4573	JOAN.STORER@AVERA.org
7	Dennis Weldreyer	5510 Shadowwood PL	605-351 0219	dweldreyer@lincolnhealthsp.org
8	Josh Larson	2208 S Sheffield	605-205-0016	joshuadavid@hotmail.com
9	GEORGE HAHN	647 S. Main	360-6639	SFSD 57104
10	ARNIE WULF	1600 S GRAY GOOSE	335-1897	AMWULF@SVTV.com
11	Glenda Broad	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@dakotabirrits.org
14	Mike Murphy / SF YMCA	2411 S. Carter Pl.	360-7414	camp@siouxfallsymca.org
15	Duane A.			duane@hass.com
16	Brian Ray	8404 Indian Hills Drive Omaha NE	402.399 1000	brian.ray@hdrinc.com
17				
18				
19				

DOT Connecting South Dakota and the Nation

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 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	Joel W Gangler SDDOT	700 E Broadway Ave Pierre SD	605-773-3746	—
2	Pete Longman SDDOT	700 E Broadway Ave Pierre	605-773-6488	-
3	Vicki Meirose	1001 S. Juliet Ave. SF SD 57110		
4	Rex Rolfing	SF SD		
5	Gerald Tewnissen	SF, SD		
6	James Unruh	HDR SF, SD		
7	Sam Trebilcock	City of SF	367-8890	
8	Heath Hoffieser	City of SF		
9	Jan Wiegand	HR Green		
10	Bill Moran	HR Green		
11	Cheryl Rath	SF SD		
12	Clint Kolda	7605 W. Regina St SF		dakotacyclist@gmail.com
13	Steven Janssen	5000 Junnymoon Cir SF		
14	Rick Kiley	1108 N. West Ave Sioux Falls	605-361-7785	kiley@southdakotasafety.org
15	Senator Ernie Otten	46787 273rd ter.		
16	Tom Sweetman	PO Box 2320 SF SD 57101	605 366 5746	thomas r sweetman@gmail.com
17	Greg Boris	5915 S. Westwind	321-5514	
18	[illegible]	616 E. Wilwell Pl	376.4056	
19	Marshall Lavin	1710 S. Southeastern Ave	334-7979	alavins@sio.midco.net

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(97) 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	Mary; Jack Mortenson	2116 S. Crestwood Rd	605.321.0509	mary@sparklight.org
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

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 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

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 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: 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

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 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: _____

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 - showed 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:

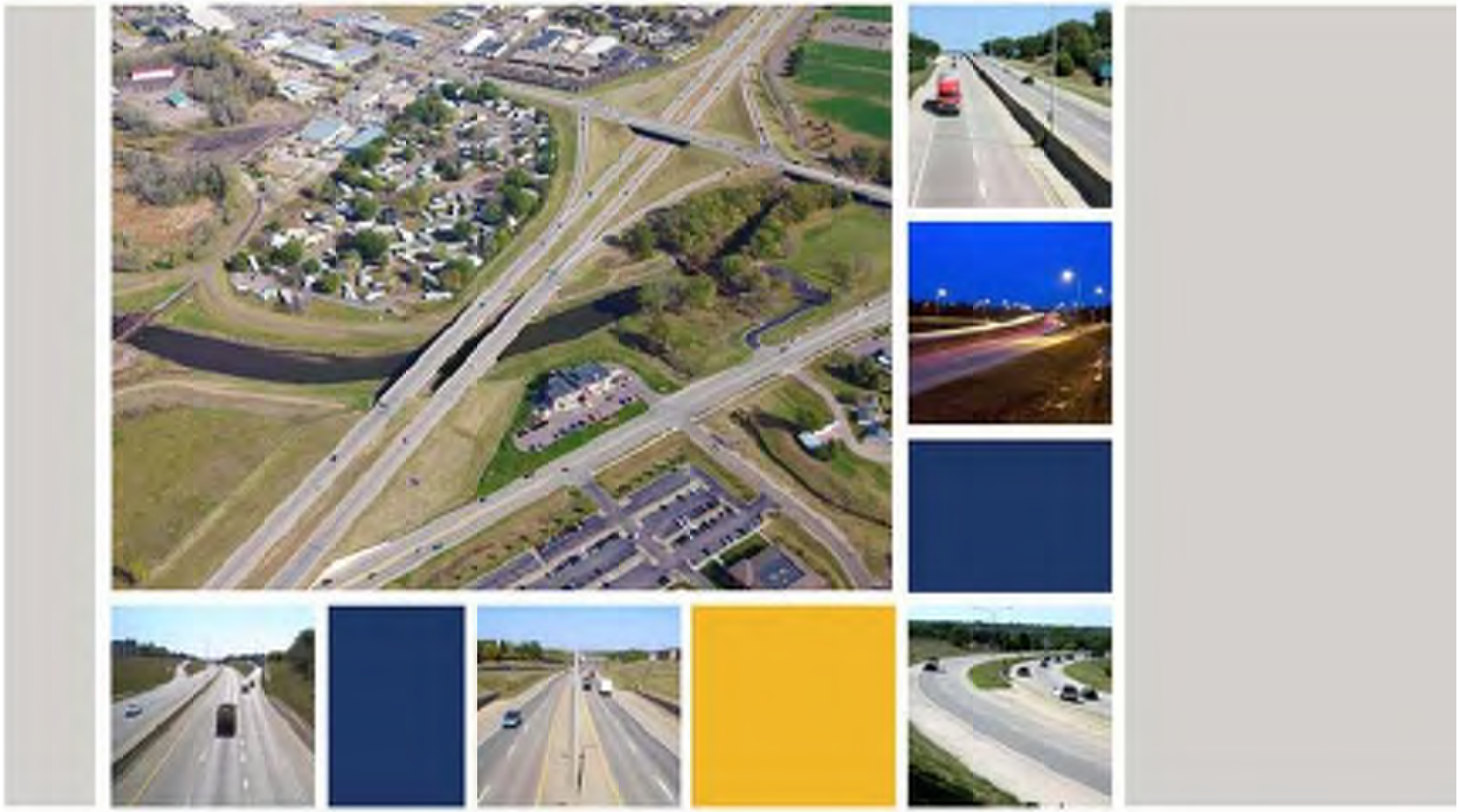
Field	Value
Name	Michael Christensen
Org	
Address2	1813 S Purdue Ave
CSZ	Sioux Falls, SD, 57106
Phone2	605-929-8923
Email2	mytzpyk@gmail.com
Study2	I-229 Corridor Study
Comments	Please include Cliff Ave in the study: because the Cliff Ave interchange is so similar to the Minnesota Ave interchange I am 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

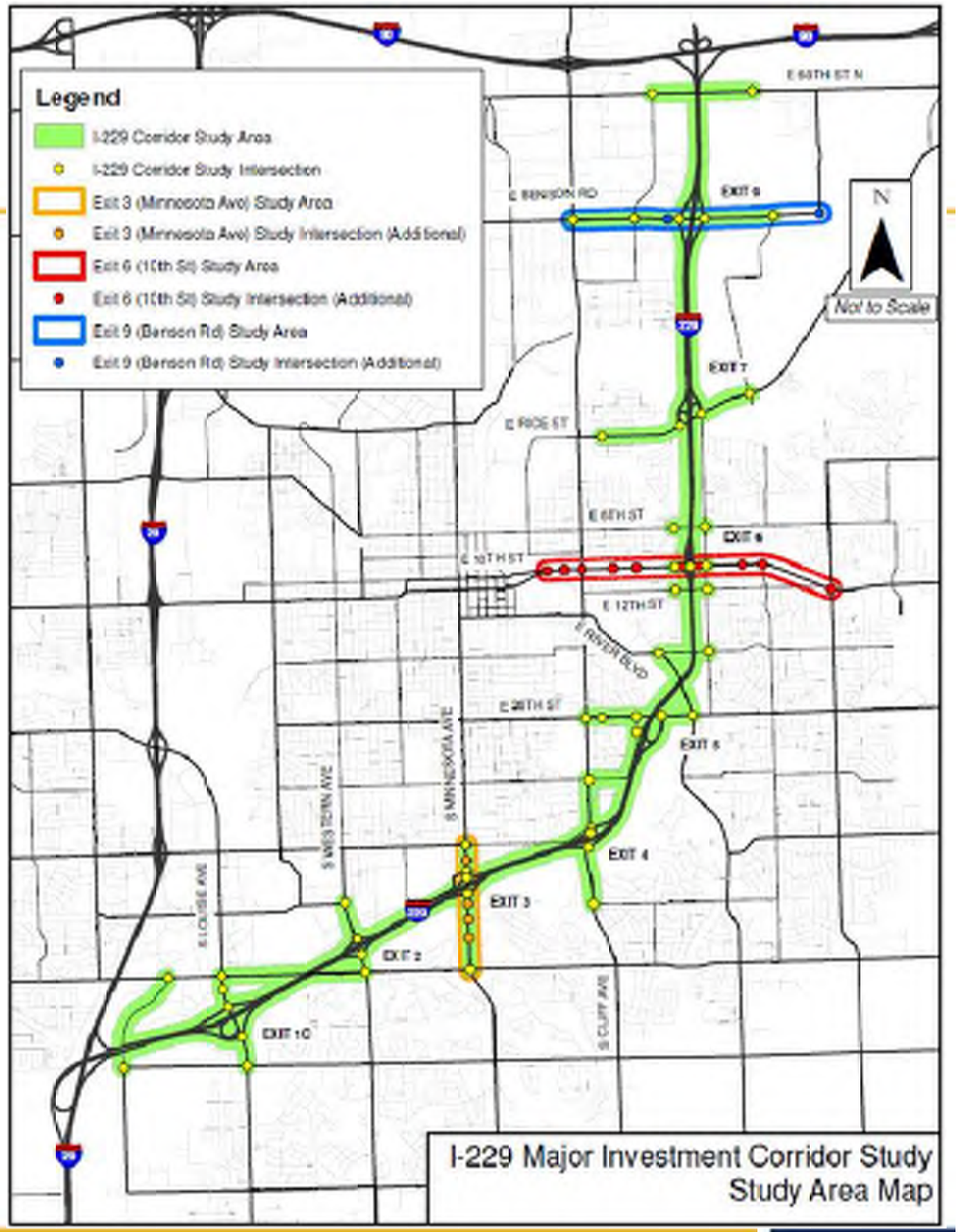
Solberg Avenue Overpass
to
60th Street N. Overpass

Additional Studies

Exit 3 – Minnesota Ave

Exit 6 – 10th Street

Exit 9 – Benson Road



What is Driving this Study?

Louise Avenue Area – 1990's

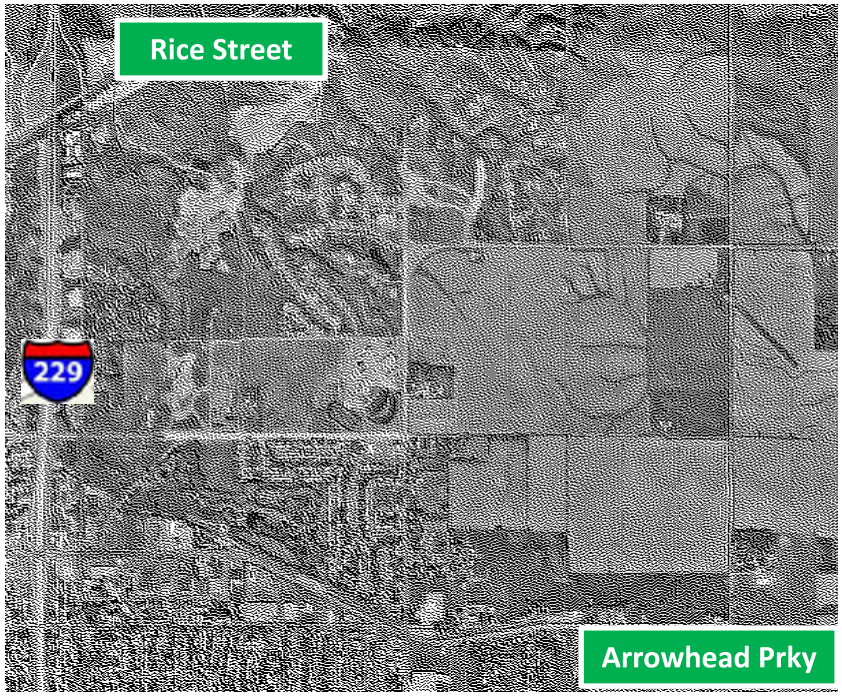


Louise Avenue Area – 2010's



What is Driving this Study?

10th Street Area – 1990's

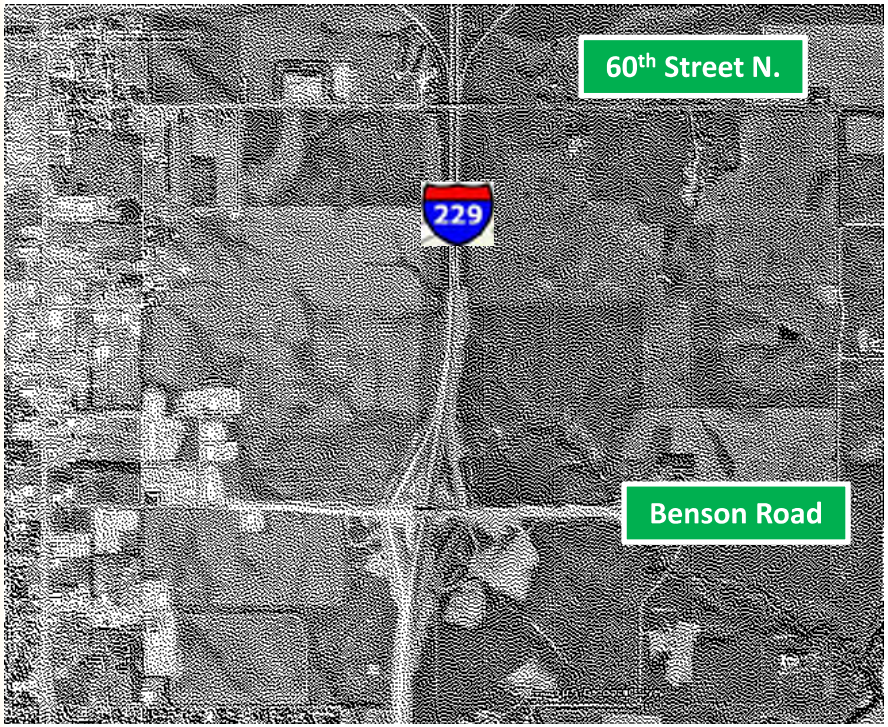


10th Street Area – 2010's



What is Driving this Study?

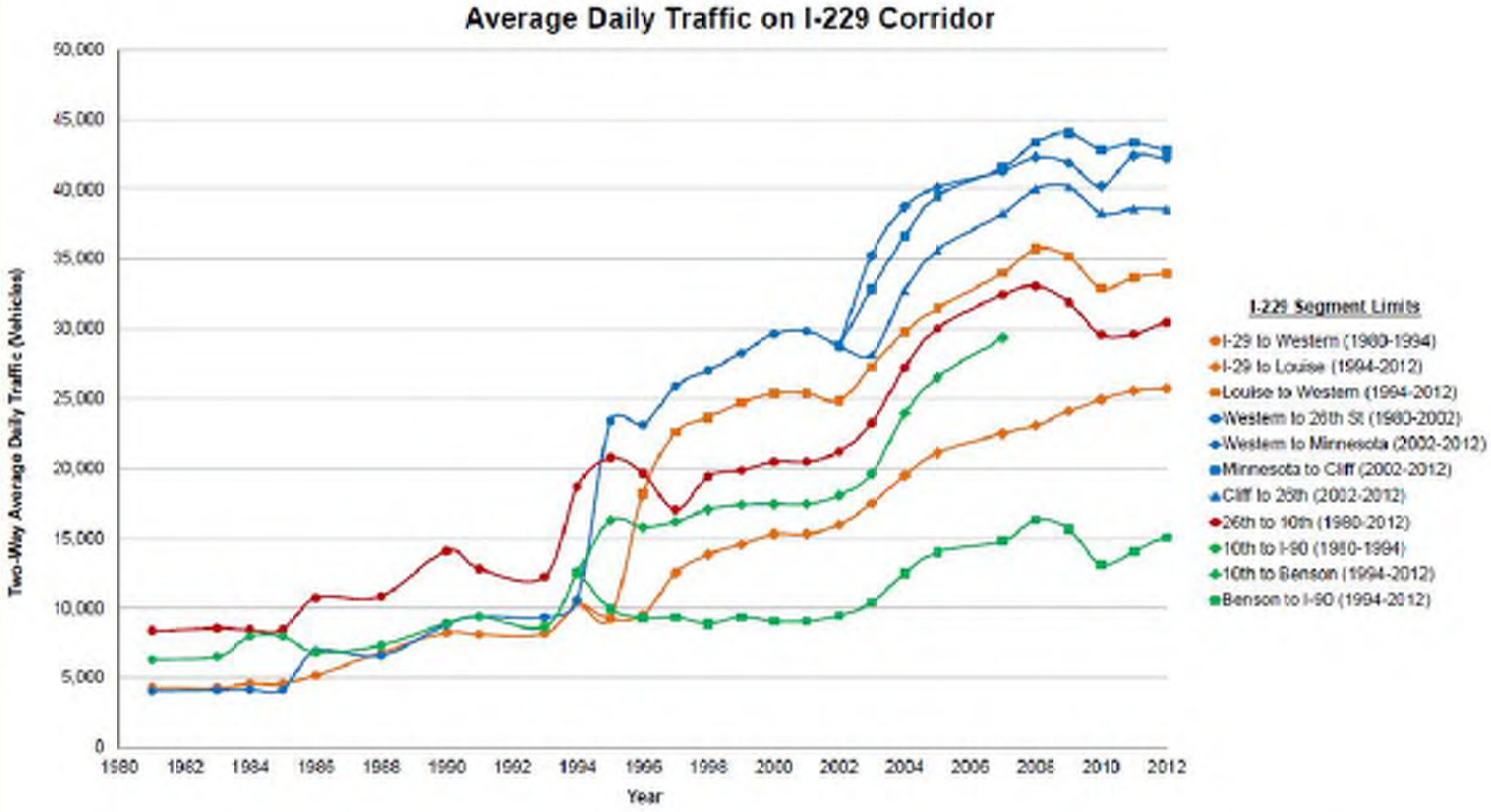
Benson Rd Street Area – 1990's



Benson Rd Street Area – 2010's



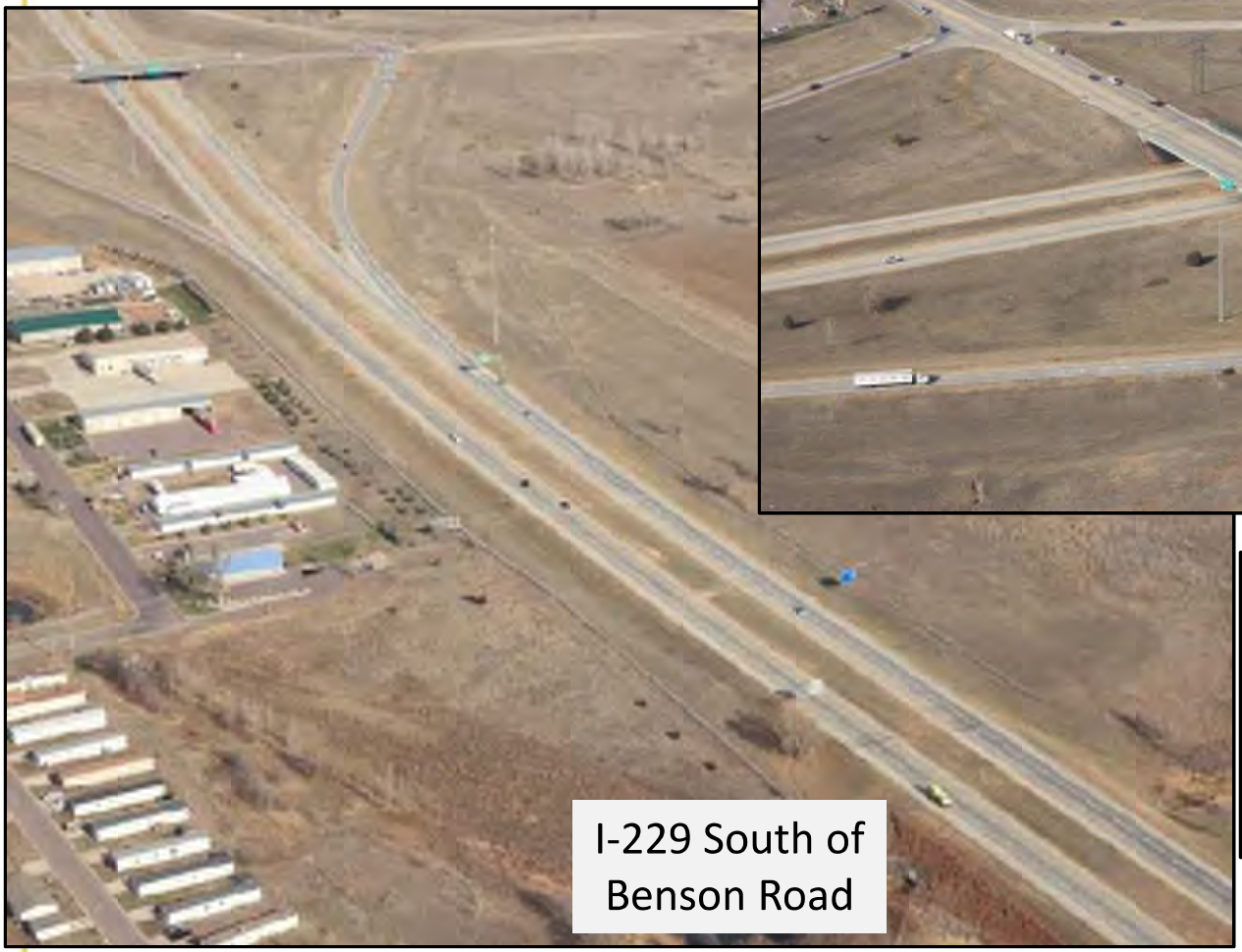
What is Driving this Study?



Historic Traffic Growth

What Should the Study Tell Us?

- **Traffic Capacity**



I-229 South of Benson Road



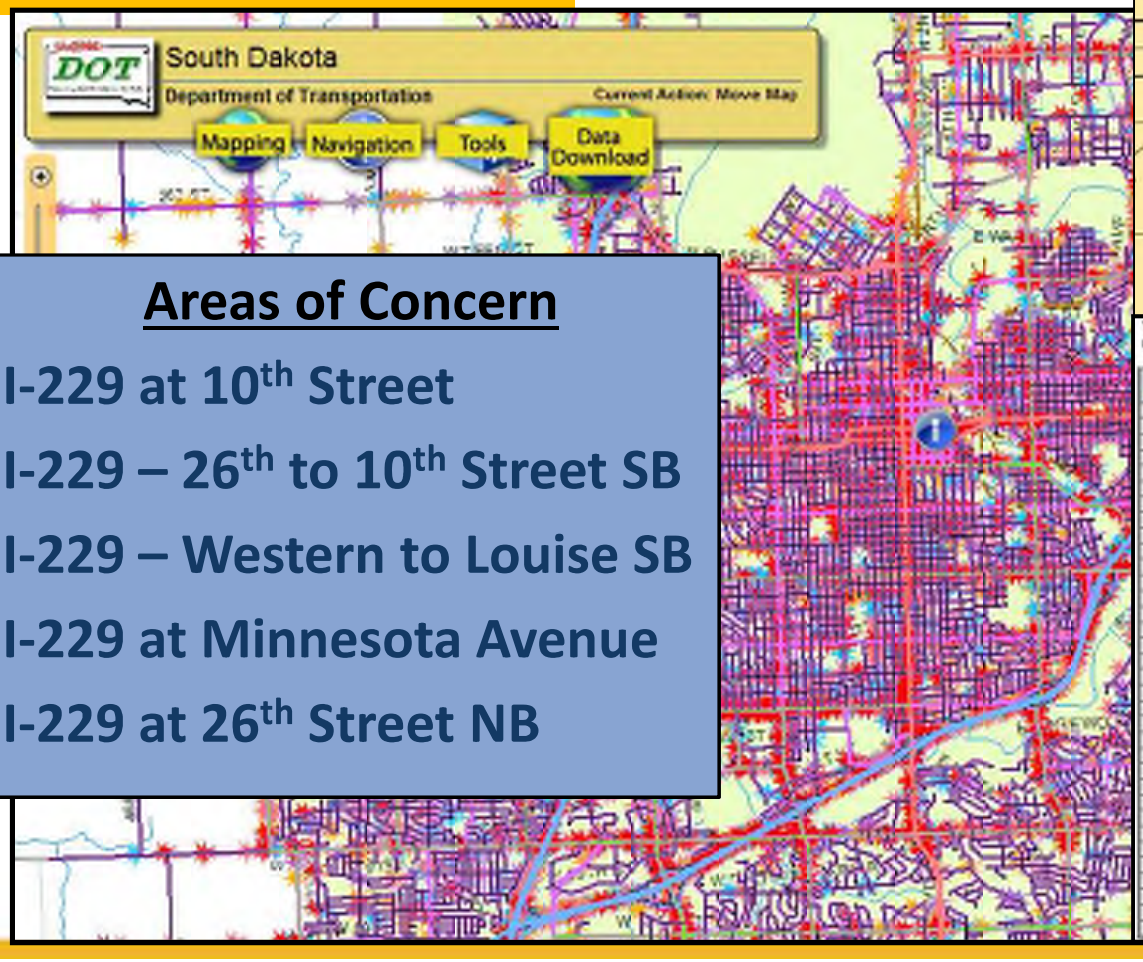
(Exit 9) Benson Road Interchange

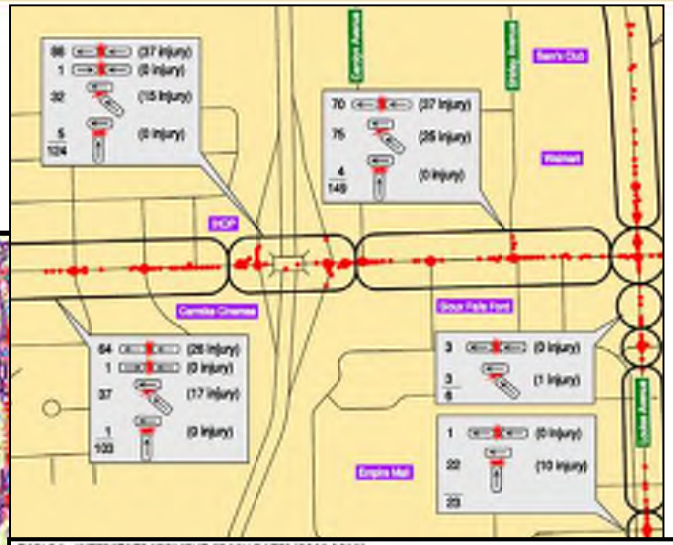
Traffic Analysis Locations

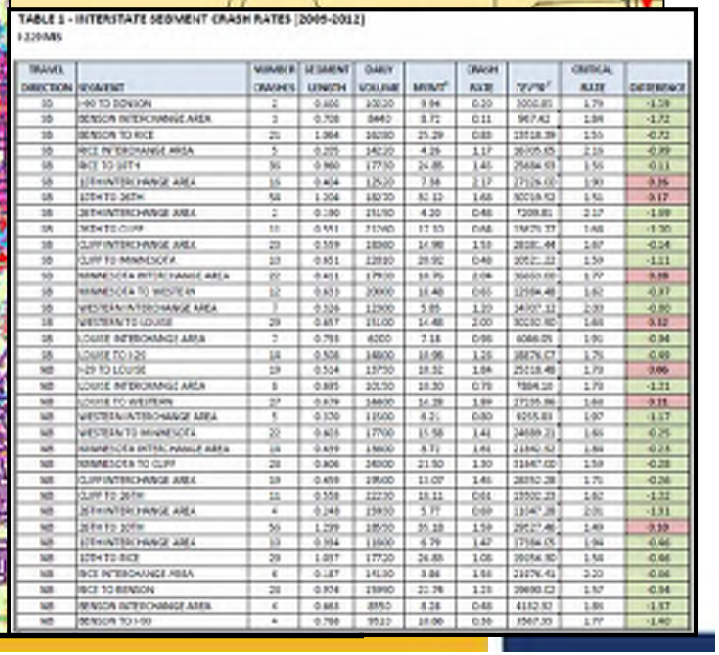
- I-229 Mainline
- I-229 Ramps
- Interchange Intersections
- Crossroad Intersections

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**



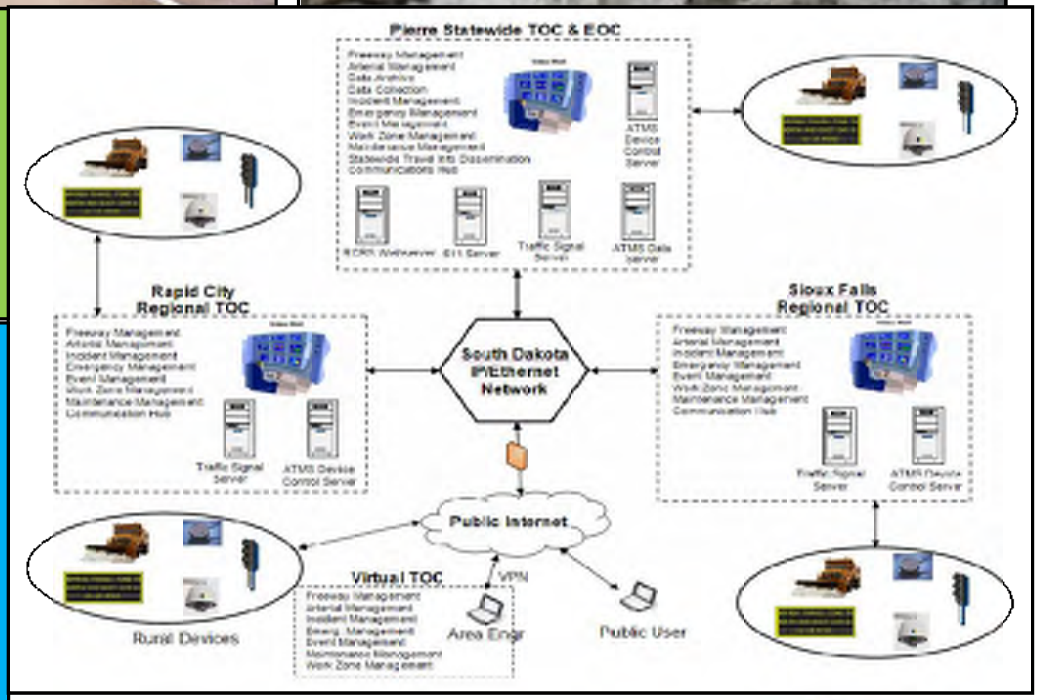


Incident Management Study Goals

- Development of Base Mapping for Detours along I-229
- Begin discussions on Communication Activities

Traffic Incident Management Partners

- Law Enforcement
- Fire and Rescue
- Medical Services
- Public Safety Communications
- Traffic Information Media
- SDDOT, City of Sioux Falls, and others



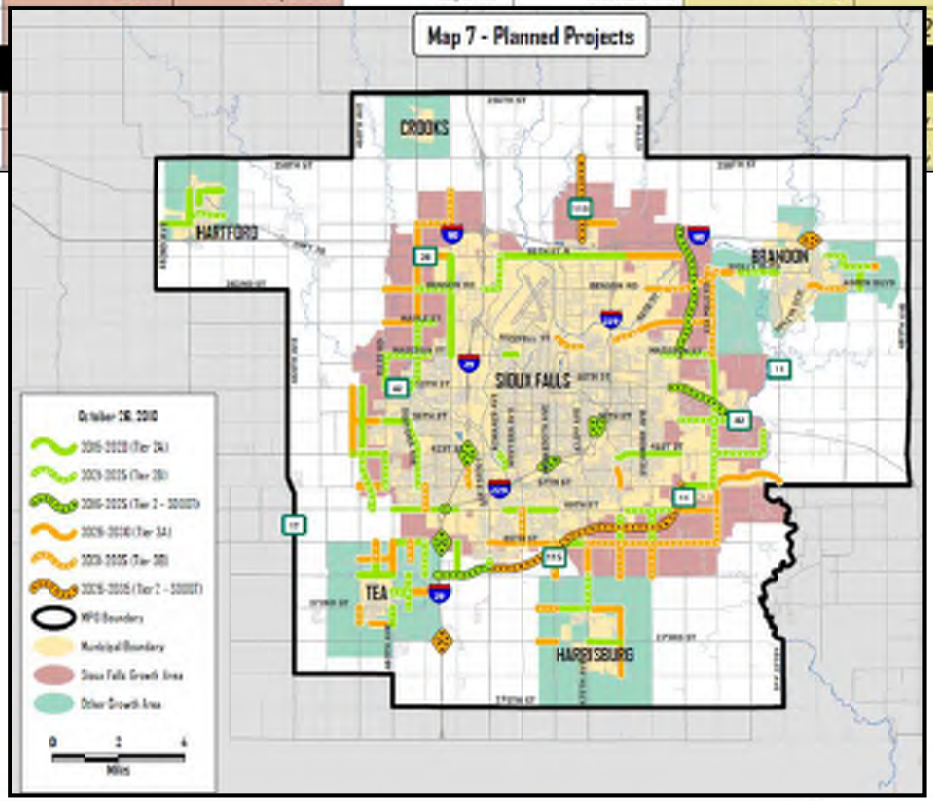
What Should the Study Tell Us?

- Traffic Capacity
- Traffic Safety
- Incident Management
- **Short & Long Term Planning**

Chart 5-P: MPO Community 2035 Growth Projections

Minnehaha County Population and Employment

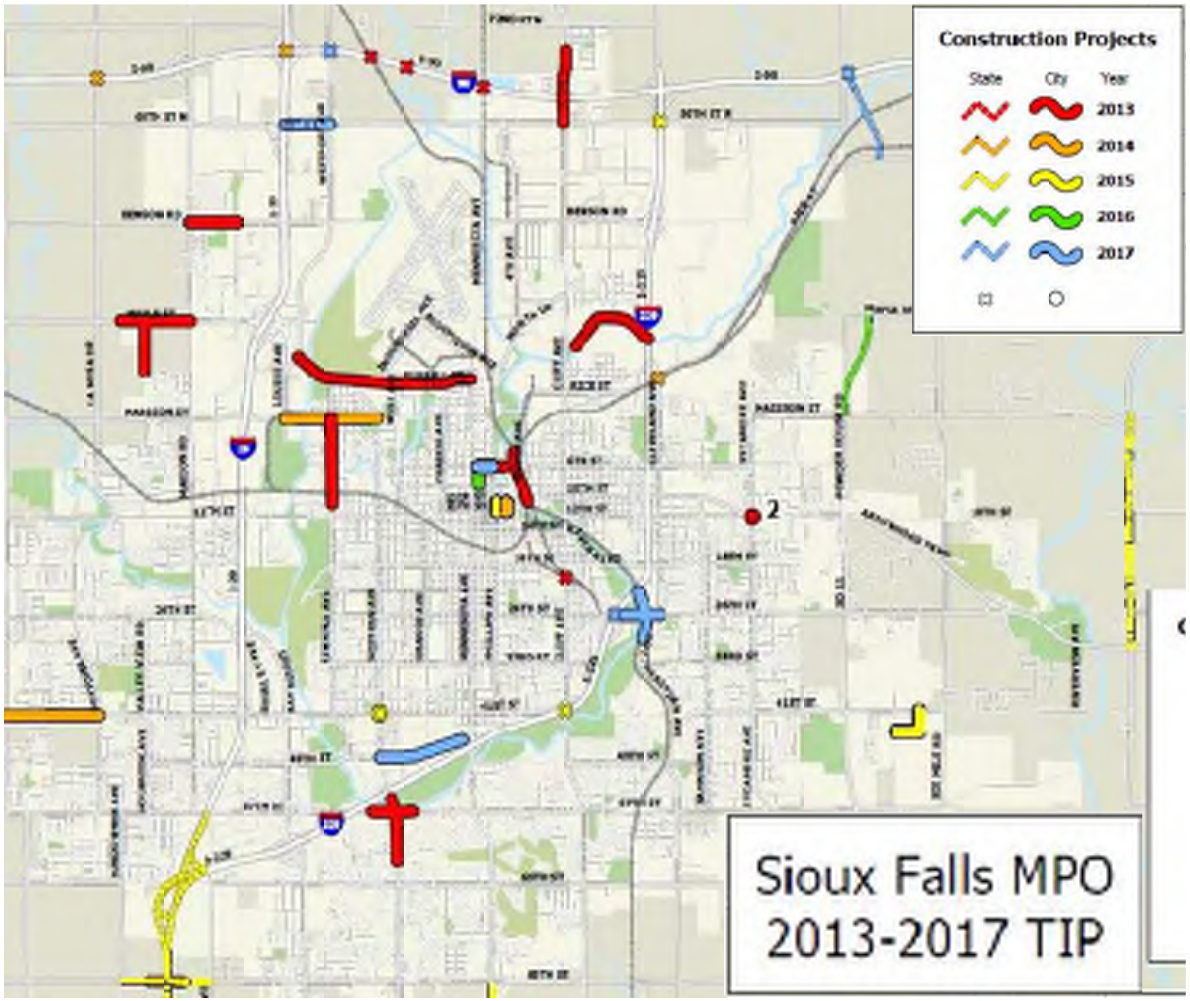
City	No. of Employees 2008	Population 2008	Population 2010	Population-to-Employee Ration	No. of Employees 2035	Population 2035
Brandon	2,058	9,000	9,500	24.36%	4,889	19,500
Crooks	127	1,263	1,272	10.30%	285	2,800
Hartford	558	2,680	2,717	18.24%	935	5,000
Sioux Falls						270,000
Tea						200
Harrisburg						800





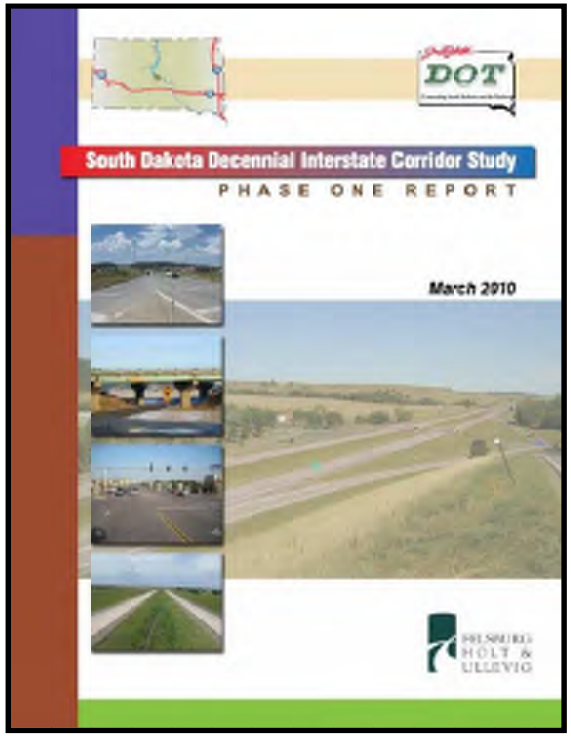
What Should the Study Tell Us?

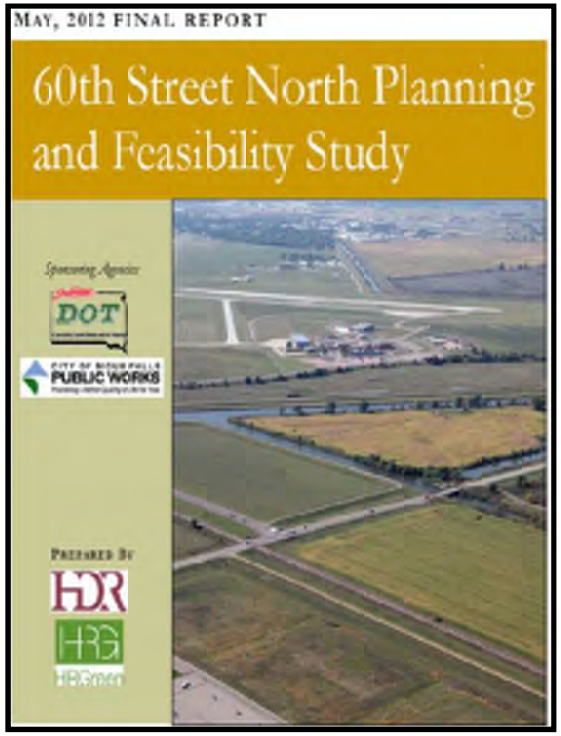
- Traffic Capacity
- Traffic Safety
- Incident Management
- Short & Long Term Planning
- **Coordinated Implementation**

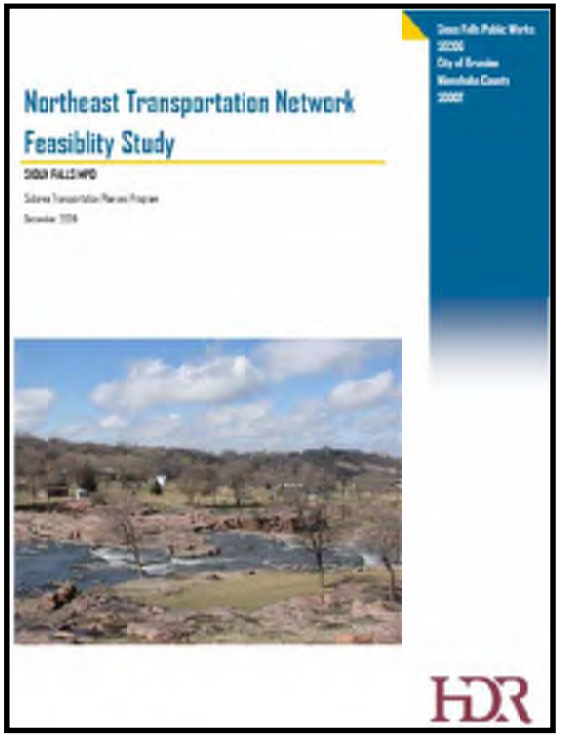


Why Additional Studies?

- 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





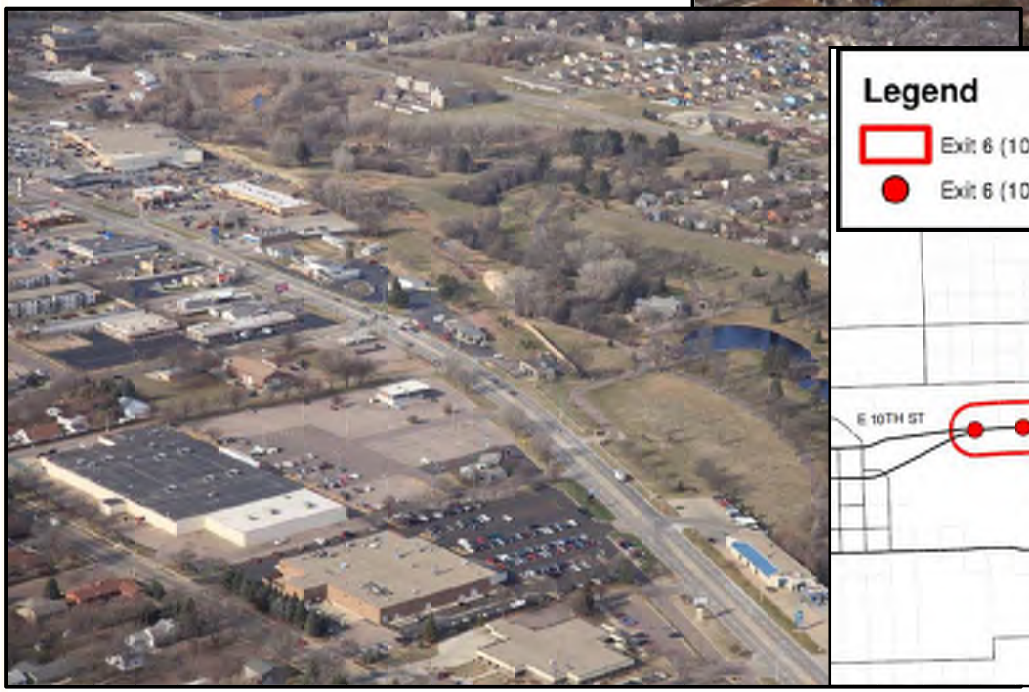


Exit 6 (10th Street)

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

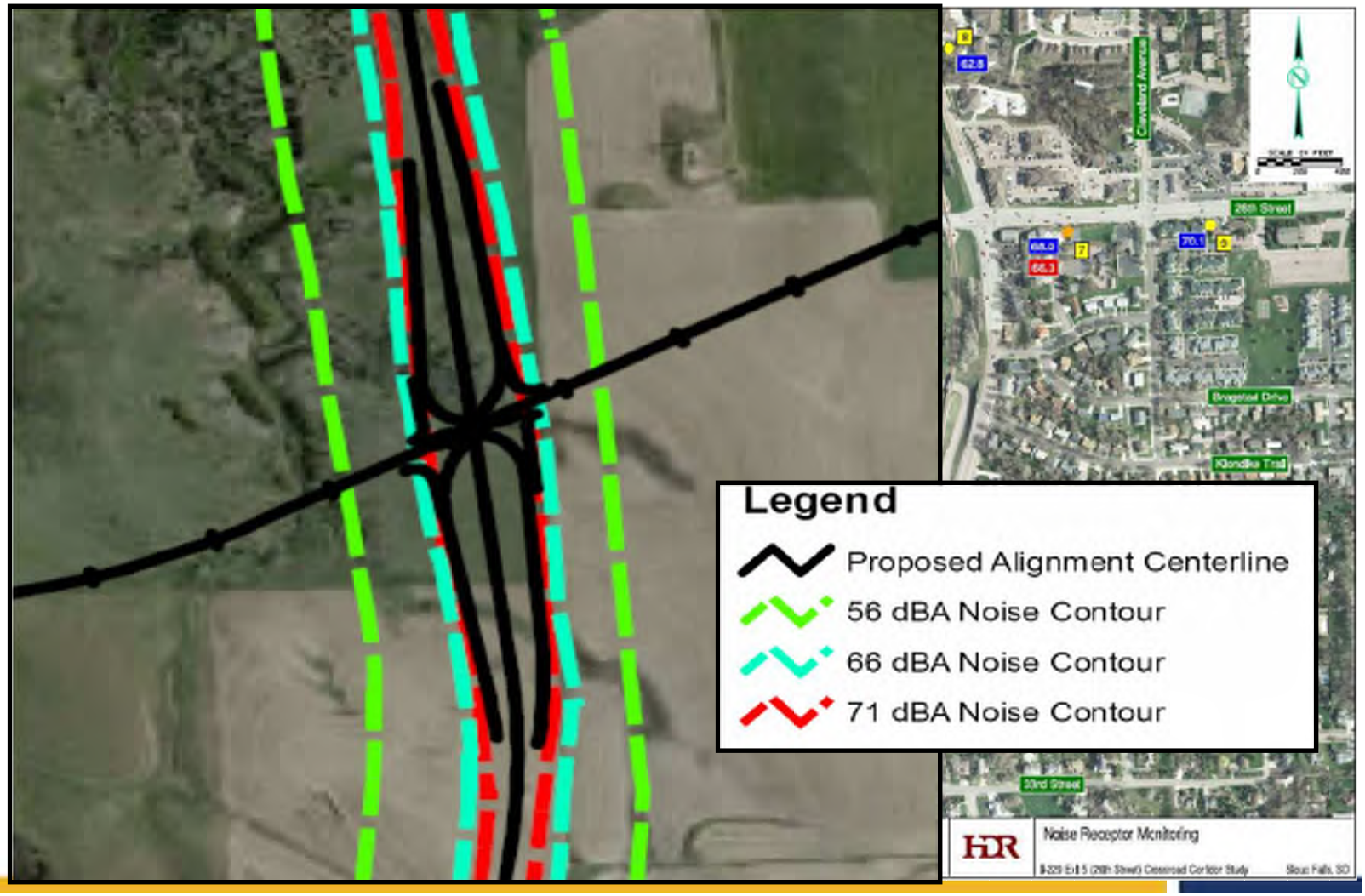






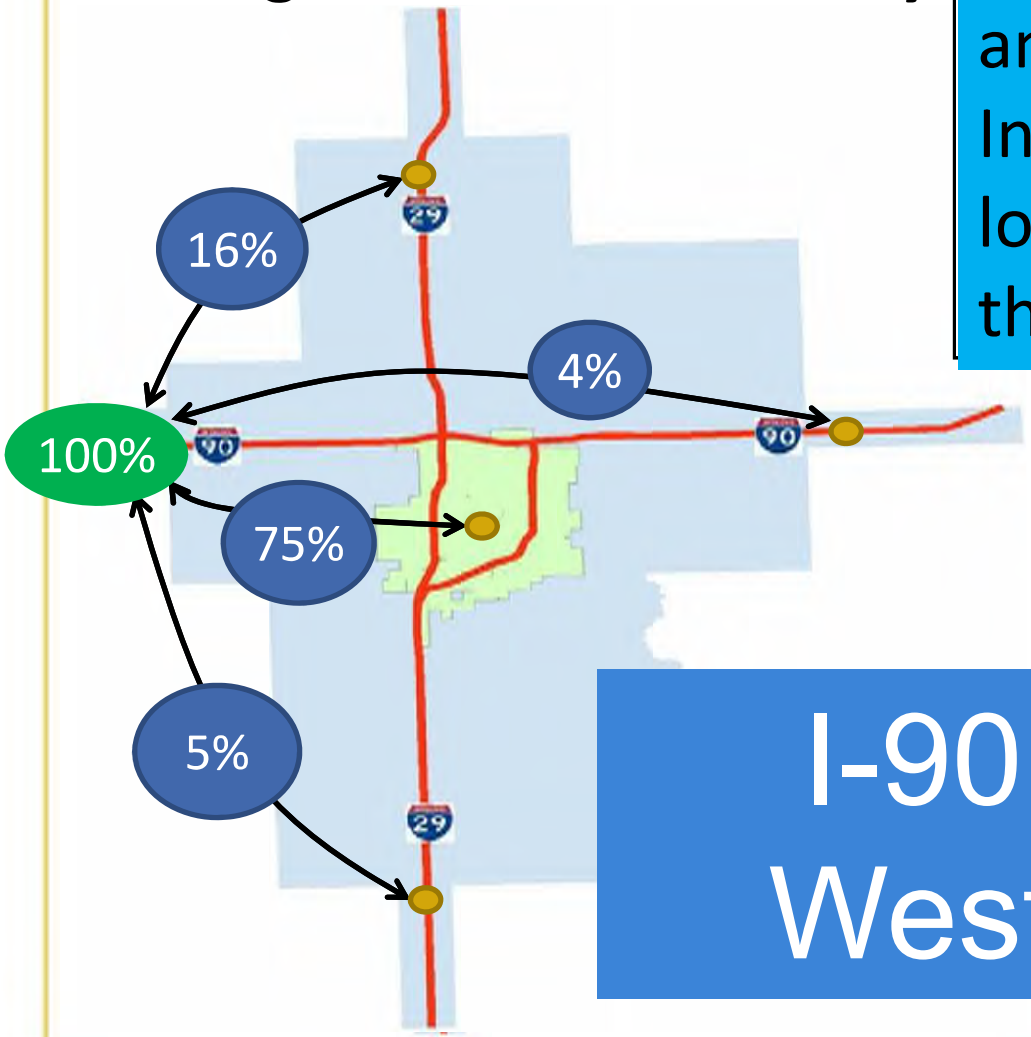
Other Study Activities?

- **Noise Data Collection**



Other Study Activities?

- **Origin-Destination Study**



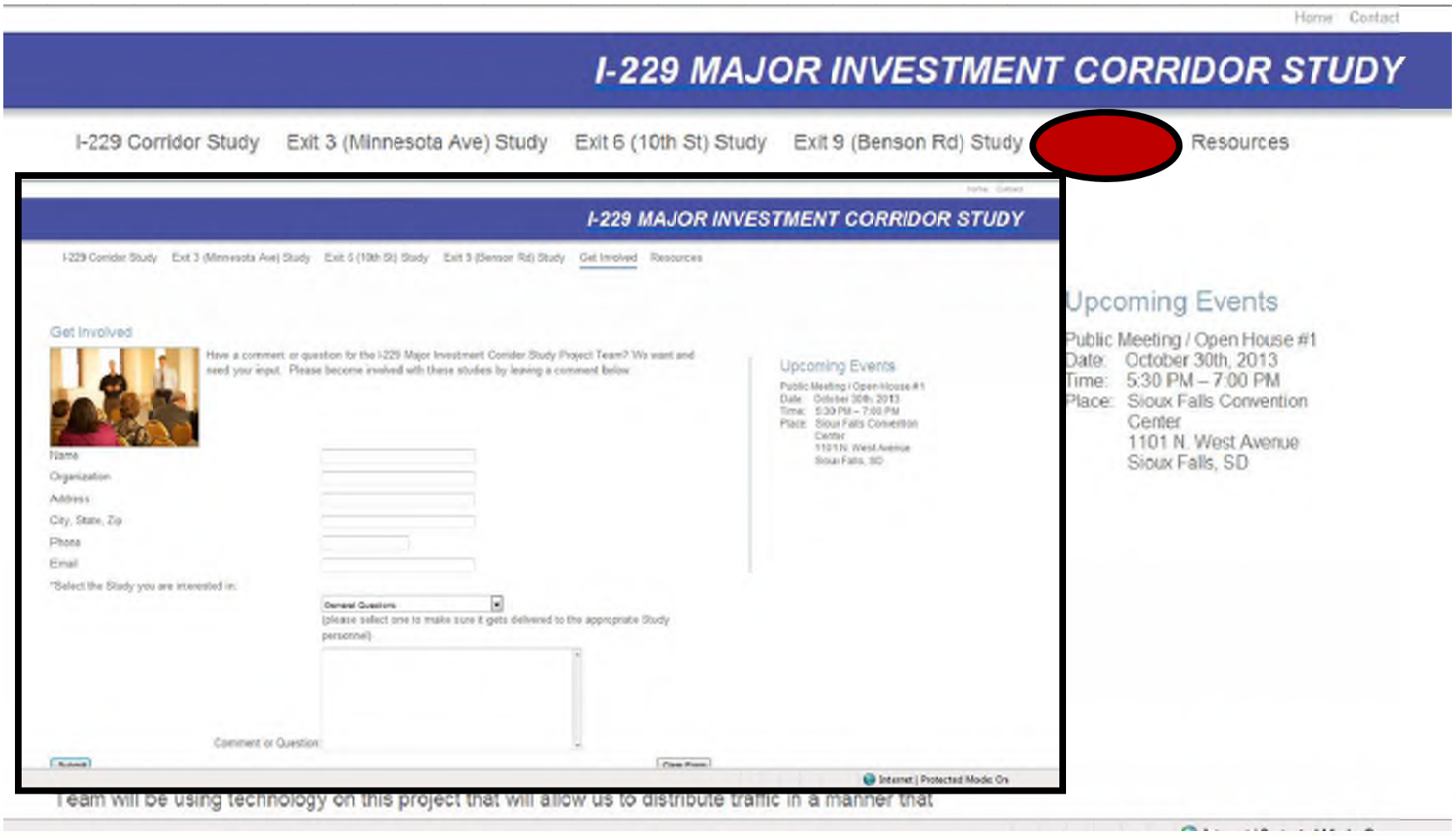
What is the amount of state and regional traffic on the Interstate system versus local traffic in and around the study area?

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



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*

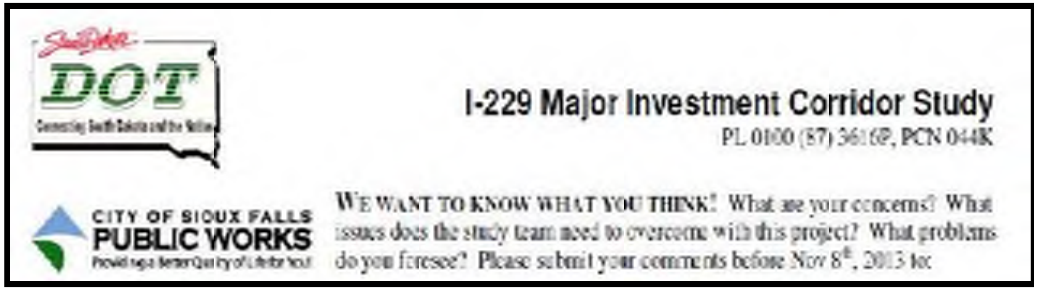
April / July 2014 – Refine Alternatives & Produce Draft Reports

August 2014 – *Public Meeting (Final)*

October 2014 – Complete Study

Next Steps

(1.) Take public comments on concerns you have regarding I-229 Study Areas



(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

I-229 Major Investment Corridor Study – Public Open House #1

City of Sioux Falls / South Dakota Department of Transportation

PL 0130(87) 361NP, PCN 044K

Project No: 207030

Wednesday, Oct 30th, 2013 5:30 – 7:00 PM

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) 361NP, 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 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

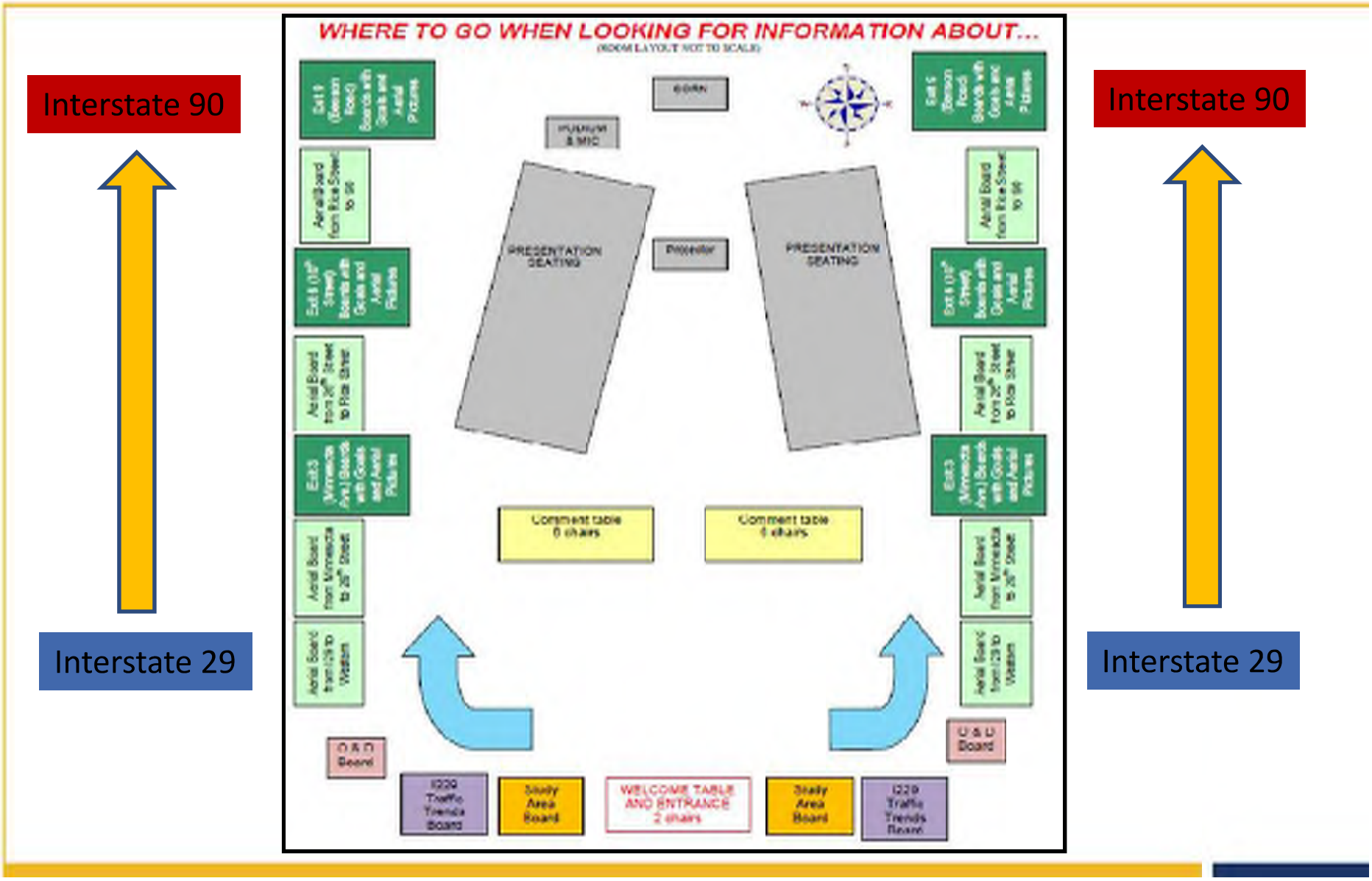
Fax: 605-977-7747

(optional)
Name: _____ Address: _____

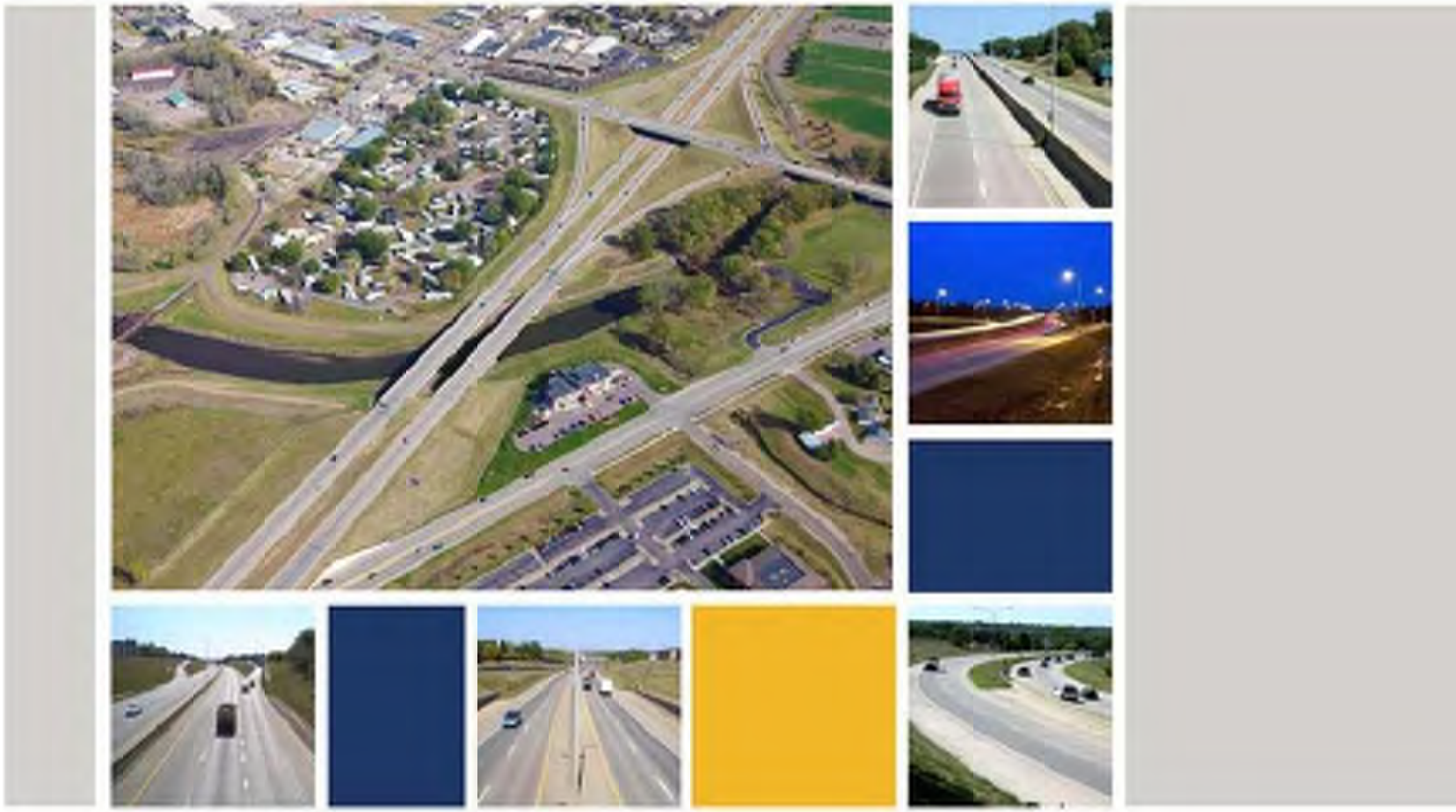
Phone: _____ Email: _____

Leave a Comment or Suggestion!!!!

Room Layout



Interstate 90
Interstate 29
WHERE TO GO WHEN LOOKING FOR INFORMATION ABOUT...
(ROOM LAYOUT NOT TO SCALE)
BORN
PRESENTATION SEATING
Presenter
PRESENTATION SEATING
Comment table 6 chairs
Comment table 6 chairs
O & D Board
O & D Board
I229 Traffic Trends Board
Study Area Board
WELCOME TABLE AND ENTRANCE 2 chairs
Study Area Board
I229 Traffic Trends 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.:** 207630

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	Ray Kirlin	3209 S. Lincoln	334-2411	kirlin.r@dotzero.com
2	Pam + Steve [illegible]	3000 S. Tunnymead	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	Tren Burman	1501 W Washington Dr		
6	Art Holden	705 W Victory Ln SF 57108	605-371-3928	artholden67@gmail.com
7	Bruce Danielson	PO Box 441 SF 57101		
8	Bob Bohm	3600 S Duluth	334-4220	robert.bohm@dakotabilities.org
9	Guy Boris	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 Thoover	605 E 21st St	332 5319	sah@nazar.net
13	Gerald Teunissen	808 Jane Lane SF-SD	366-1979	gerald@benderco.com
14	Kurt Griffin	605 E 21st 57105	362 6035	KJG321@yahoo.com
15				
16				
17				
18				
19				
20				

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) 8616P, 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	Brad Ramsdale	SDDOT		
2	Craig Smith	SDDOT	995-3300	craig.smith@state.sd.us
3	Steve Gramm	SDDOT	773-6641	steve.gramm@state.sd.us
4	Bd Kelly		605-521-9881	[illegible]
5	Dave Rowe	Empire Bldg Cat	321-9823	DaveinSiouxFalls+msn.com
6	Sara Bertsch	Argus Leader	605-281-0831	
7	Jon Wiegand	HDR Green		jon.wiegand@hdrgreen.com
8	Amber Gibson	SFCOG	367-5390	amber@sfcog.org
9	Kevin Kruzel	Boen & Associates	336-0425	KevinK@BoenAssociates.com
10	James Unruh	HDR	977-7766	james.unruh@hdrinc.com
11	Trevor Preston	5700 S Chuck Drive		Trevorhockey@sio.midco.net
12	Gregg Johnson	6801 E. Split Rock Cir	332-8166	grjohnson@sio.midco.net
13				
14				
15				
16				
17				
18				
19				
20				

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) 3618P, PCN 044K **Project No.:** 207036

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	Schmidt Stan Diana	2214 W Zephyr Pl. #1		Stan@ going beyond words. com
3	Kay Gollesch	LifeScape		kay.gollesch@lifescapesd.org
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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 PI C100(87) 3818P, 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	Pete Longman	SDDOT	773-6488	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 Schoenemann	1801 W 50th St SF 57105	605 376 1189	al.schoenemann@schoenemans.com
6	Thomas Hein	6100 E Hein Place SF SD 57110	605-361-8440	Theinmail@gmail.com
7	Travis Dressen	SDDOT - SF Area	605-367-5680	travis.dressen@state.sf.us
8	Ross Harris	HR Green 5525 Merle Hay Rd. Johnston, IA 50131	515-657-5263	rharris@hrgreen.com
9	Michael Greenberg	183 S Pierce Ave	605 929 8923	[illegible]@gmail.com
10	Audrey James	27002 Split Creek Ct	605-929-754	audreyjames@borderstates.net
11	Joe James	27002 Split Creek Ct S Falls	605-366-5328	james@borderstates.net
12	Chris Parsley	7001 W 66th St SF SD	319-389-1507	Compacsley@Gmail.com
13	Lori Buschene	3710 S Southeastern Ave Sioux Falls SD #A	507 360 5554	buschene@midco.net
14	West Valley Dale Froehlich	6 So Le Chateau SF, SD 57105	605-201-8810	dalefroehlich@gmail.com
15	Nancy Preston	5700 S. Chuck Drive		
16	Alex Connolly	1510 W. 57th St	231-1620	alex.connolly@sioux-falls.net
17	Kathy & Jerry Phillips	5100 S. Swift Park Dr	940-2448	[illegible]@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

© 2014 HDR, all rights reserved.

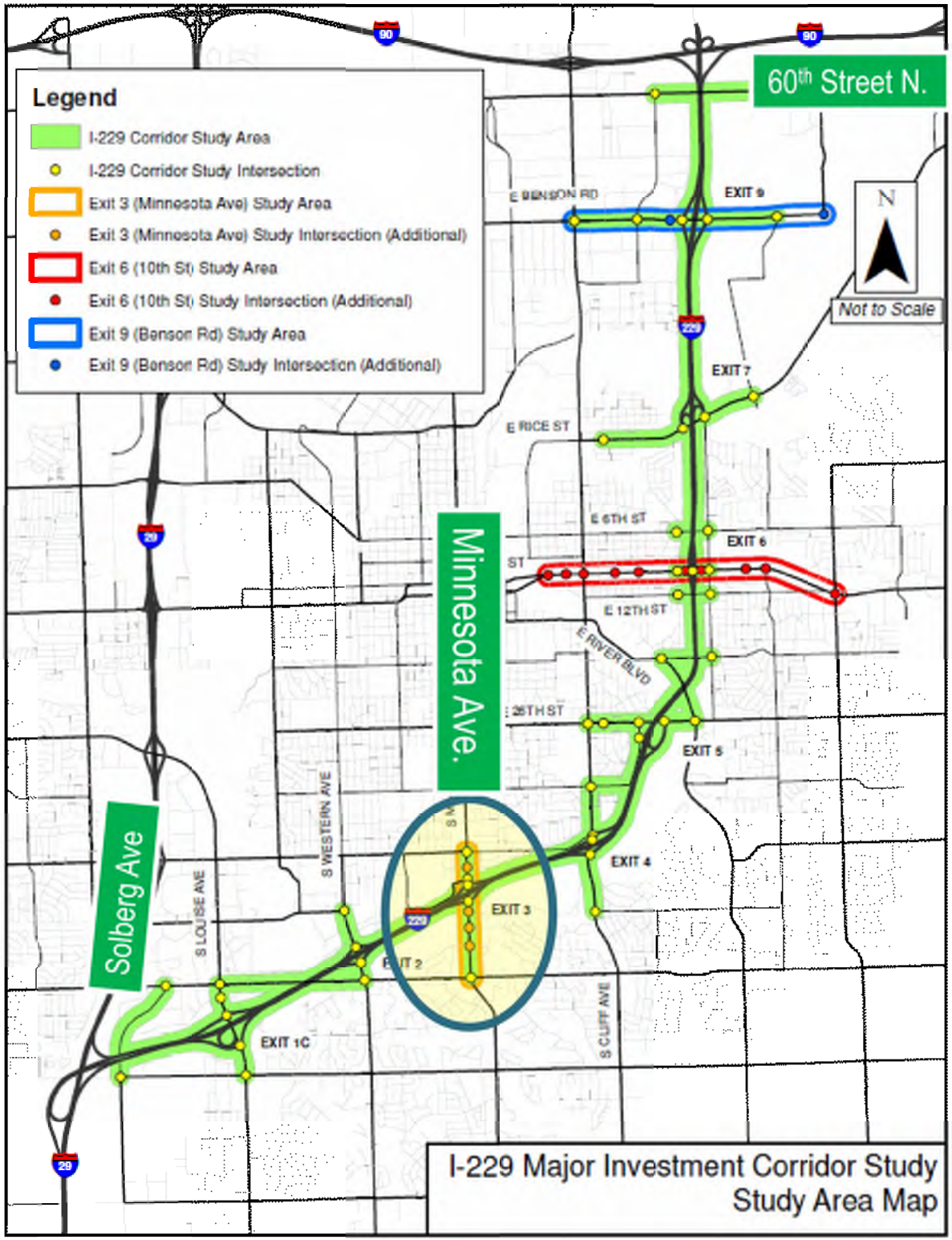
Study Area Map

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)

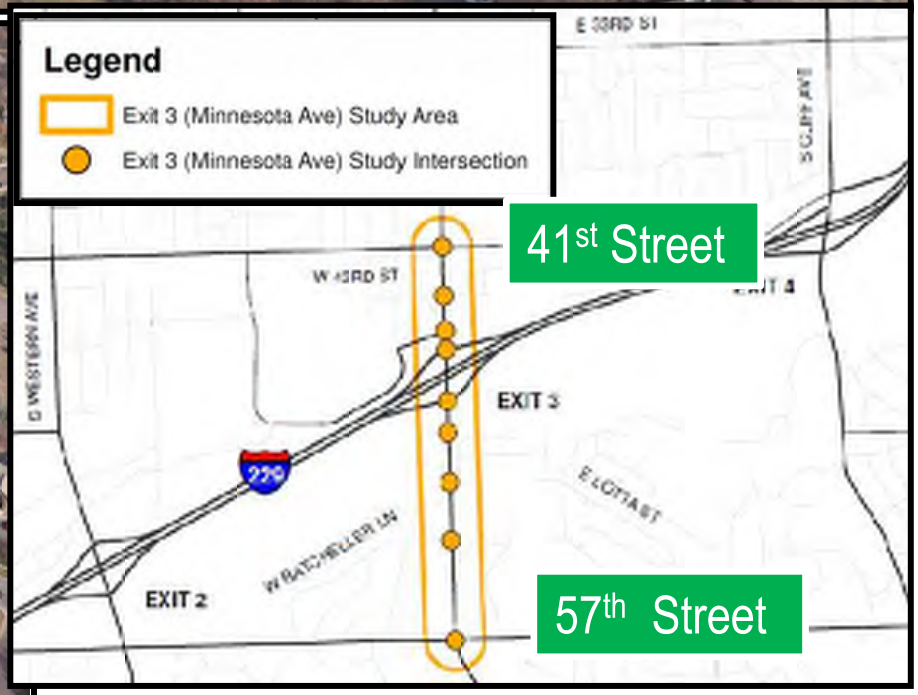
Federal Highway Administration (FHWA)

Exit 3 (Minnesota Avenue) Crossroad Study Goals

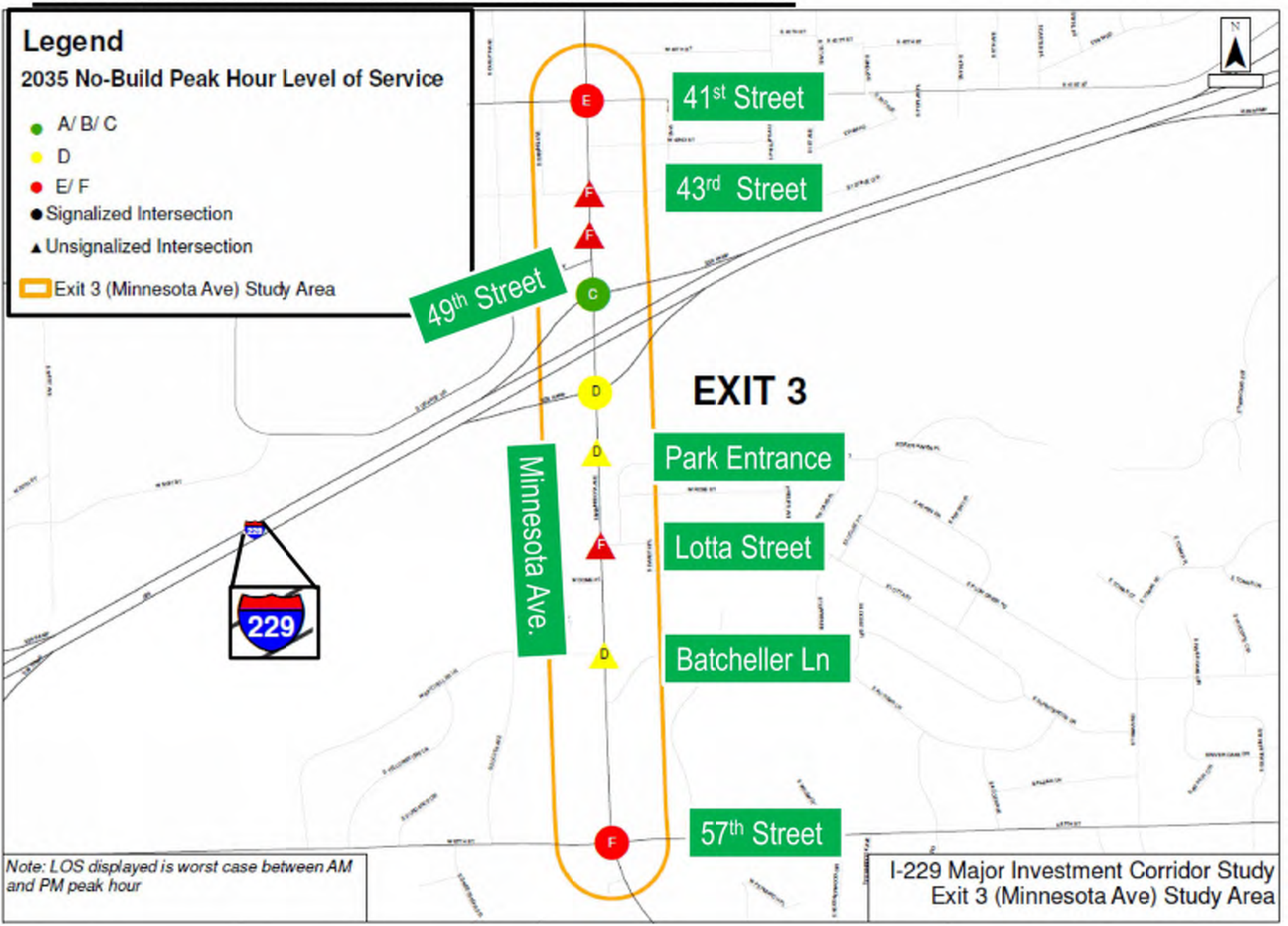
- Reduce traffic congestion
- Evaluate interchange options
- Integrate plans for the 49th Street Extension with the interchange options developed
- Improve pedestrian and bike access to the Big Sioux River Pathway
- Improve safety for corridor users
- Improve vehicle safety to Yankton Trail Park







Minnesota Avenue Corridor Overview



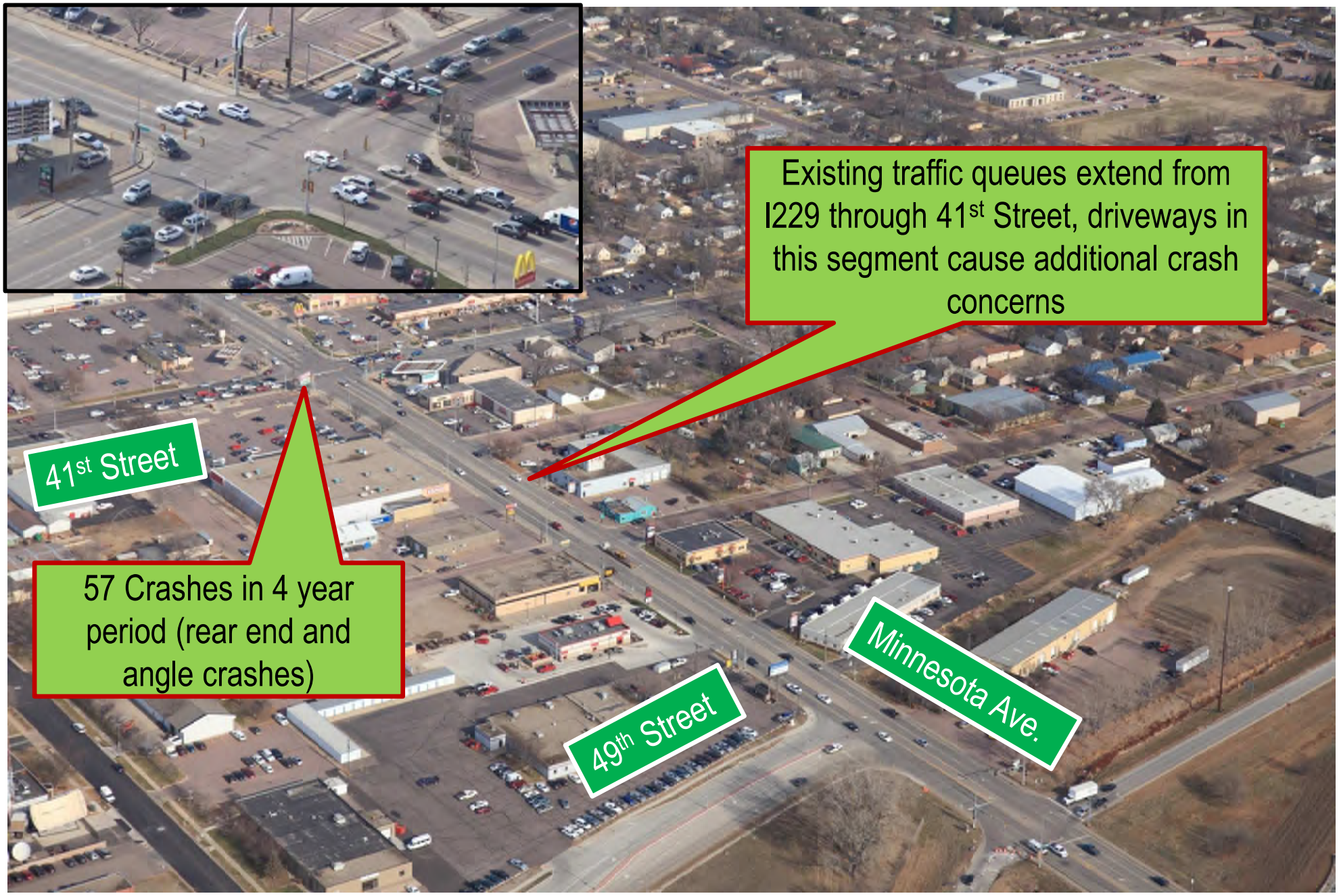
Minnesota Avenue Corridor Overview



Minnesota Avenue Corridor Overview



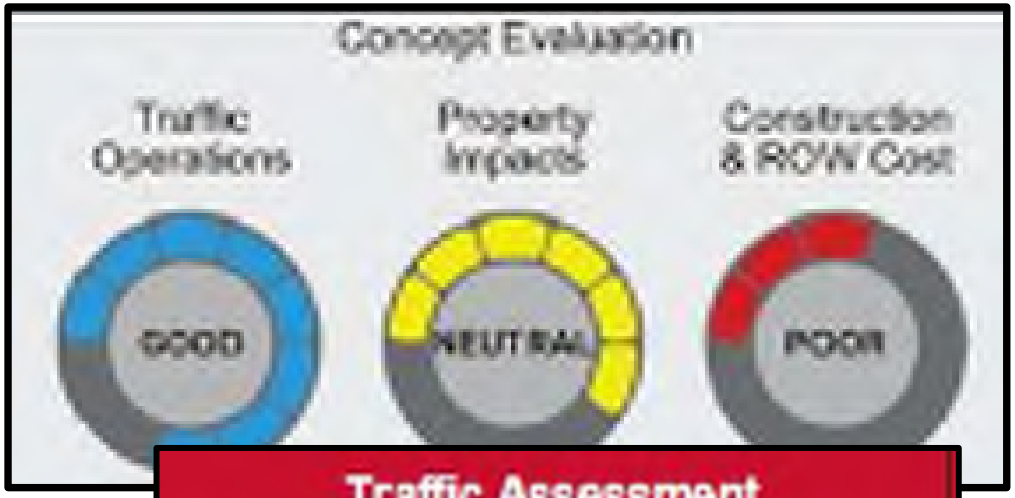
Minnesota Avenue Corridor Overview



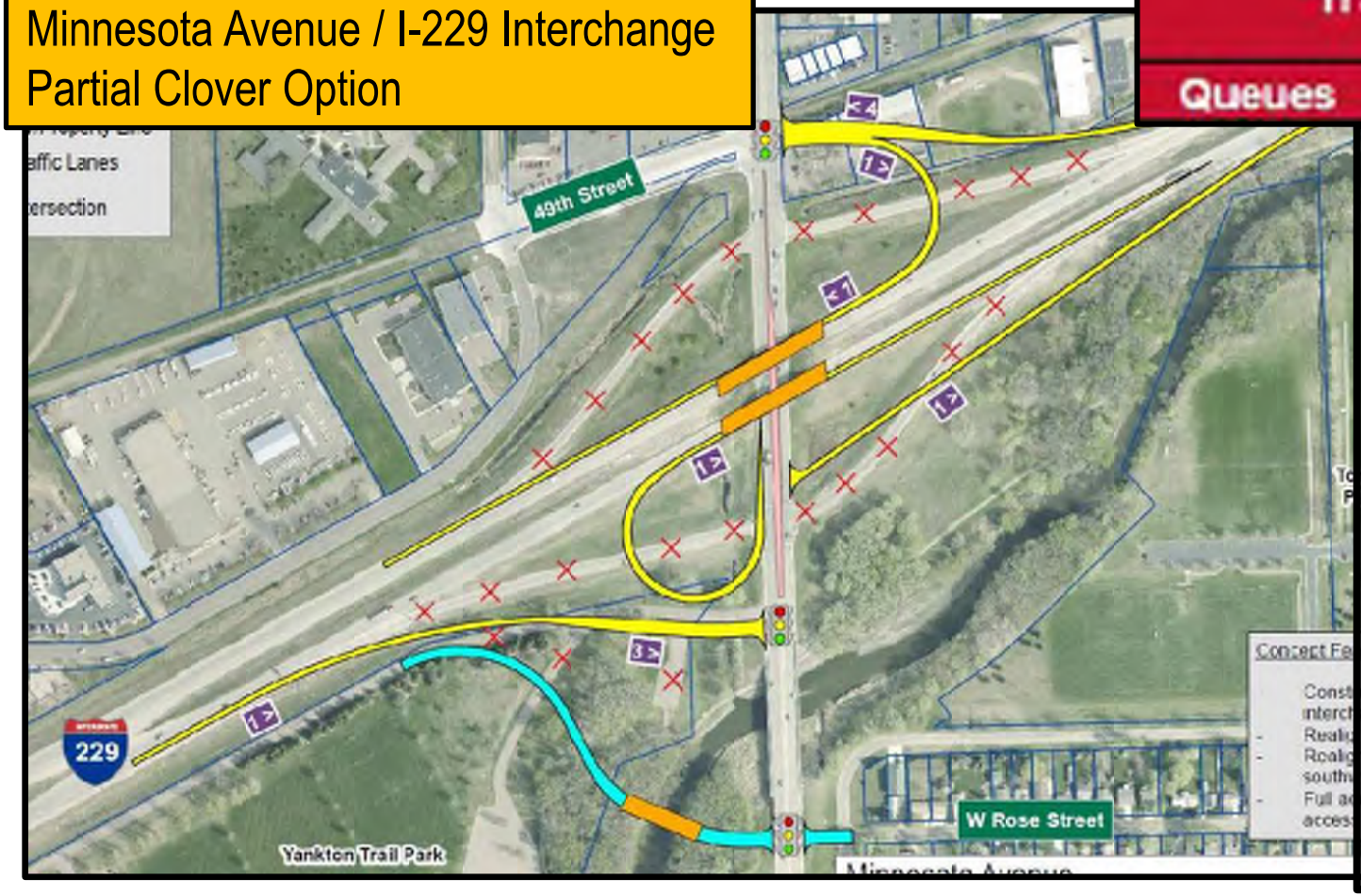
Conceptual Ideas for Minnesota Avenue

What you will be able to see tonight:

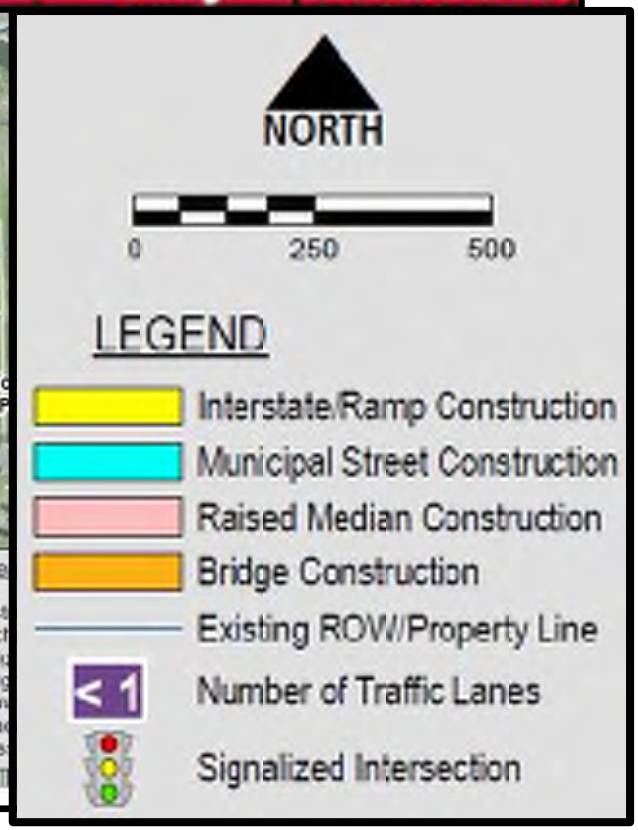
- 13 Interchange Conceptual Options
- 4 Corridor Options
- Access Changes to Yankton Trail Park
- Conceptual Options to improve safety



Minnesota Avenue / I-229 Interchange
Partial Clover Option



Traffic Assessment		
Queues	Delay	Travel Time



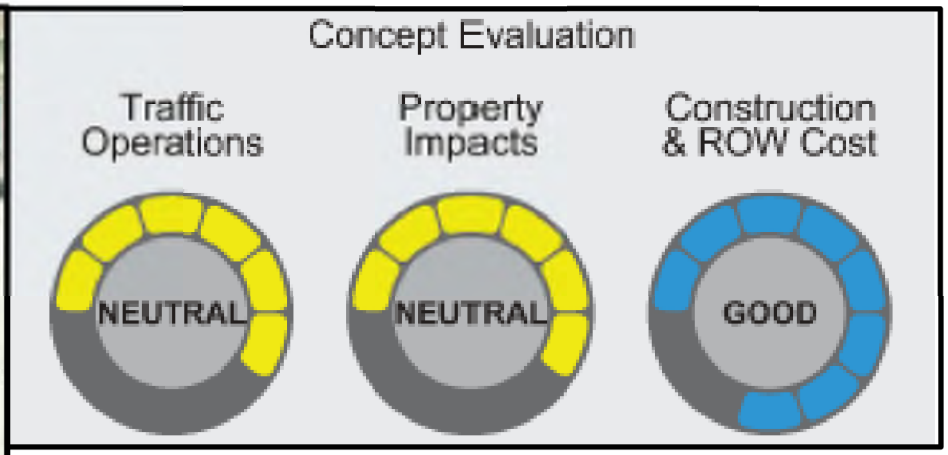
Conceptual Ideas for Minnesota Avenue

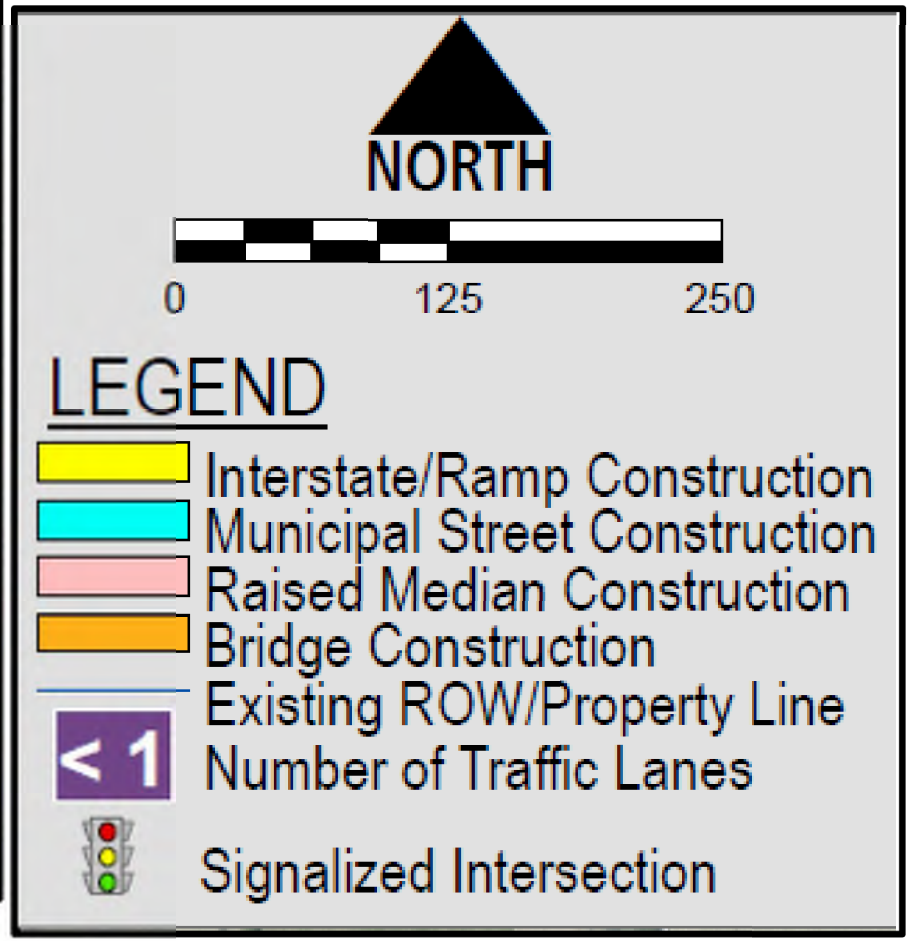
What you will be able to see tonight:

- 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





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**

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 Sub-Study

Thanks for Attending!!!!!

HDR

HRGreen

© 2014 HDR, all rights reserved.

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 Bose	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	Hersil Patel	3610 N 7th Street	721 776 1976	gm@superb sioux falls.com
7	Bob Bohm	3600 S Dale Ave	605 334 4720	robert.bohm@ctkatabilities.org
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Sign In Sheet

Subject I-229 Major Investment Corridor Study -- Informational Meeting for 16th Street Sub-Study

Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3618P, 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 Nikoles	SDDOT	367-5680	Paul.Nikoles@state.sd.us
4	Collin Moriarty	Gage Bros	336.118	cmoriarty@gagebrothers.com
5	[illegible]	840 S. Day	338-6900	—
6	Lodermeier Family LLC Barbara Anderson	840 S. Day SP 57103	338-6900	amandad840@aol.com
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for 10th Street Sub-Study

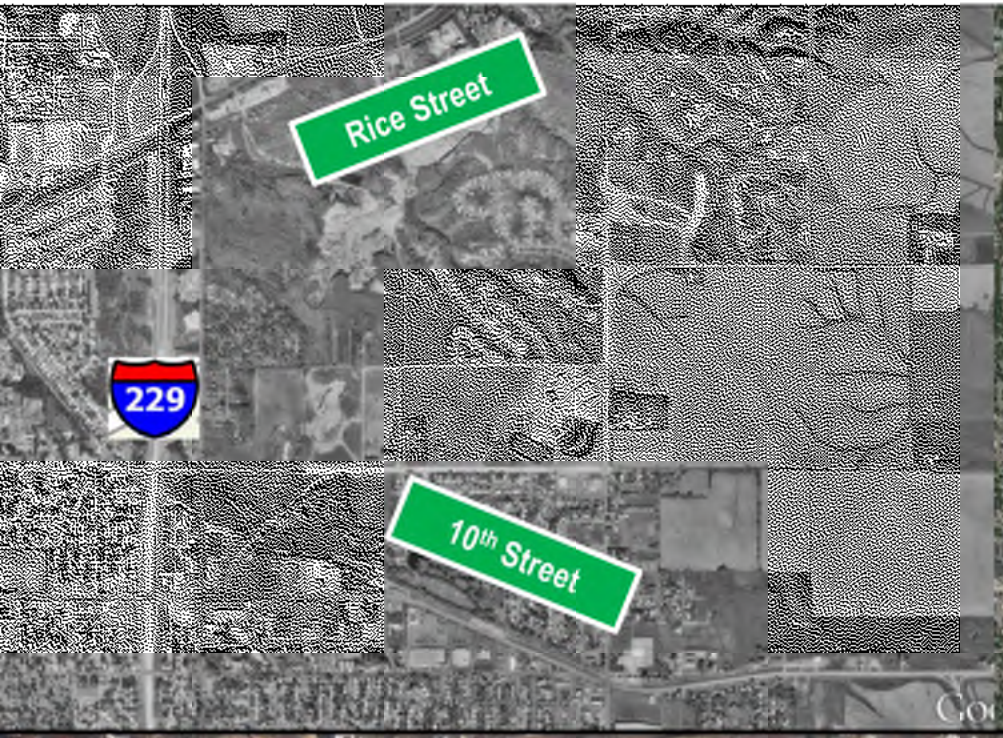
Client City of Sioux Falls/South Dakota Department of Transportation

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	605 336 8150	
2	Dave Nelson	3413 Southern Cir.	366-7308	
3	Jason Kjenstad	HDR	605-977-7740	jason.kjenstad@hdrinc.com
4	Mark Elisson	101 S Cleveland	605-338-6231	melisson@sio.midco.net
5	Ron McMahon	116 E Dakota Ave Suite A Pierre	605-776-1009	ronmcmahon@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	603 336 1180	esmith@gagebrothers.com
9	Sharon Fix	101 S. Cleveland Ave	(605) 338-8151	fixdds@midconetwork.com
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







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

© 2014 HDR, all rights reserved.

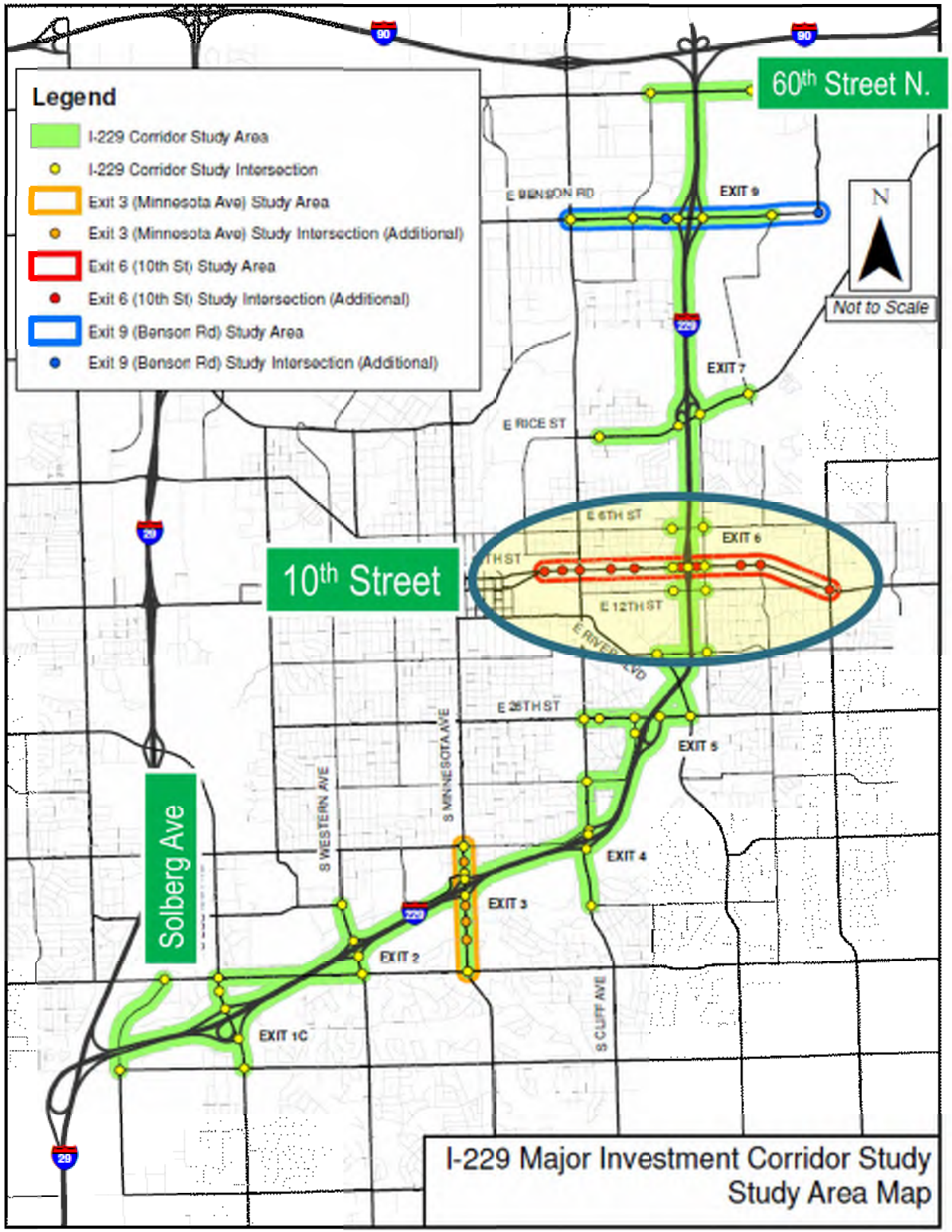
Study Area Map

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

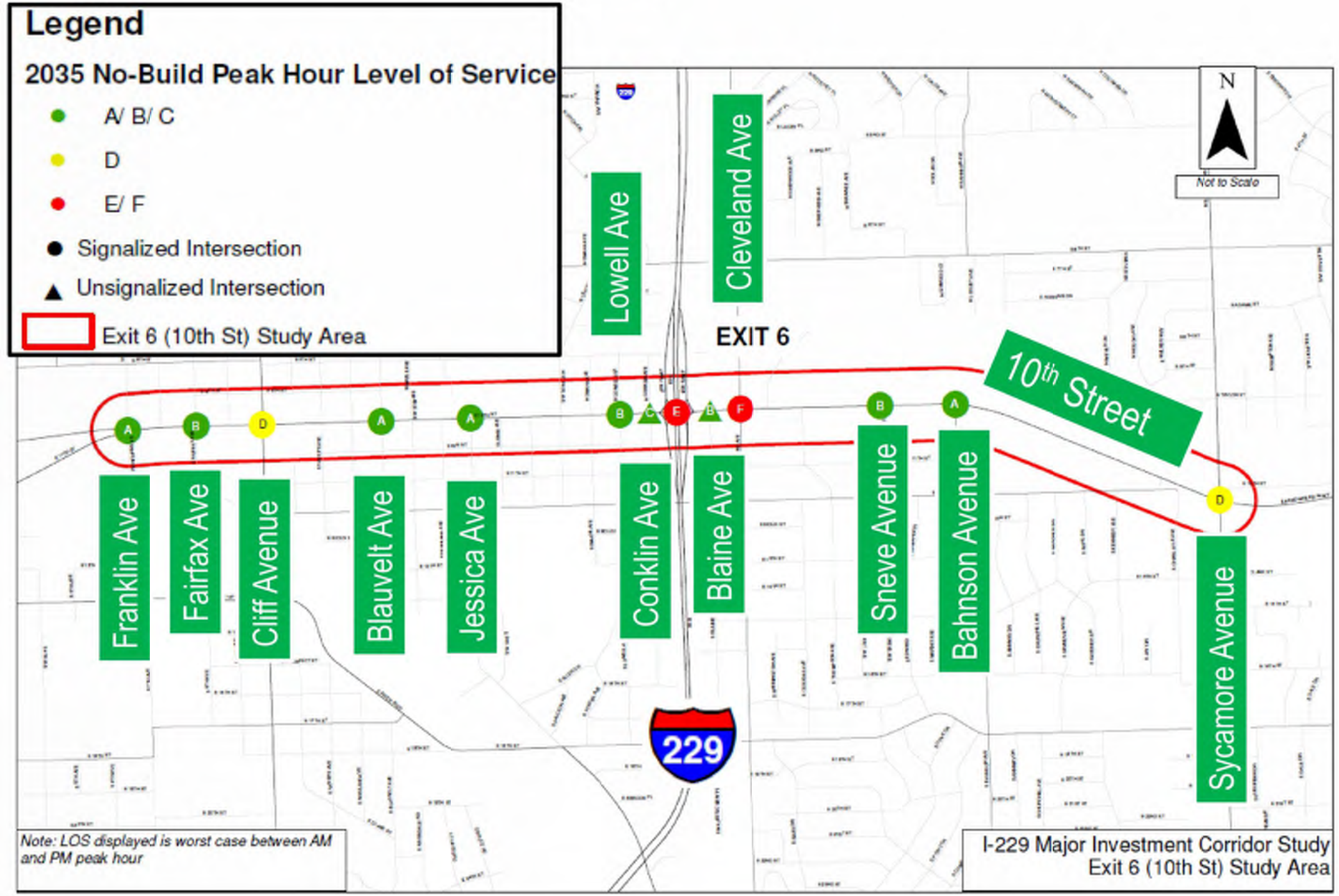
- Reduce traffic congestion
- Develop Corridor Growth Plan to meet traffic demands but minimizing impacts to developed properties
- Improve pedestrian mobility
- Improve safety for corridor users
- Identify improvements to the interchange as well as the 10th Street and Cleveland Ave intersection



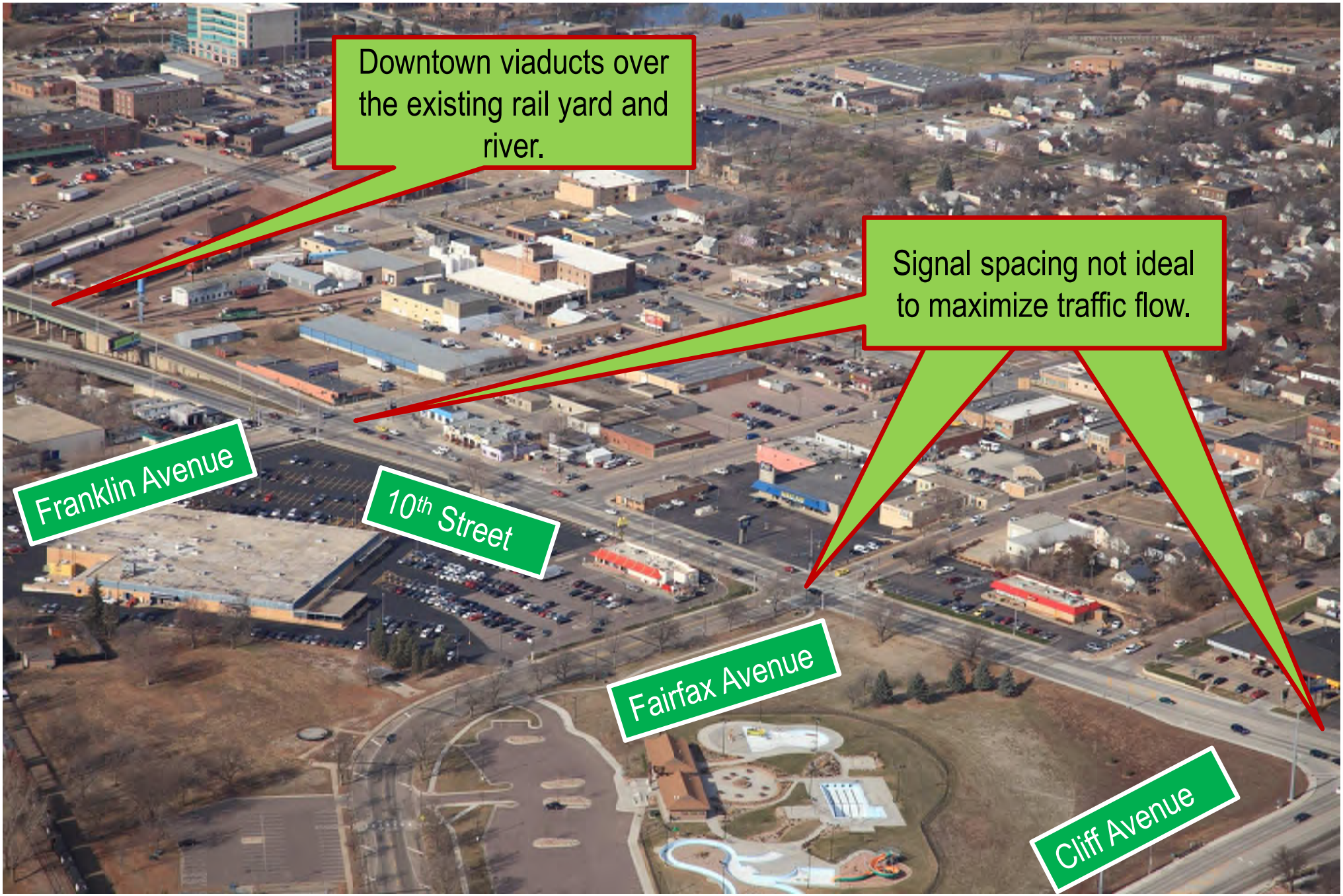




10th Street Corridor Overview



10th Street Corridor Overview



10th Street Corridor Overview



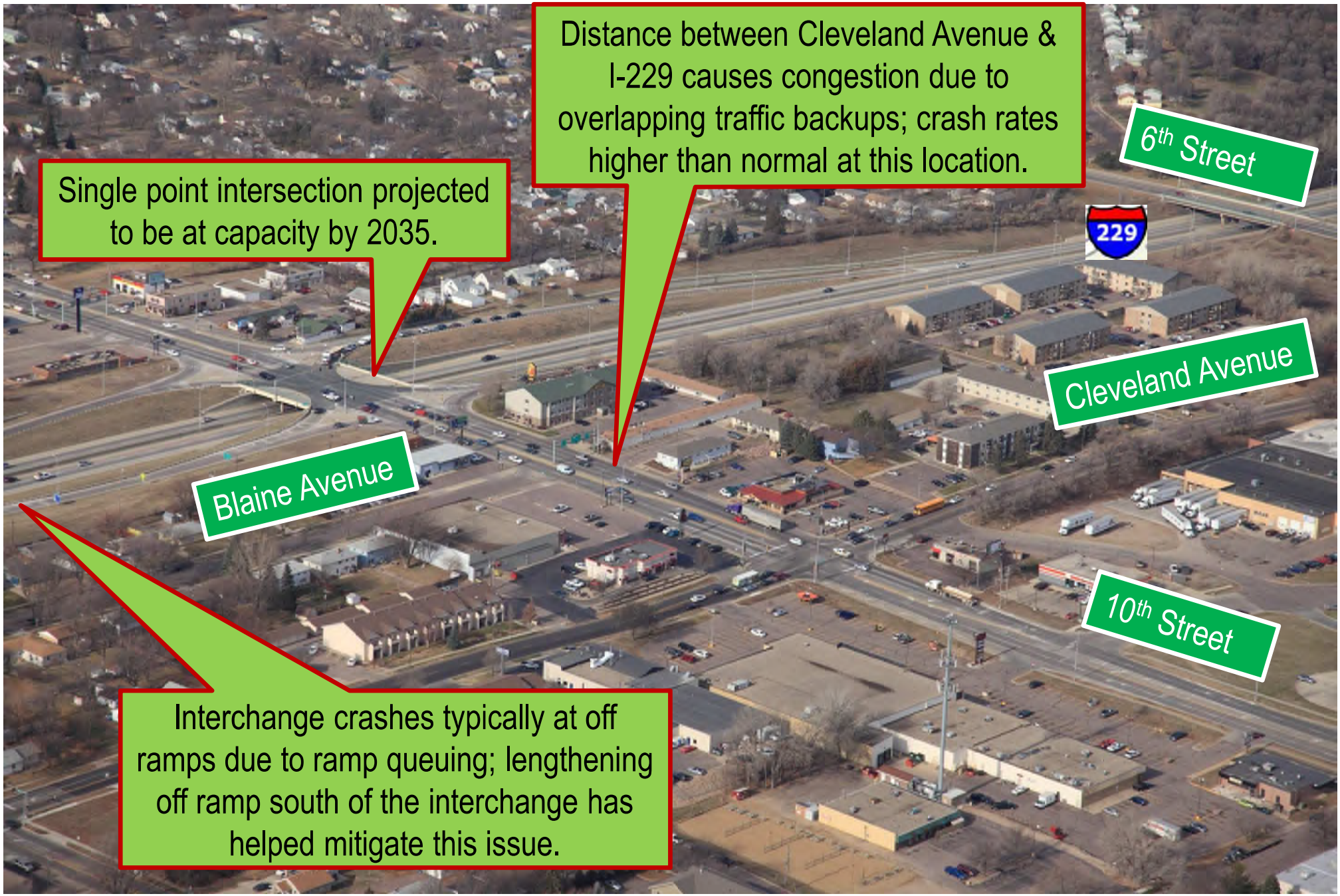
10th Street Corridor Overview



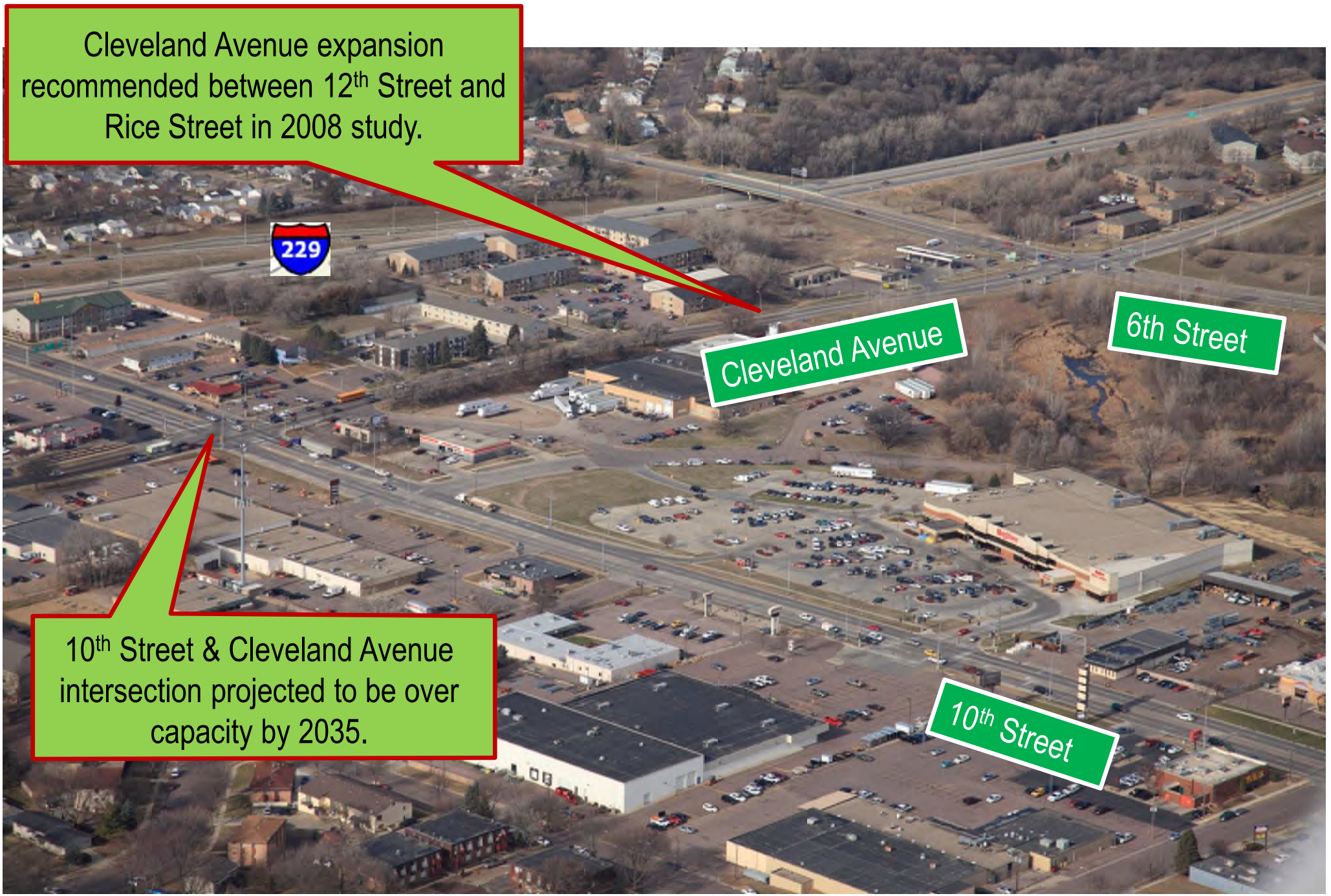
10th Street Corridor Overview



10th Street Corridor Overview



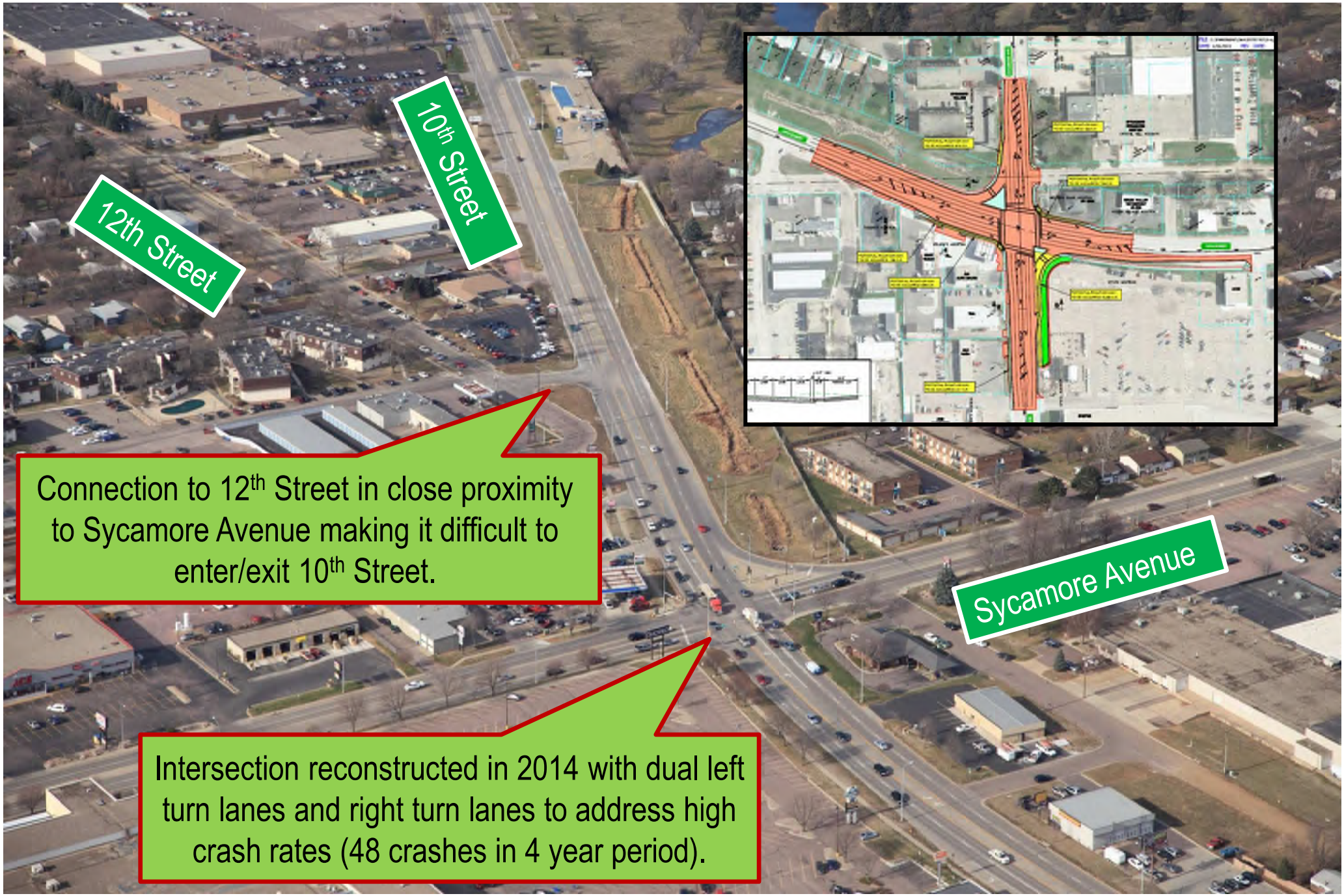
10th Street Corridor Overview



10th Street Corridor Overview



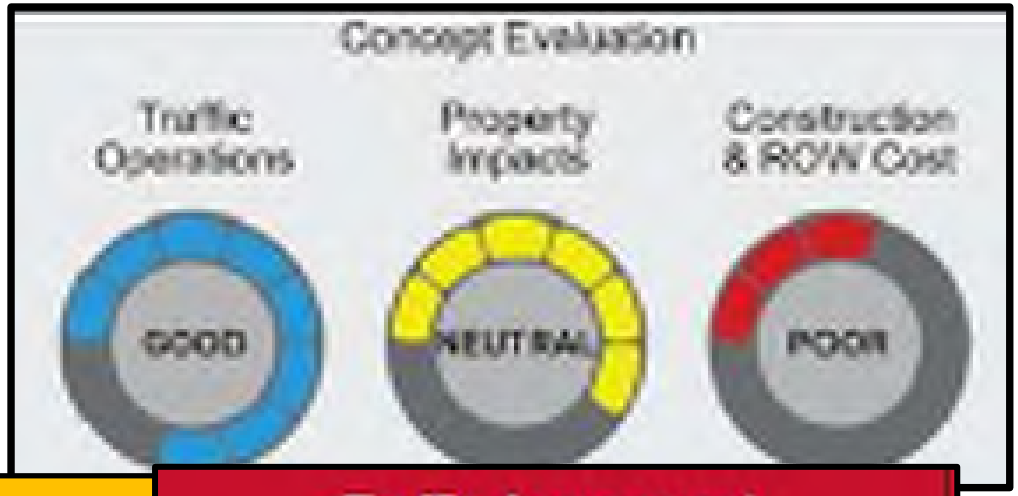
10th Street Corridor Overview



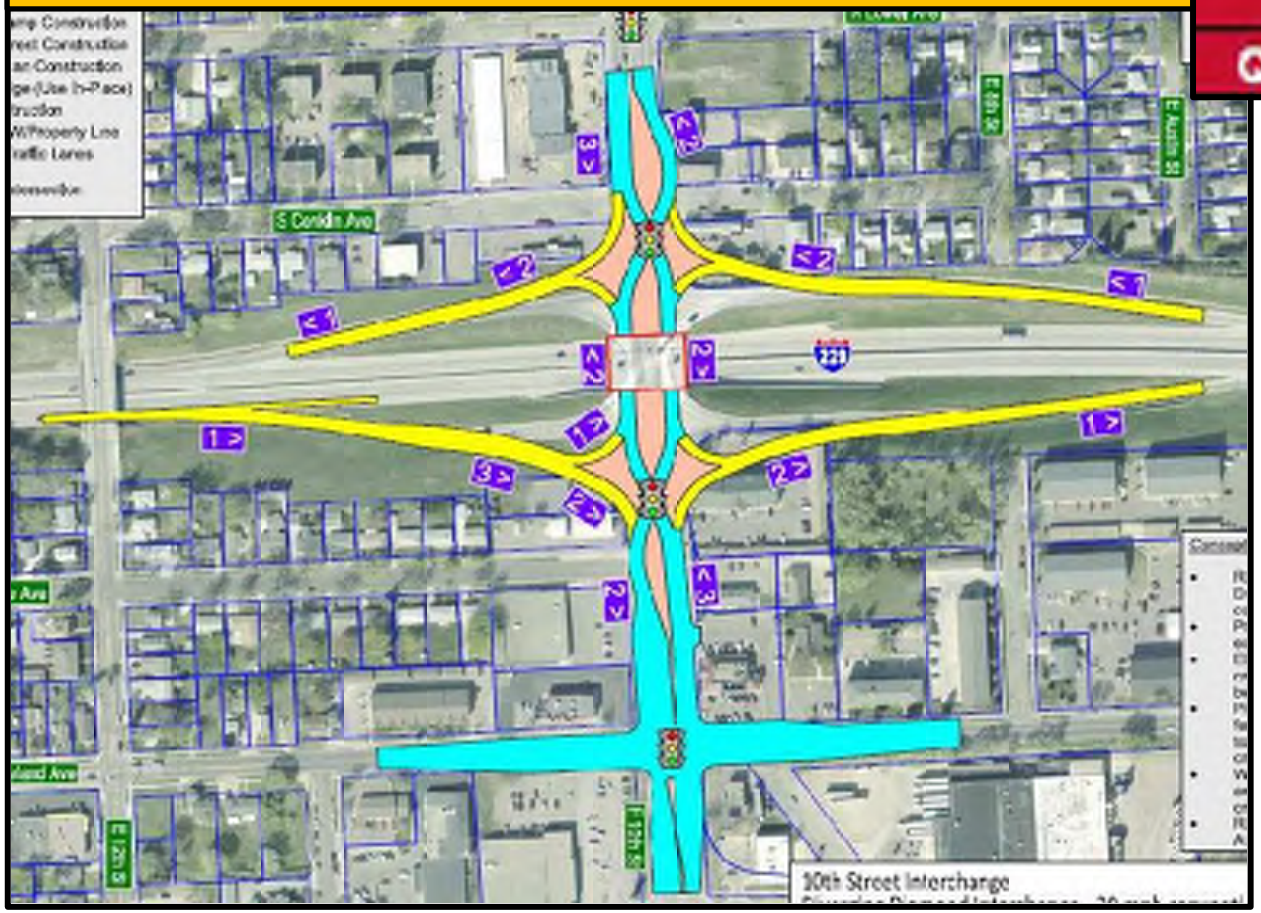
Conceptual Ideas for 10th Street Corridor

What you will be able to see tonight:

- 8 Interchange Conceptual Options
- 4 Corridor Options
- Median Changes or Driveway Closures to Improve Safety

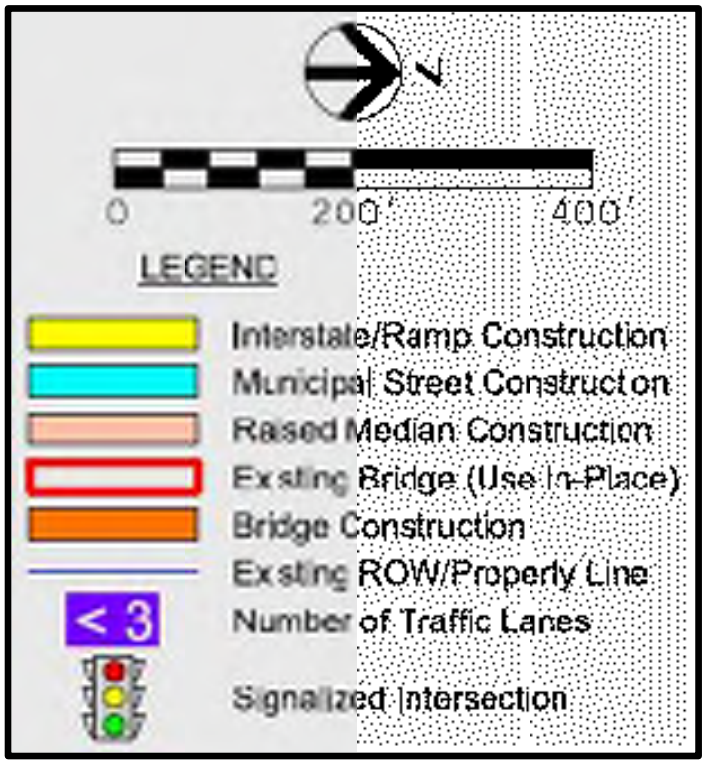


10th Street / I-229 Interchange Diverging Diamond Option



Traffic Assessment

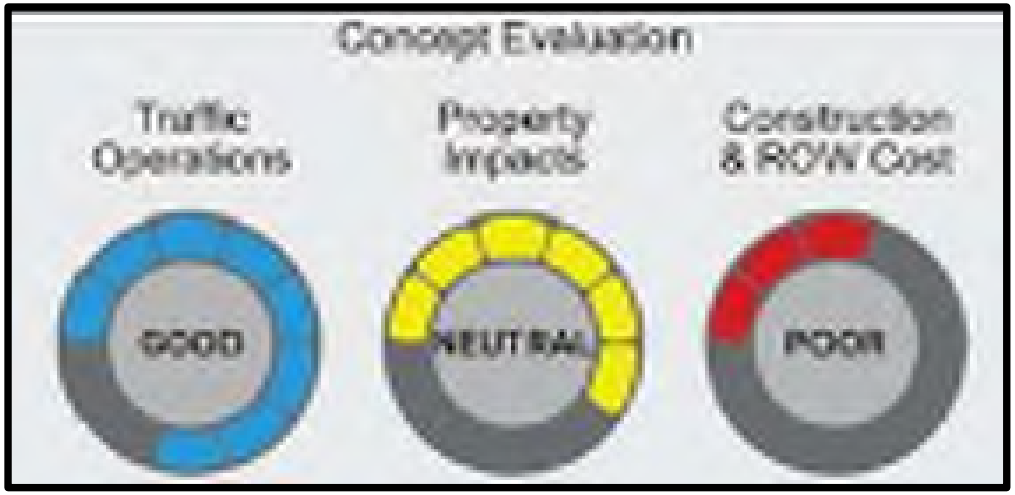
Queues	Delay	Travel Time



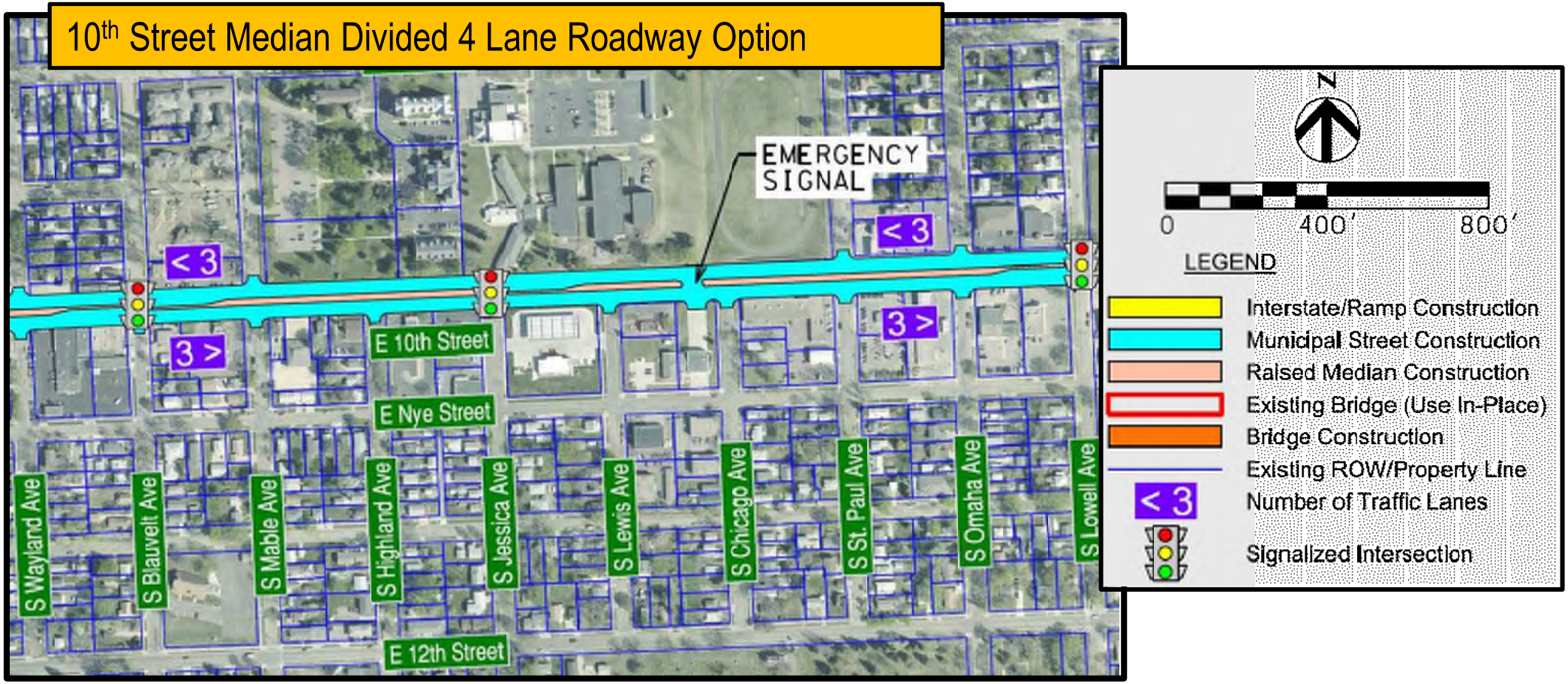
Conceptual Ideas for 10th Street Corridor

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 Median Divided 4 Lane Roadway Option



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!!!!!

HDR

HRGreen

© 2014 HDR, all rights reserved.

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 Gollesch	lifescape	[illegible]	kay.gollesch@lifescapesd.org
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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) 3618P, 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	Benderco Commercial	605-728-5800	dbrock@benderco.com
3	Travis Dresson	SDDOT - SF Area	605-367-5180	travis.dresson@state.sd.us
4	Kurt Griffin	605 E 21st St 57105	312 6035	kgr-321@yahoo.com
5	Rick Kovalan	Sioux Falls	521-6076	
6	Jason Kjrastad	HDR	605-977-7740	jason.kjrastad@hdrinc.com
7	Rush Smith	3560 E 60th St W	605-940-4943	
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Informational Meeting for Benson Road Sub-Study

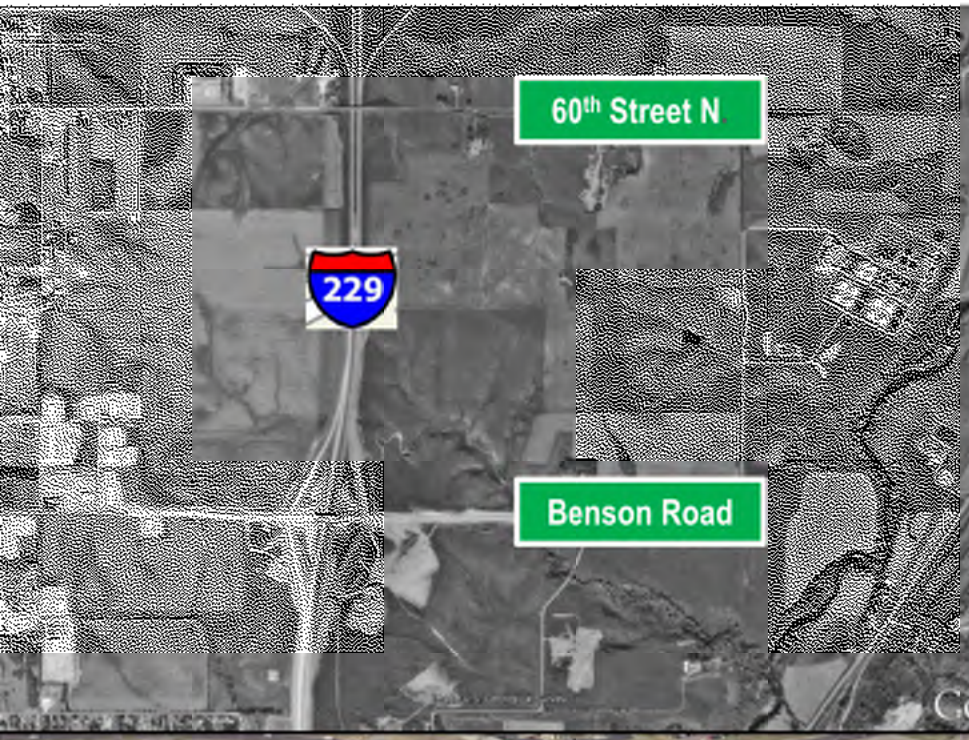
Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3010P, 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@myrl andrey spring.com
3	Rick Vander Haar	3408 N Potsdam Ave	605-366-1111	eaale@midcontwork.com
4	Steve Gramm	SDDOT	773-6641	Steve.gramm@state.sd.us
5	Shannon Schultz	Minnehaha County H.D.	367-4316	SSchultz@minnehahacounty.org
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







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

© 2014 HDR, all rights reserved.

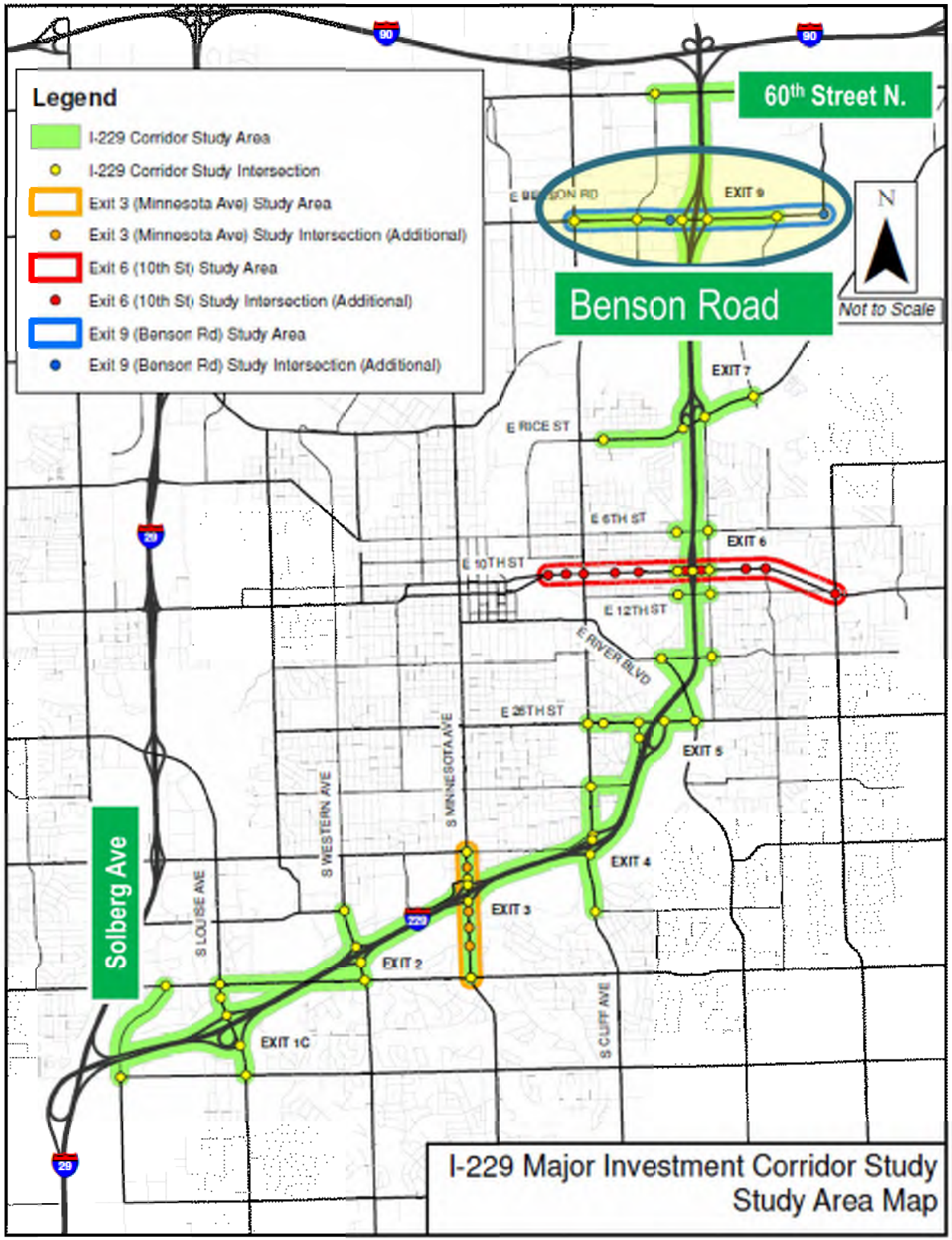
Study Area Map

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

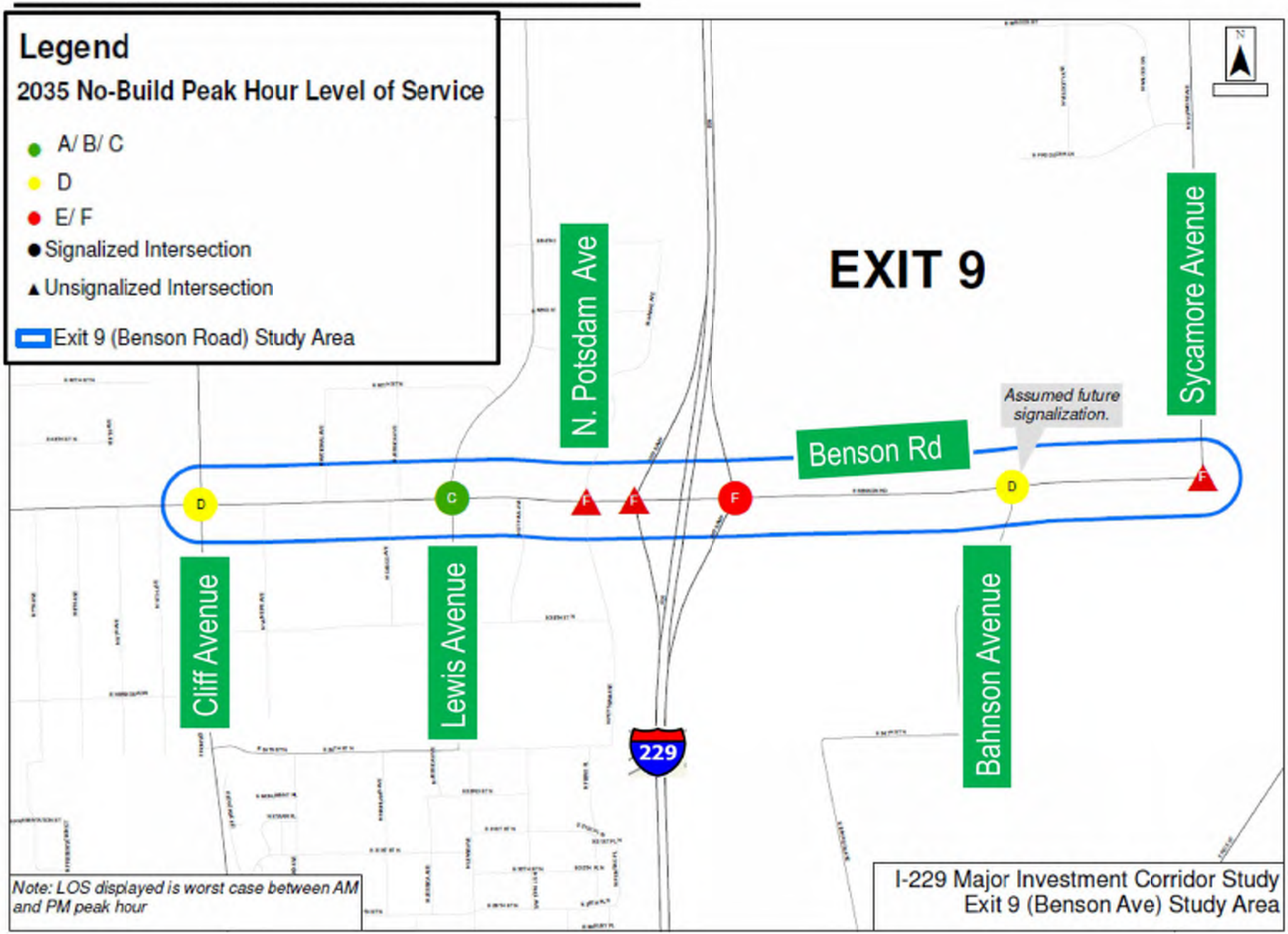
- Reduce traffic congestion at NB on/off interchange ramp terminal
- Develop Corridor Growth Plan to meet traffic demands from development taking place east of I-229
- Improve pedestrian mobility
- Make recommendations to improve corridor intersections
- Develop interchange alternatives to meet future traffic demands



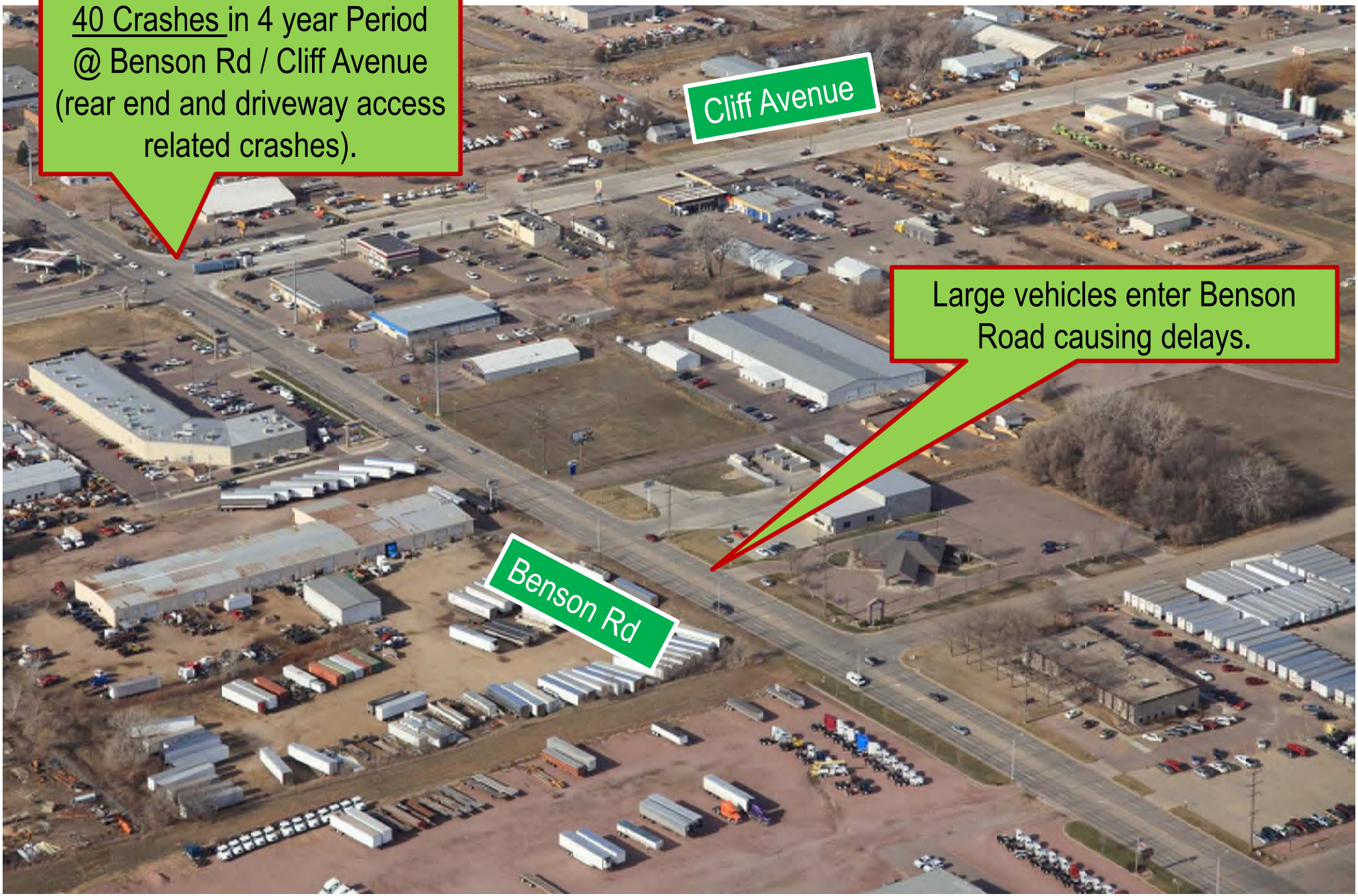




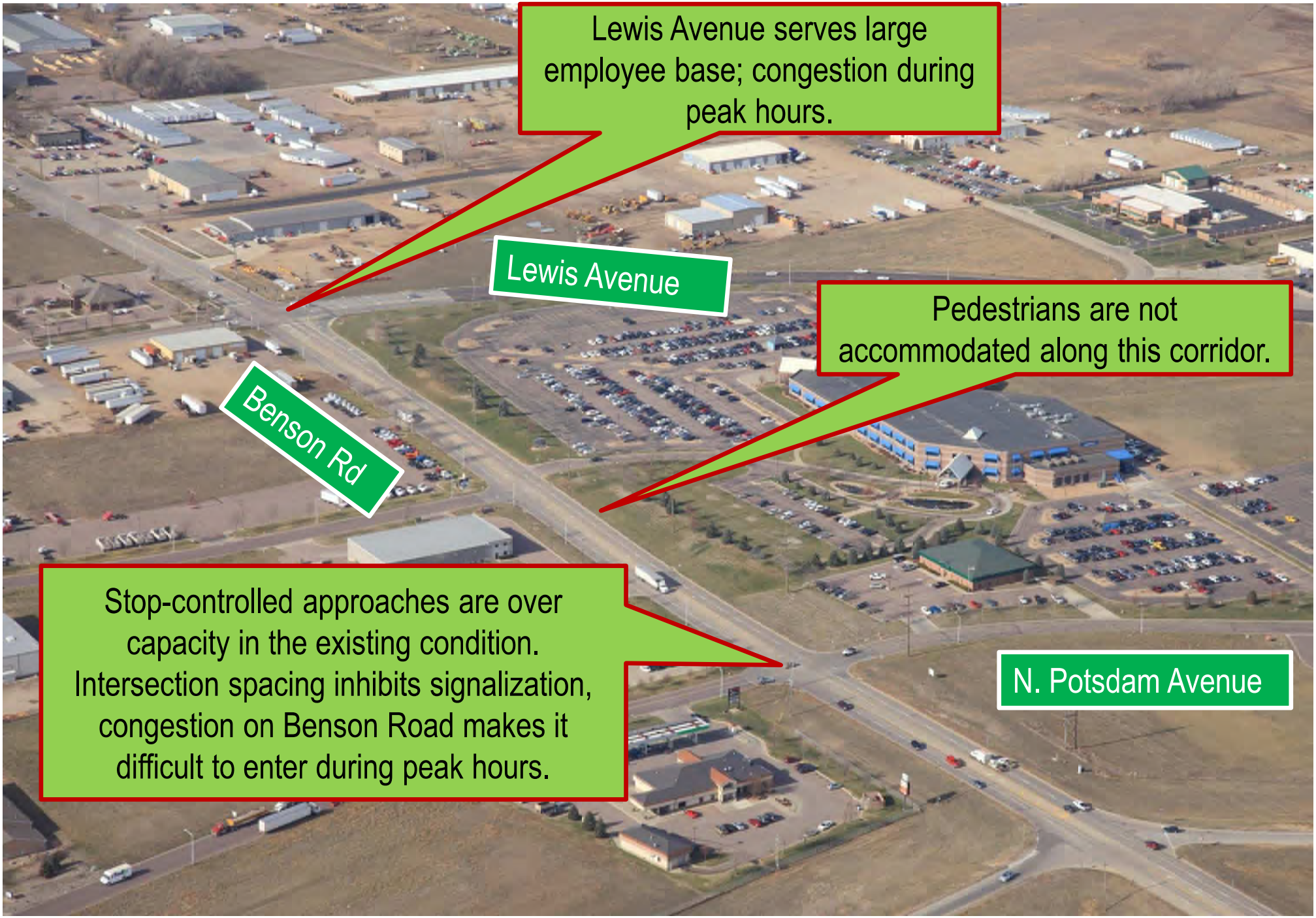
Benson Rd Corridor Overview



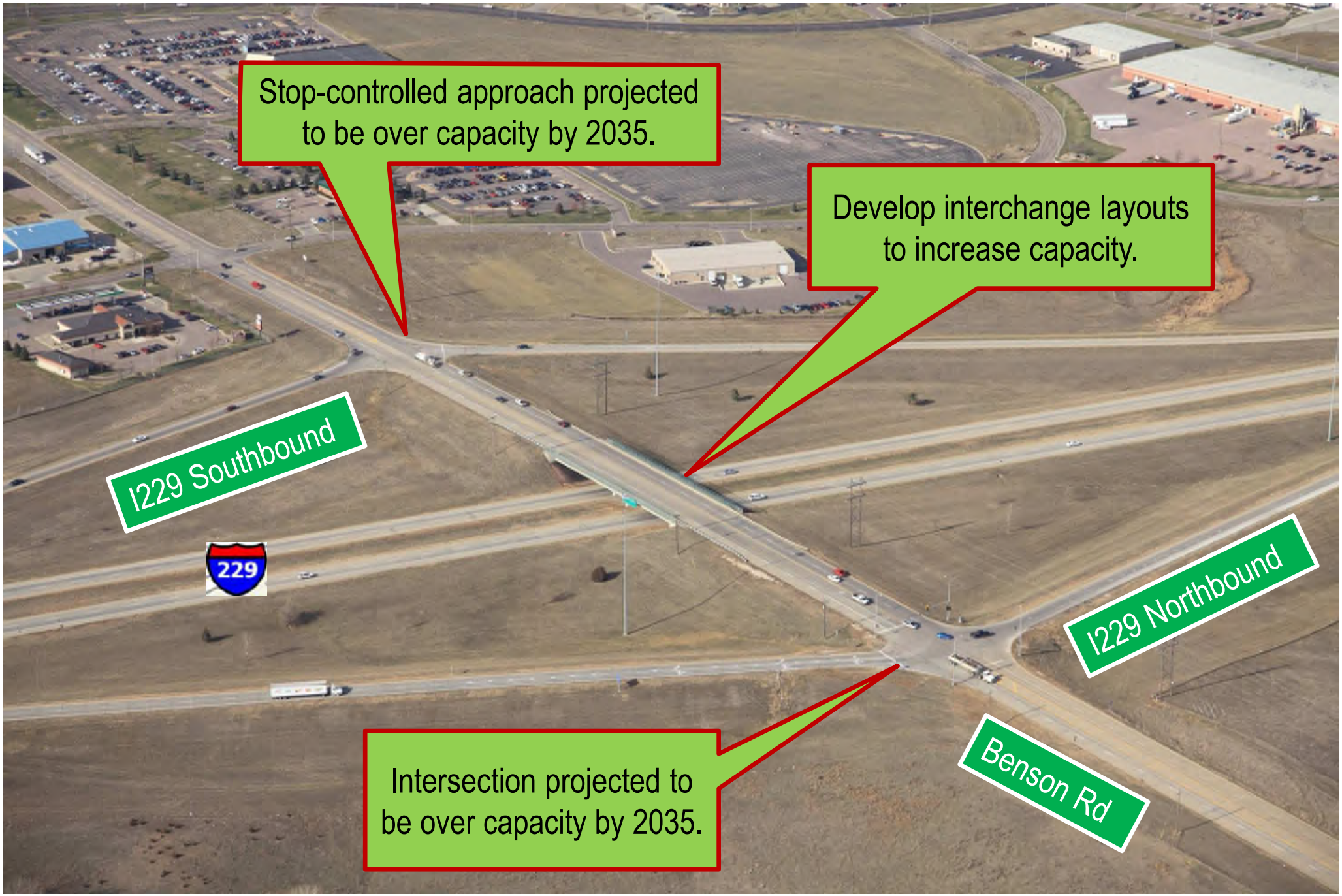
Benson Rd Corridor Overview



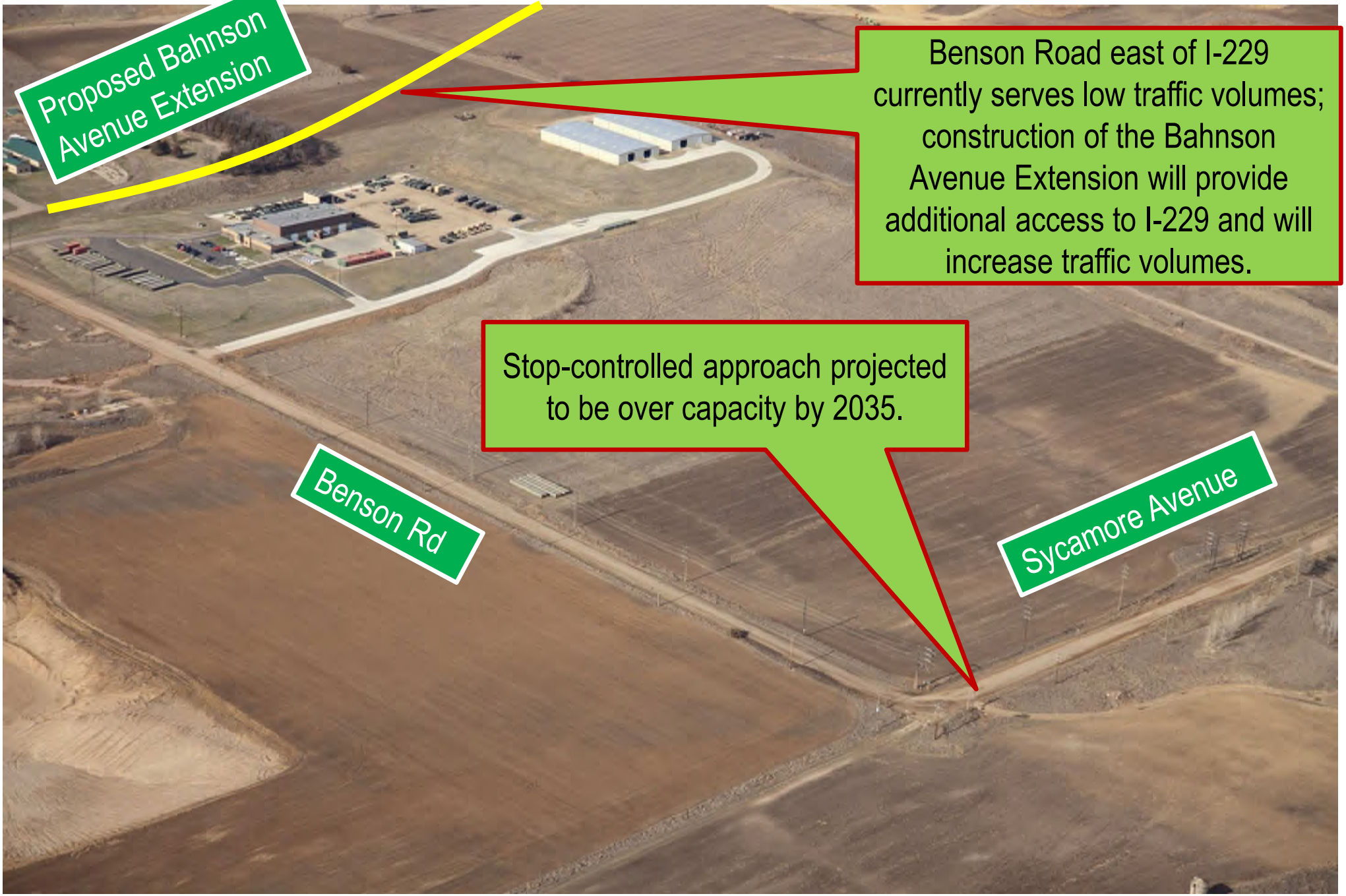
Benson Rd Corridor Overview



Benson Rd Corridor Overview



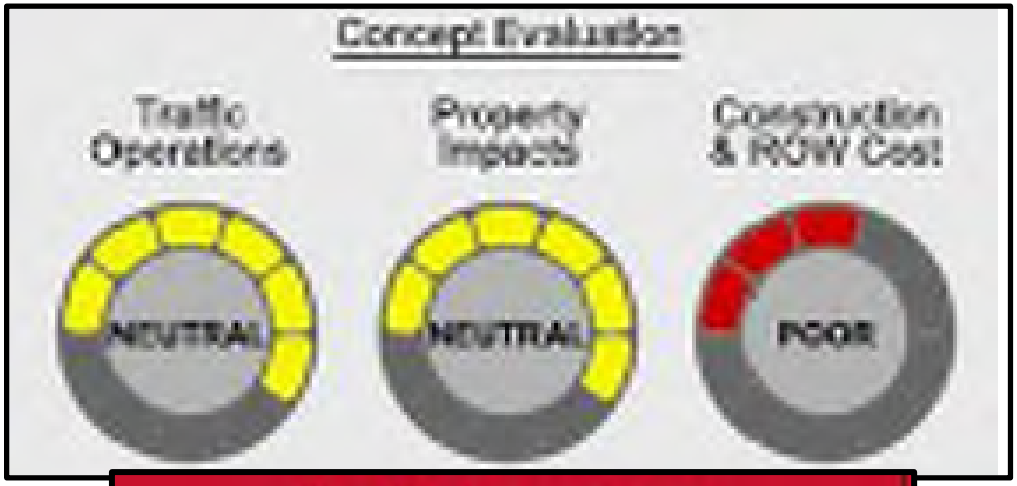
Benson Rd Corridor Overview



Conceptual Ideas for Benson Road

What you will be able to see tonight:

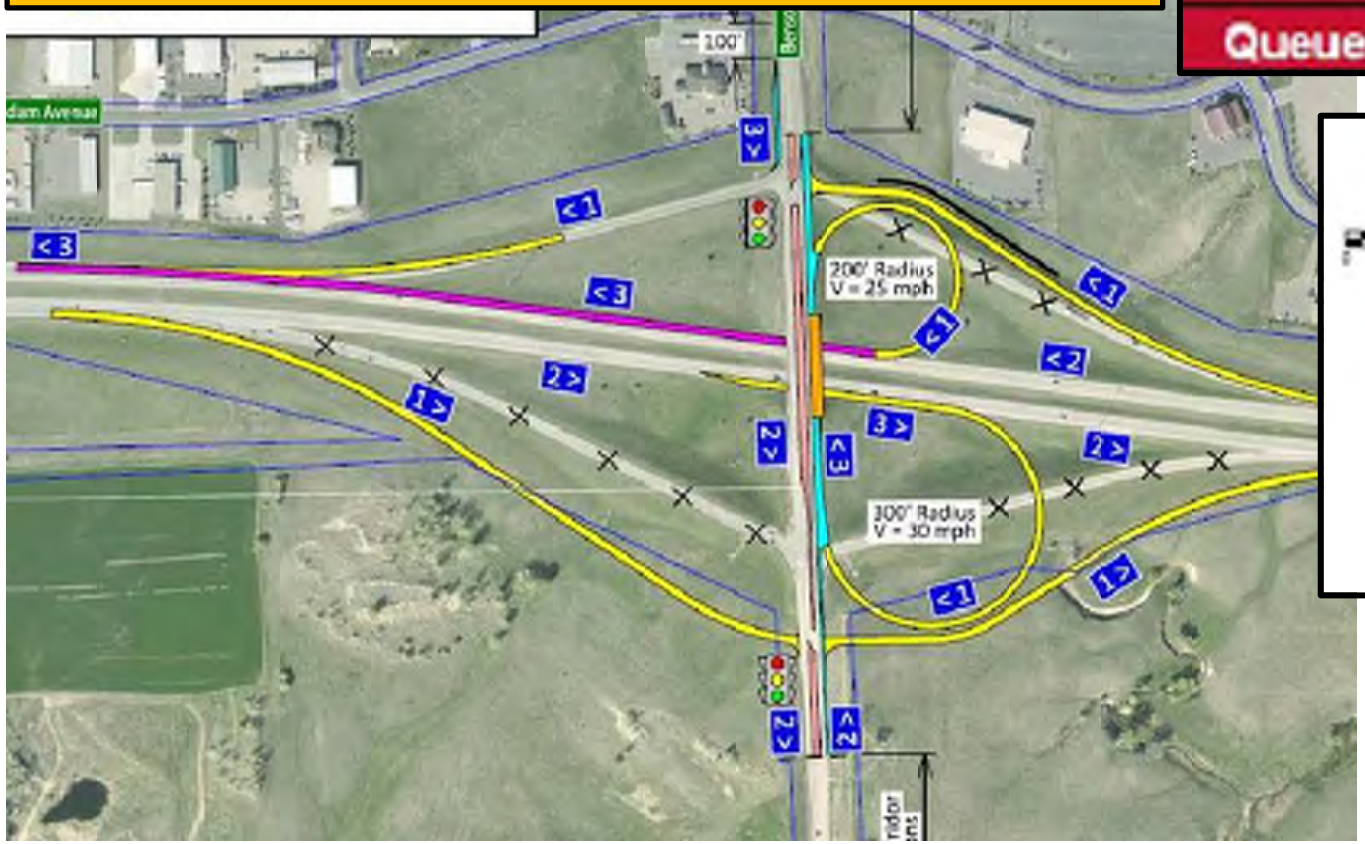
- **4 Interchange Conceptual Options**
- **1 Corridor Option**

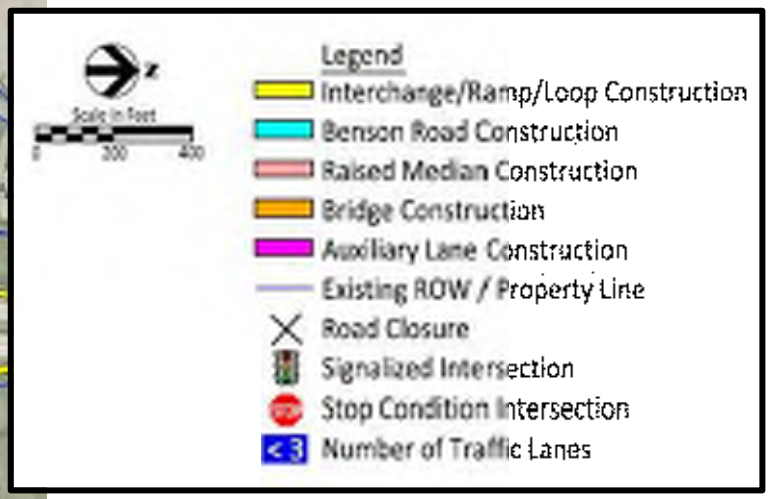


Traffic Assessment

Queues	Delay	Travel Time

Benson Road / I-229 Interchange Folded Diamond Option

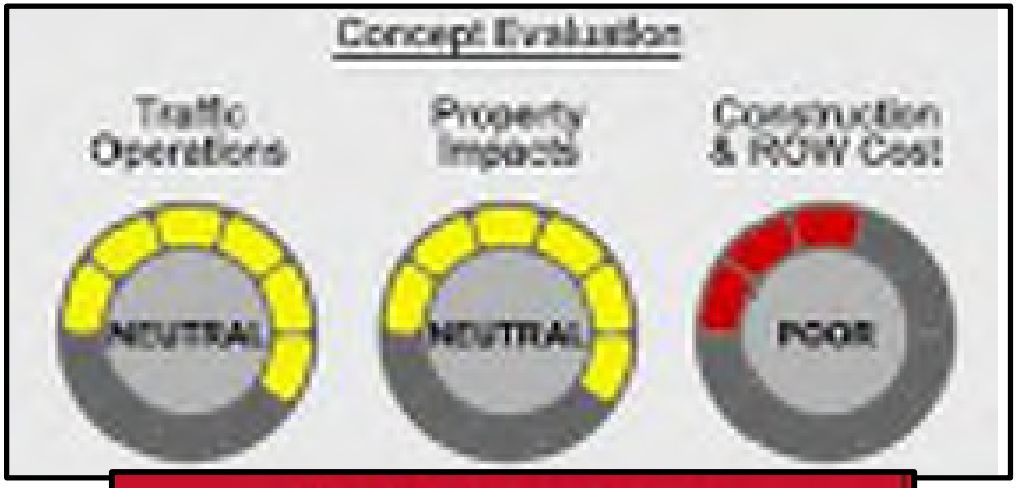




Conceptual Ideas for Benson Road

What you will be able to see tonight:

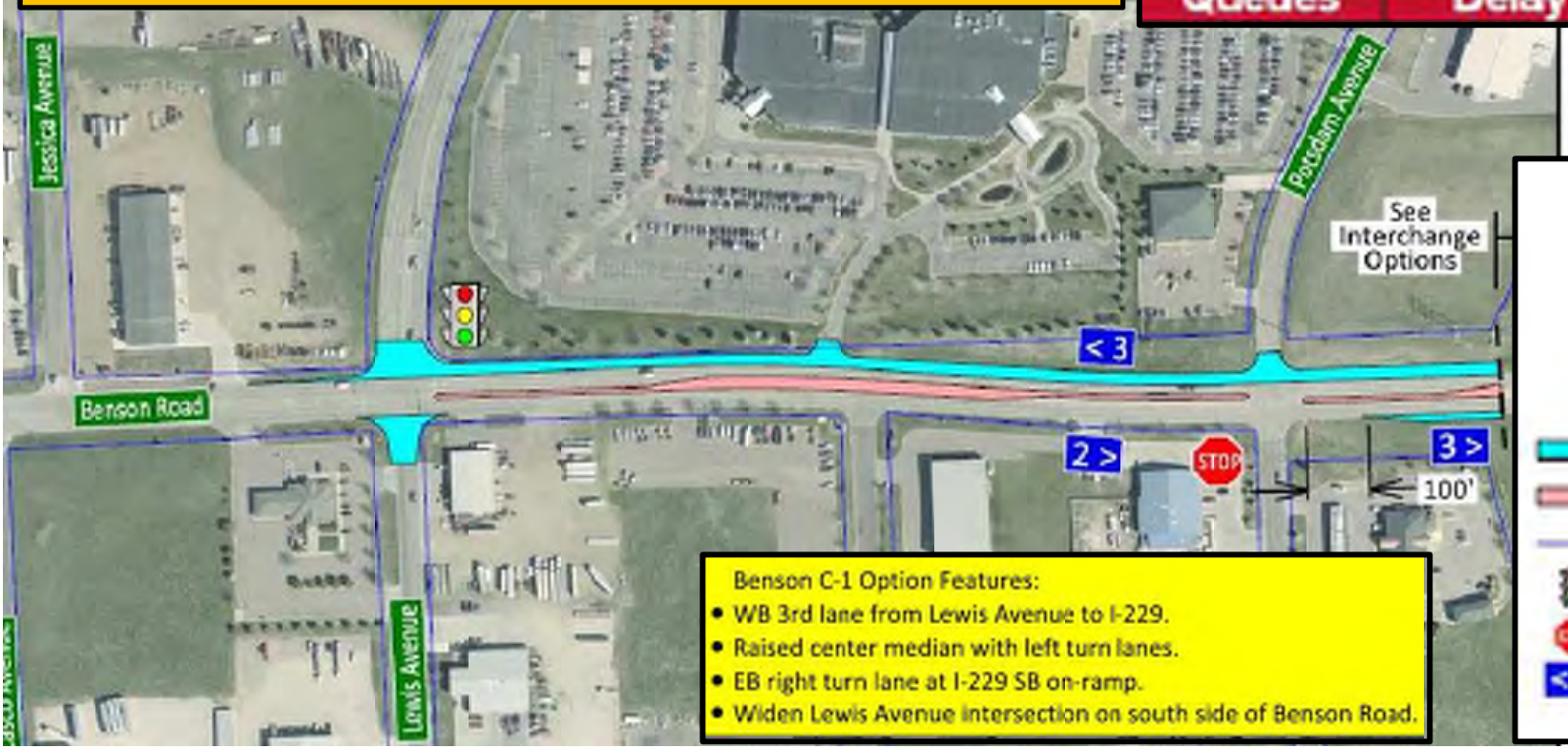
- **4 Interchange Conceptual Options**
- **1 Corridor Option**



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

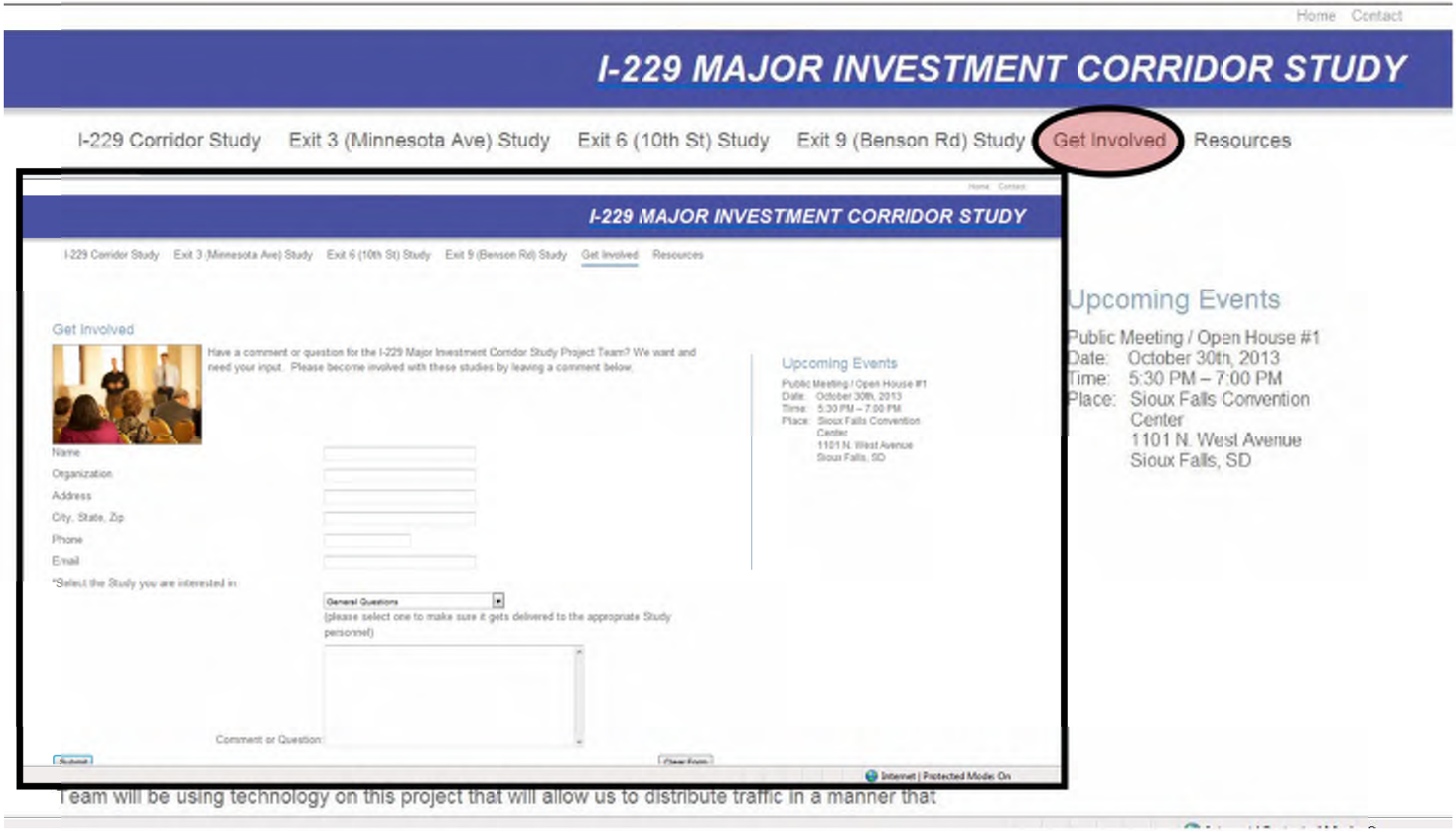


- **Complete additional Traffic Operations analysis on a reduced number of options based on the screening activities**

- **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

© 2014 HDR, all rights reserved.

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)

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 0100(87) 3515P PCN 044K **Project No.:** 207030

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	367-3810	amber@secog.org
3	Jo Wahle			
4	Jason Kjenstad	HDR	605-977-7740	
5	James Unruh	HDR		
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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 6P; PCN 044K **Project No.:** 207030

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	Ron McMahon	FHWA	776-1009	ron.mcmahon@dot.gov
2	PETE LONGMUIR	SD DOT	773-6488	pete.longmuir@state.sd.us
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







Interstate 229 Major Investment Study

Mainline I-229 Sub-Study 1

Informational Meeting
June 2nd, 2015
7:00 pm to 8:30 pm

HDR

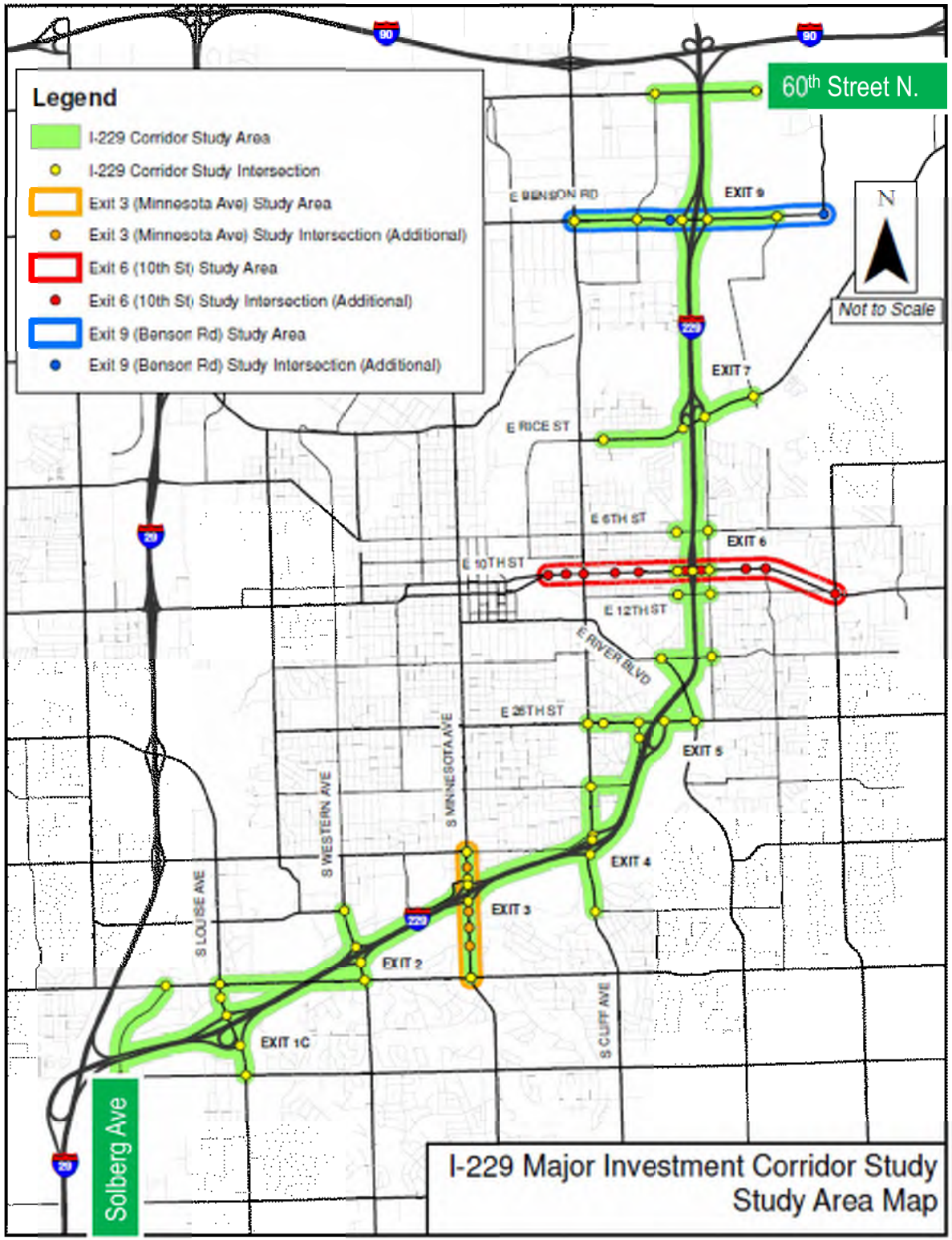
HRGreen

© 2014 HDR, all rights reserved.

Study Area Map

I-229 Corridor Study

Solberg Avenue Overpass
to
60th Street N. Overpass



Study Advisory Partners

South Dakota Department of Transportation (SDDOT)

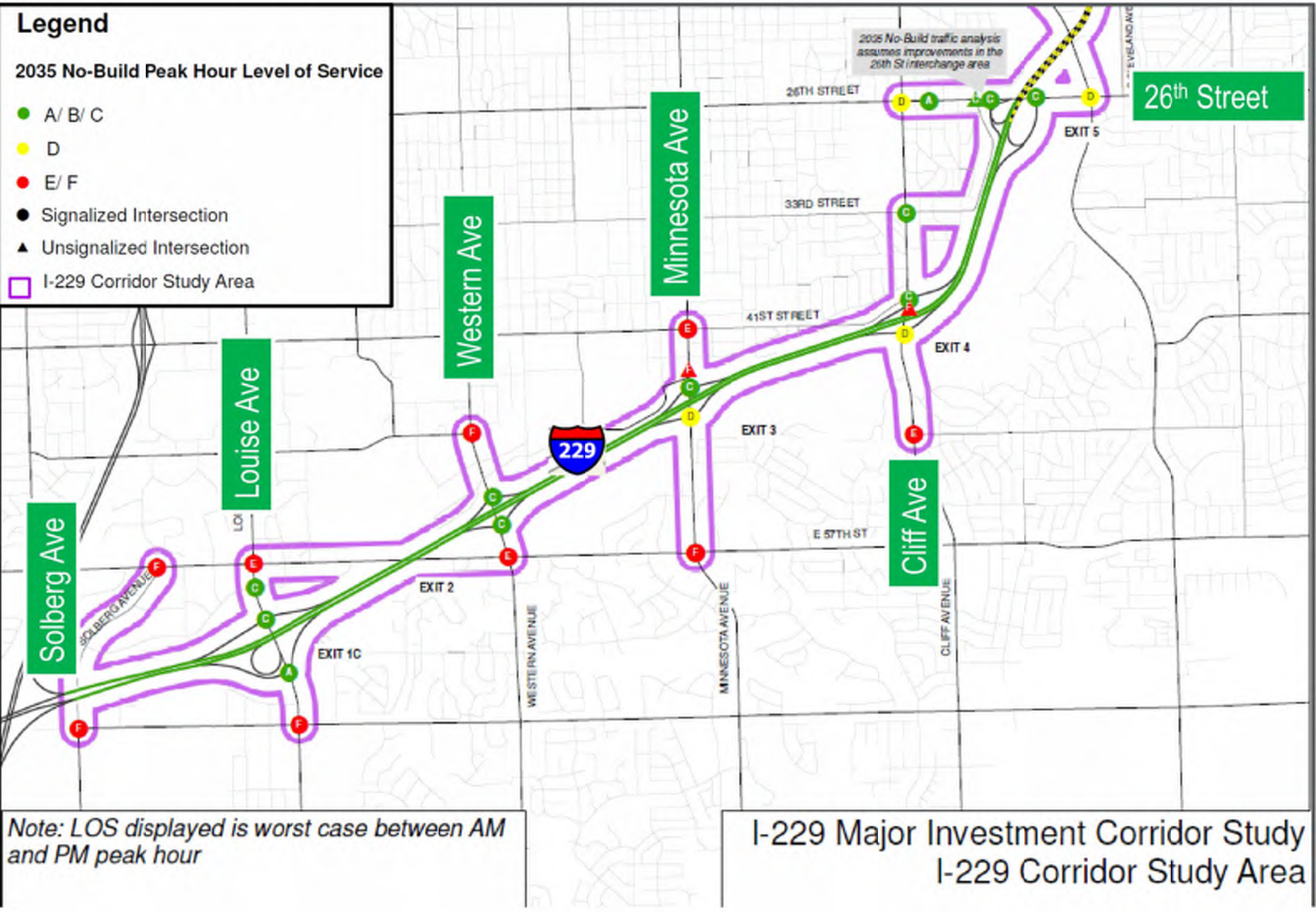
South Dakota Highway Patrol

City of Sioux Falls

Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

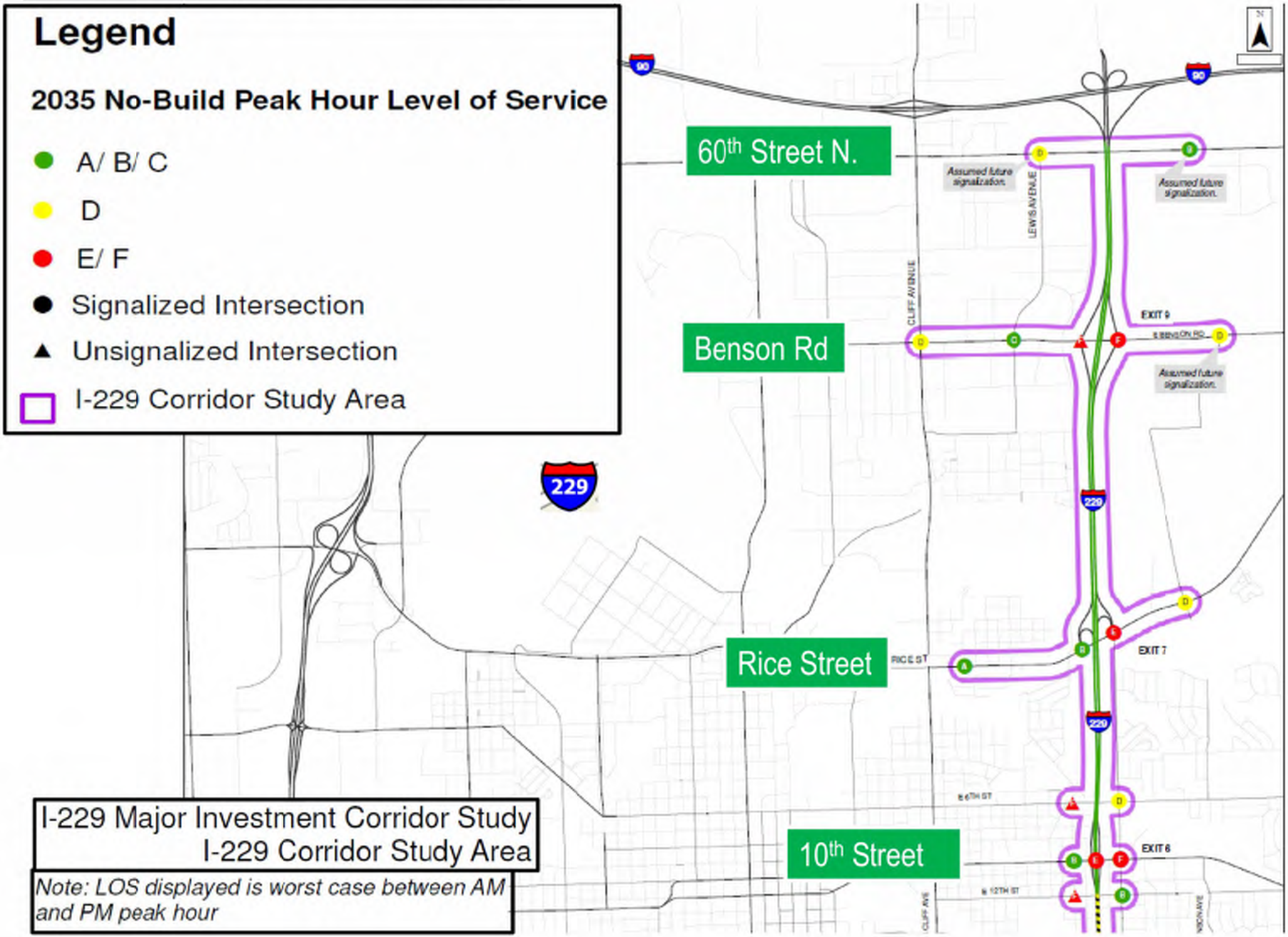
I-229 Corridor Overview



Note: LOS displayed is worst case between AM and PM peak hour

I-229 Major Investment Corridor Study
I-229 Corridor Study Area

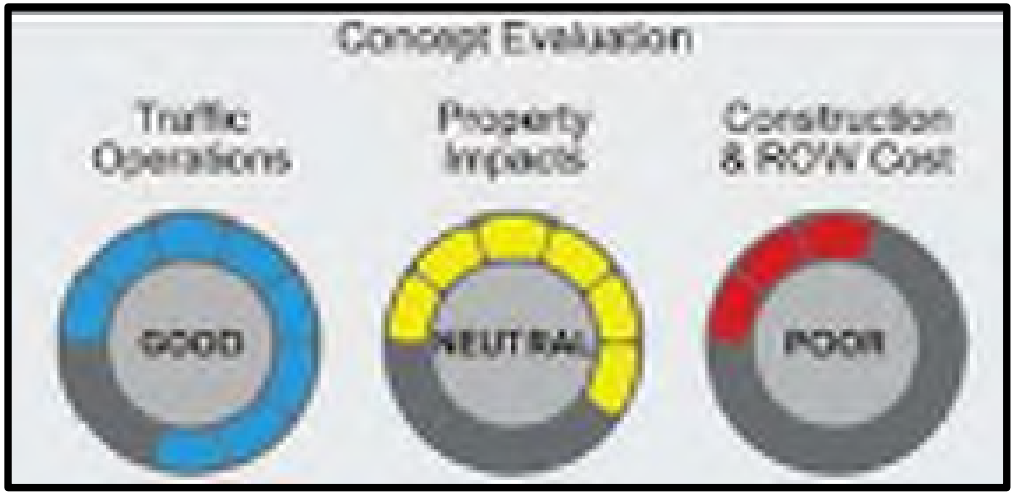
I-229 Corridor Overview



Conceptual Ideas for I-229 Mainline

What you will be able to see tonight:

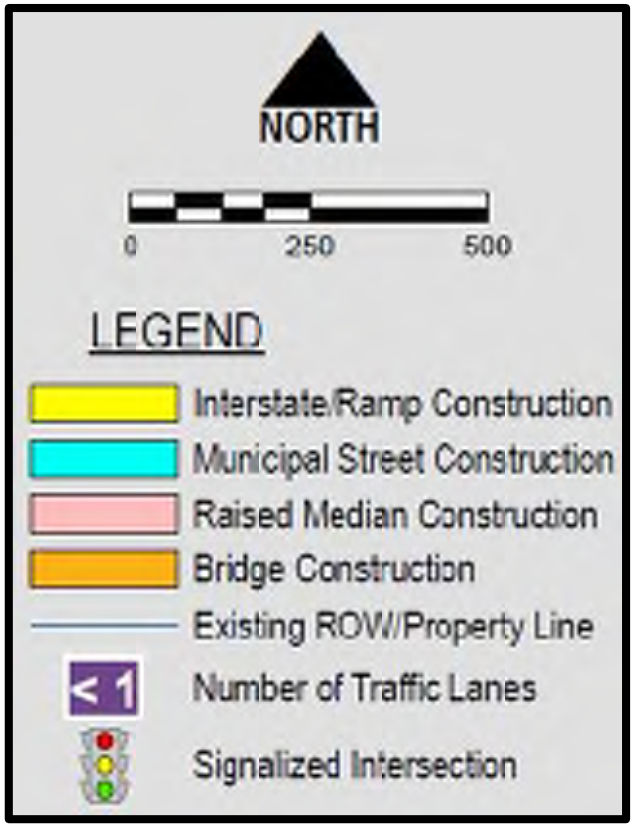
- **Additional 3rd Lane between 26th Street and 10th Street**
- **Modify design radius to allow for 65 mph design speed**



Southeastern Avenue

I-229 – Between 26th Street and 10th Street

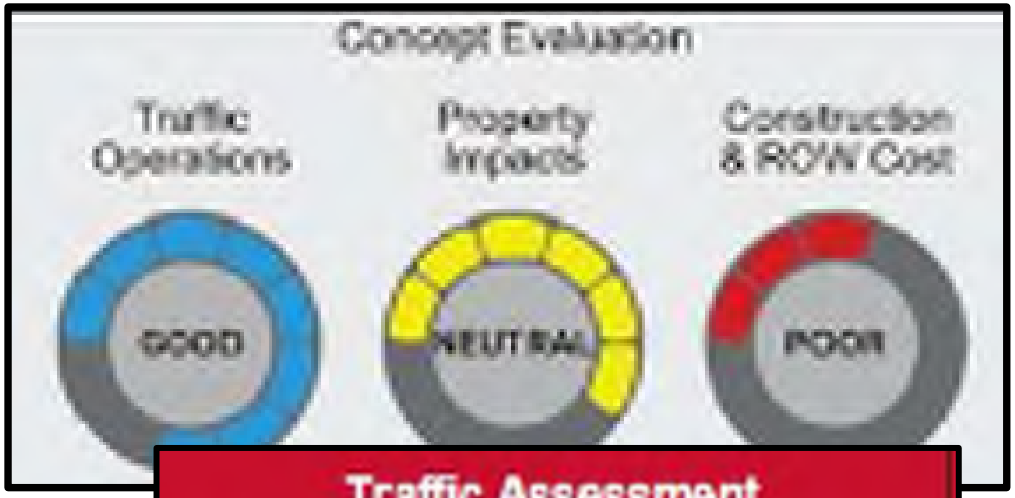




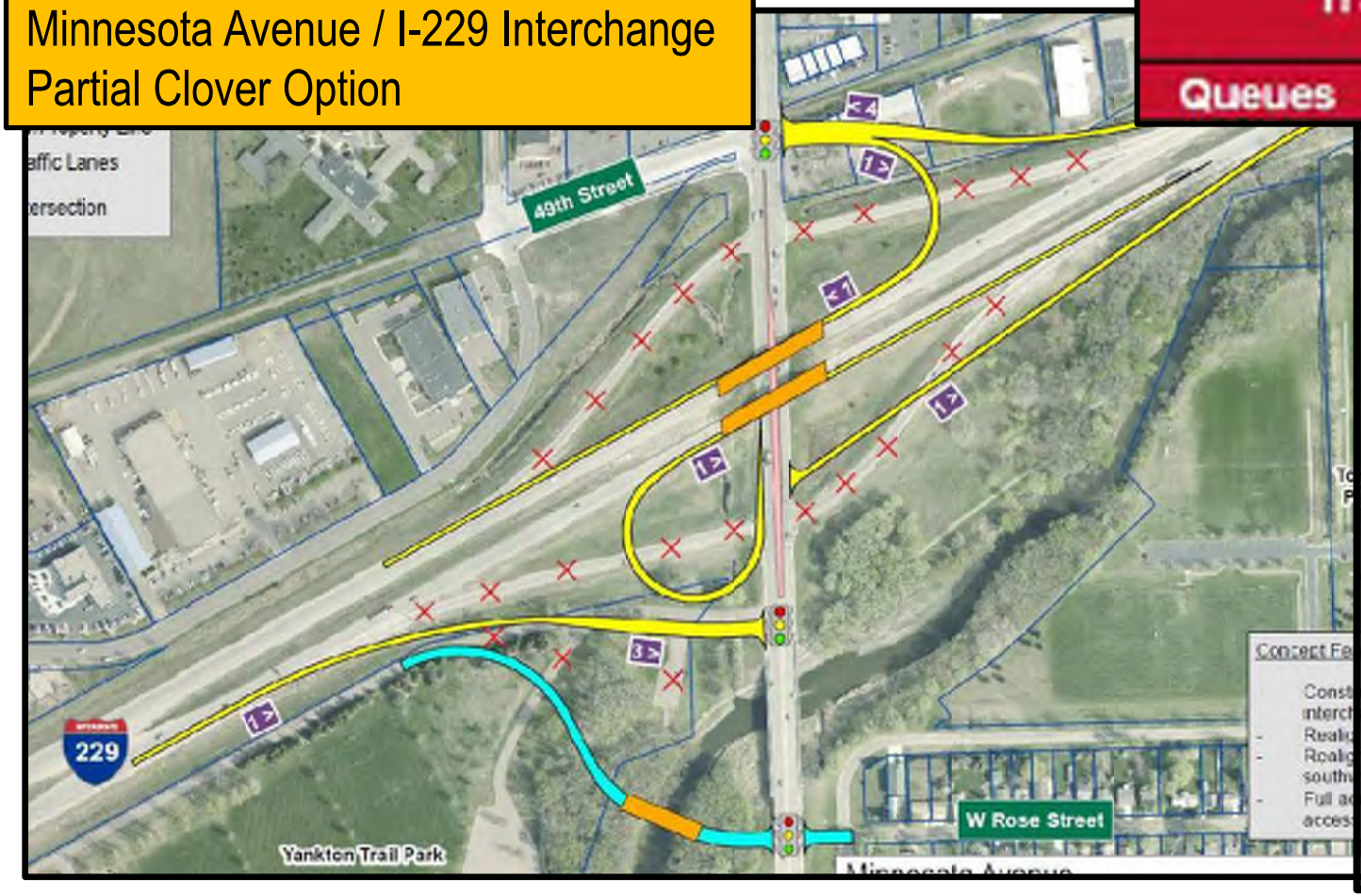
Conceptual Ideas for Minnesota Avenue

What you will be able to see tonight:

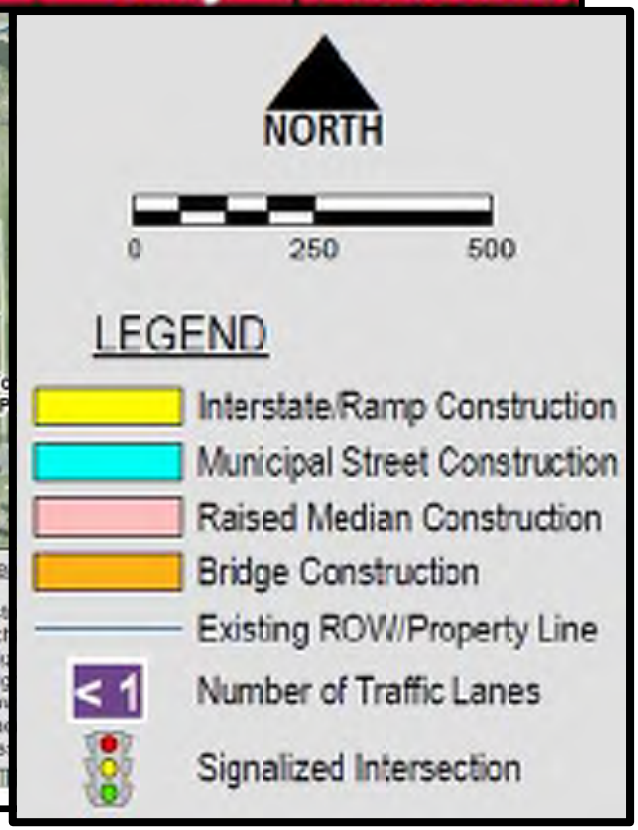
- 13 Interchange Conceptual Options
- 4 Corridor Options
- Access Changes to Yankton Trail Park
- Conceptual Options to improve safety



Minnesota Avenue / I-229 Interchange
Partial Clover Option



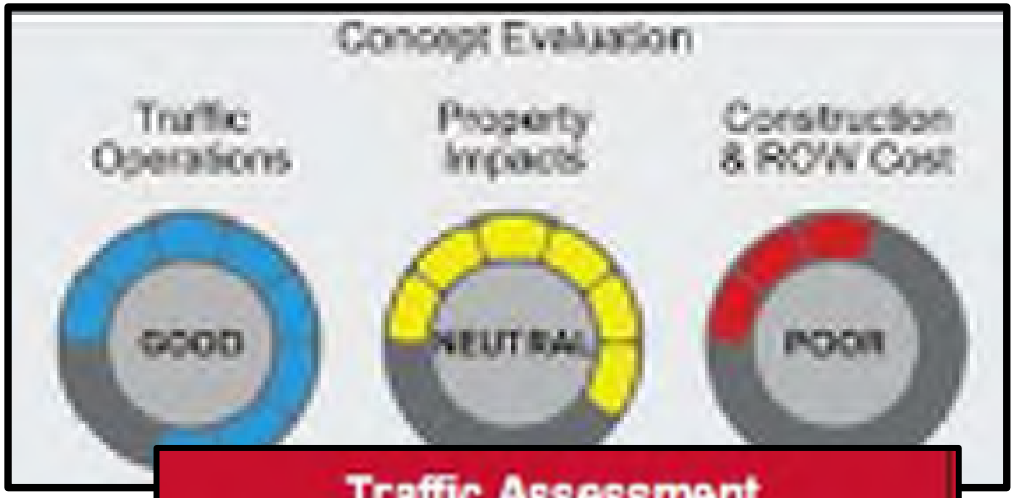
Traffic Assessment		
Queues	Delay	Travel Time



Conceptual Ideas for Cliff Avenue

What you will be able to see tonight:

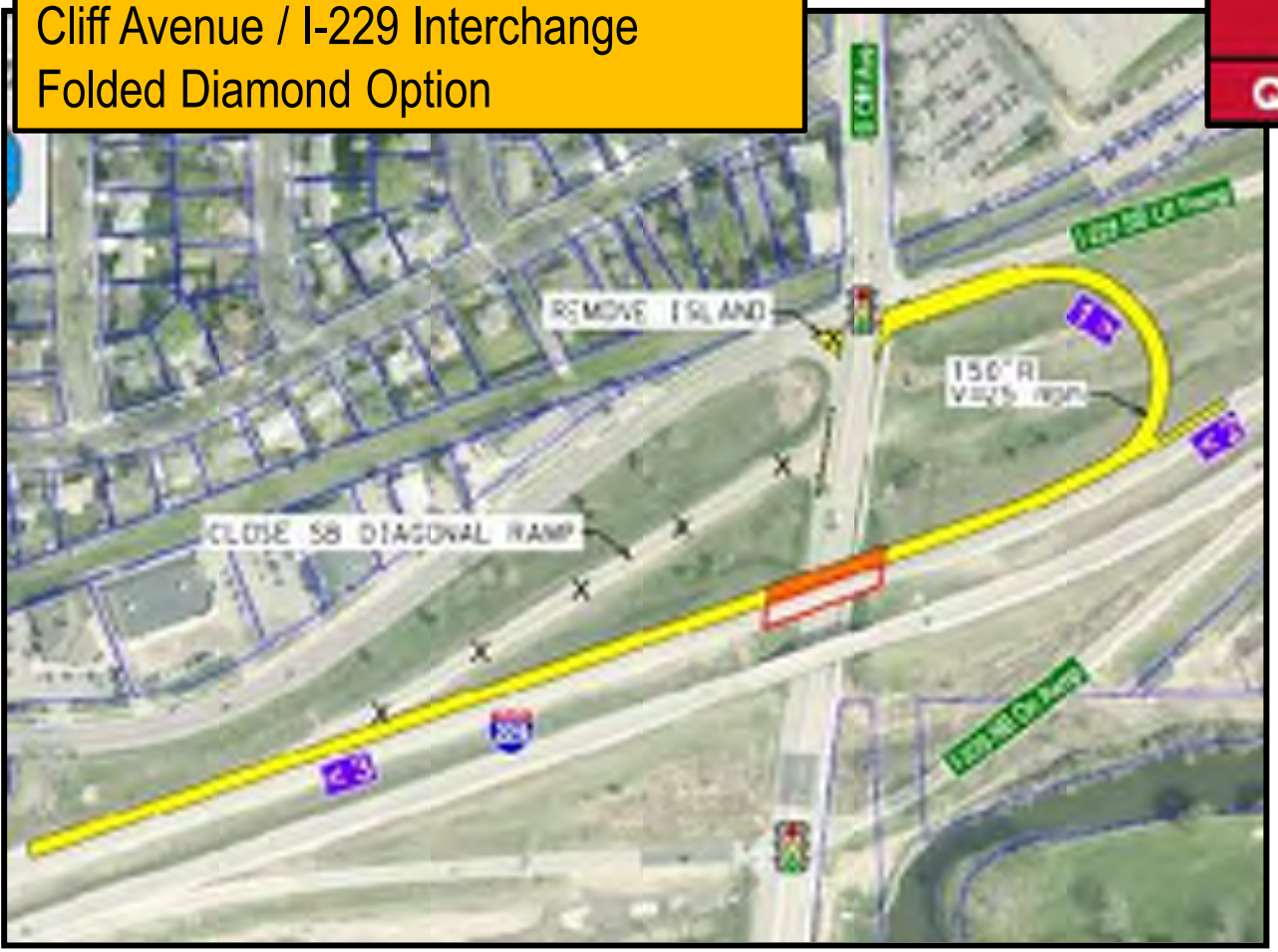
- **3 Interchange Conceptual Options**

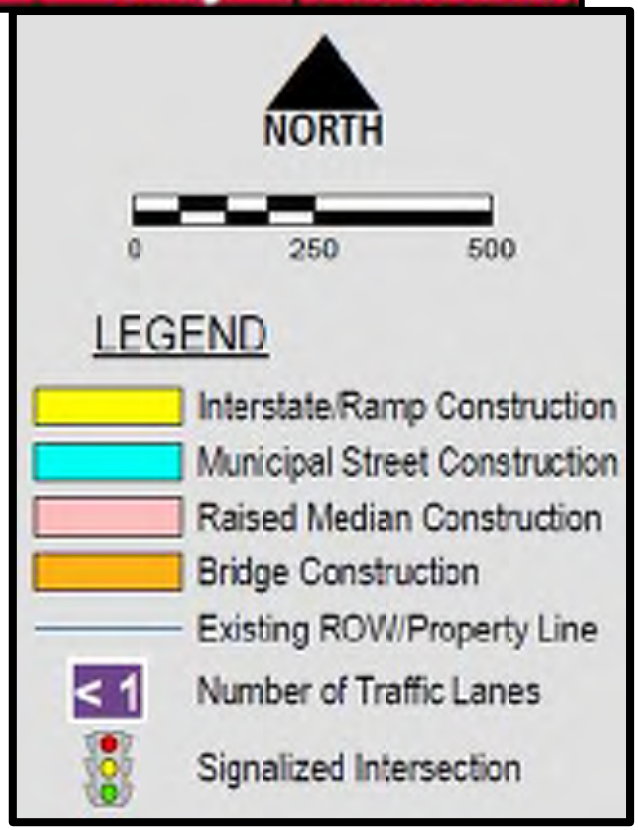


Traffic Assessment

Queues	Delay	Travel Time

Cliff Avenue / I-229 Interchange
Folded Diamond Option

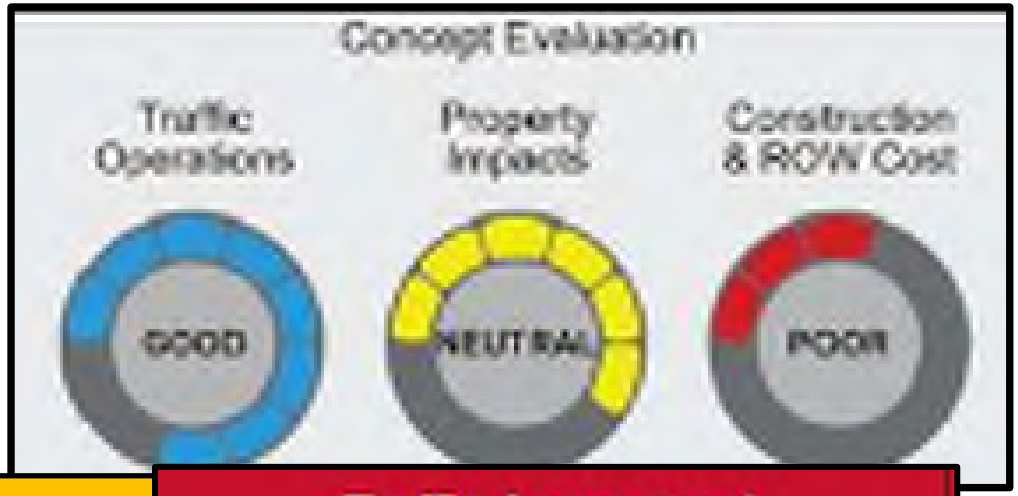




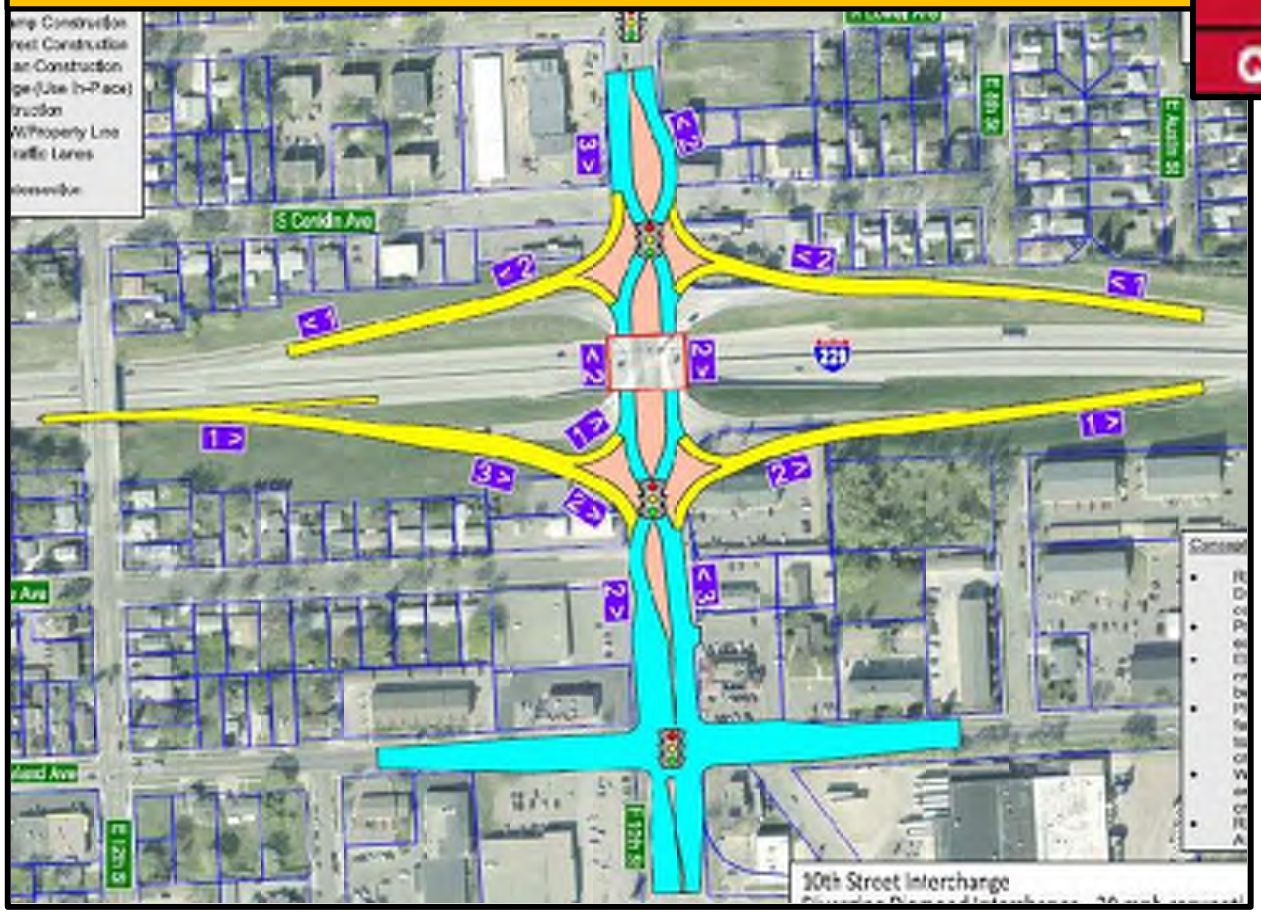
Conceptual Ideas for 10th Street Corridor

What you will be able to see tonight:

- 8 Interchange Conceptual Options
- 4 Corridor Options
- Median Changes or Driveway Closures to Improve Safety

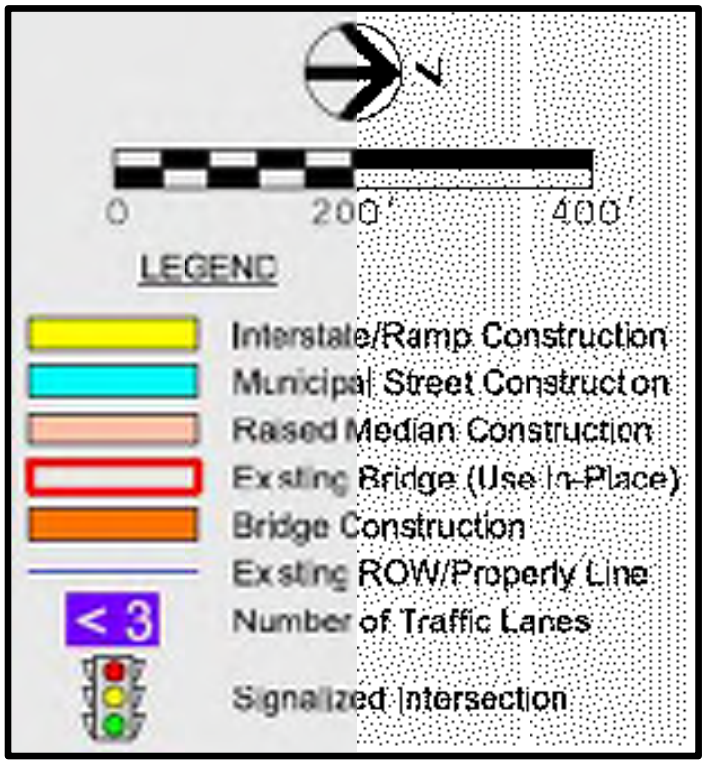


10th Street / I-229 Interchange Diverging Diamond Option



Traffic Assessment

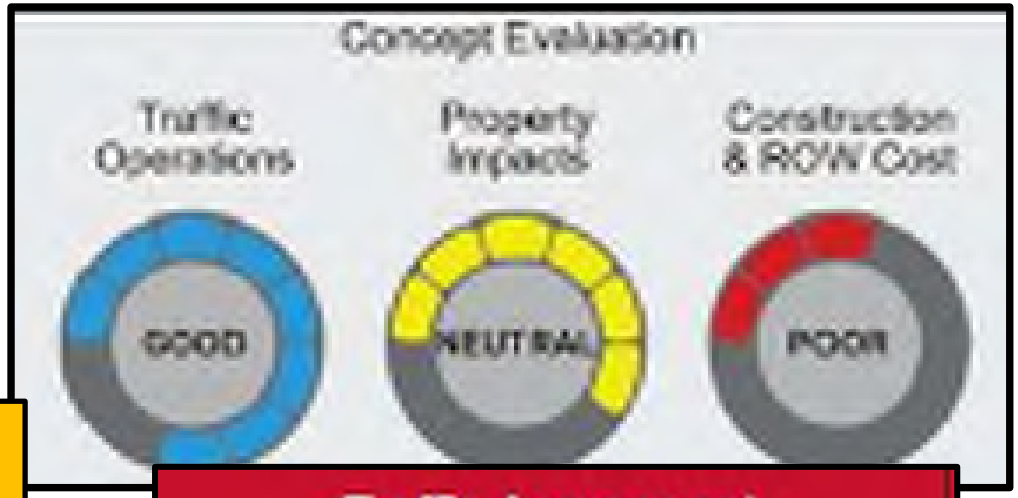
Queues	Delay	Travel Time



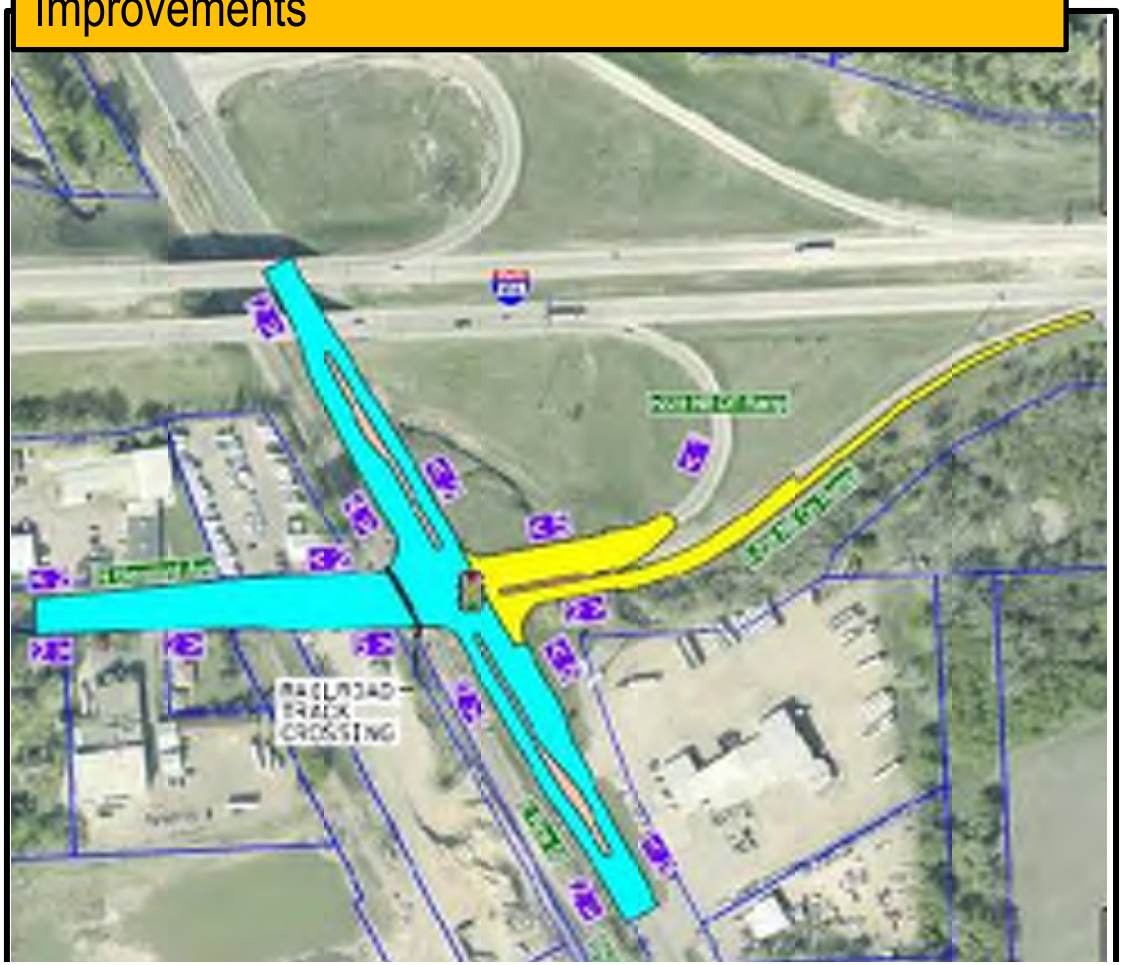
Conceptual Ideas for Rice Street Interchange

What you will be able to see tonight:

- **1 Interchange Conceptual Options**

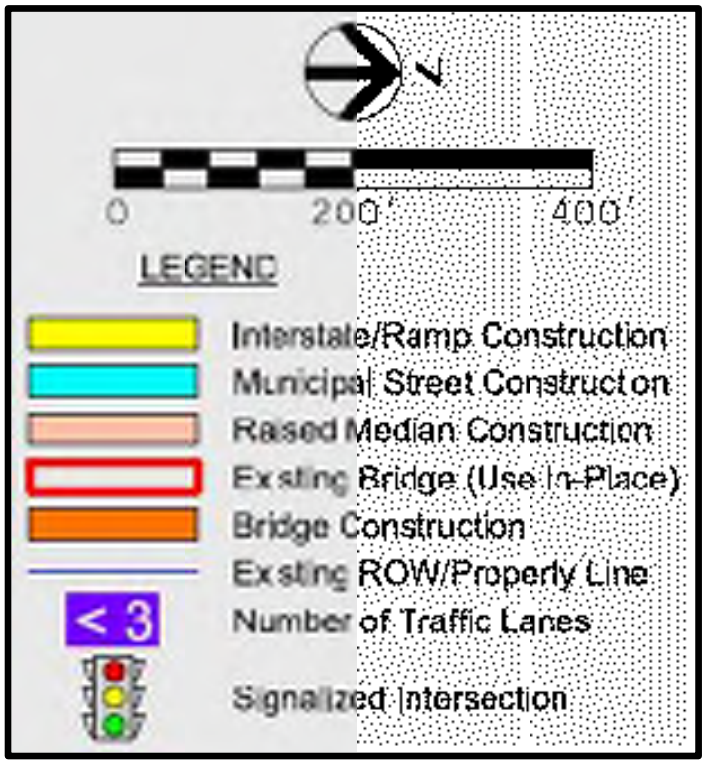


Rice Street / I-229 Interchange Folded Diamond Improvements



Traffic Assessment

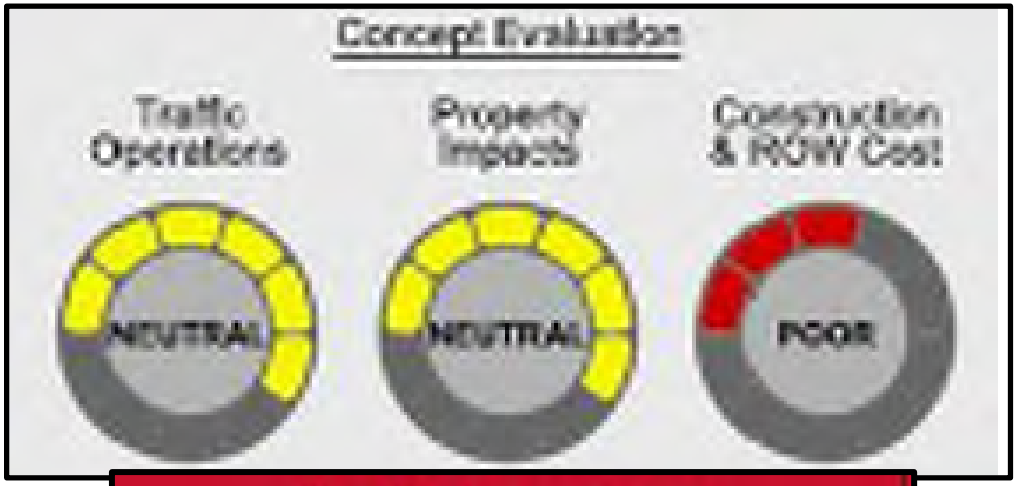
Queues	Delay	Travel Time



Conceptual Ideas for Benson Road

What you will be able to see tonight:

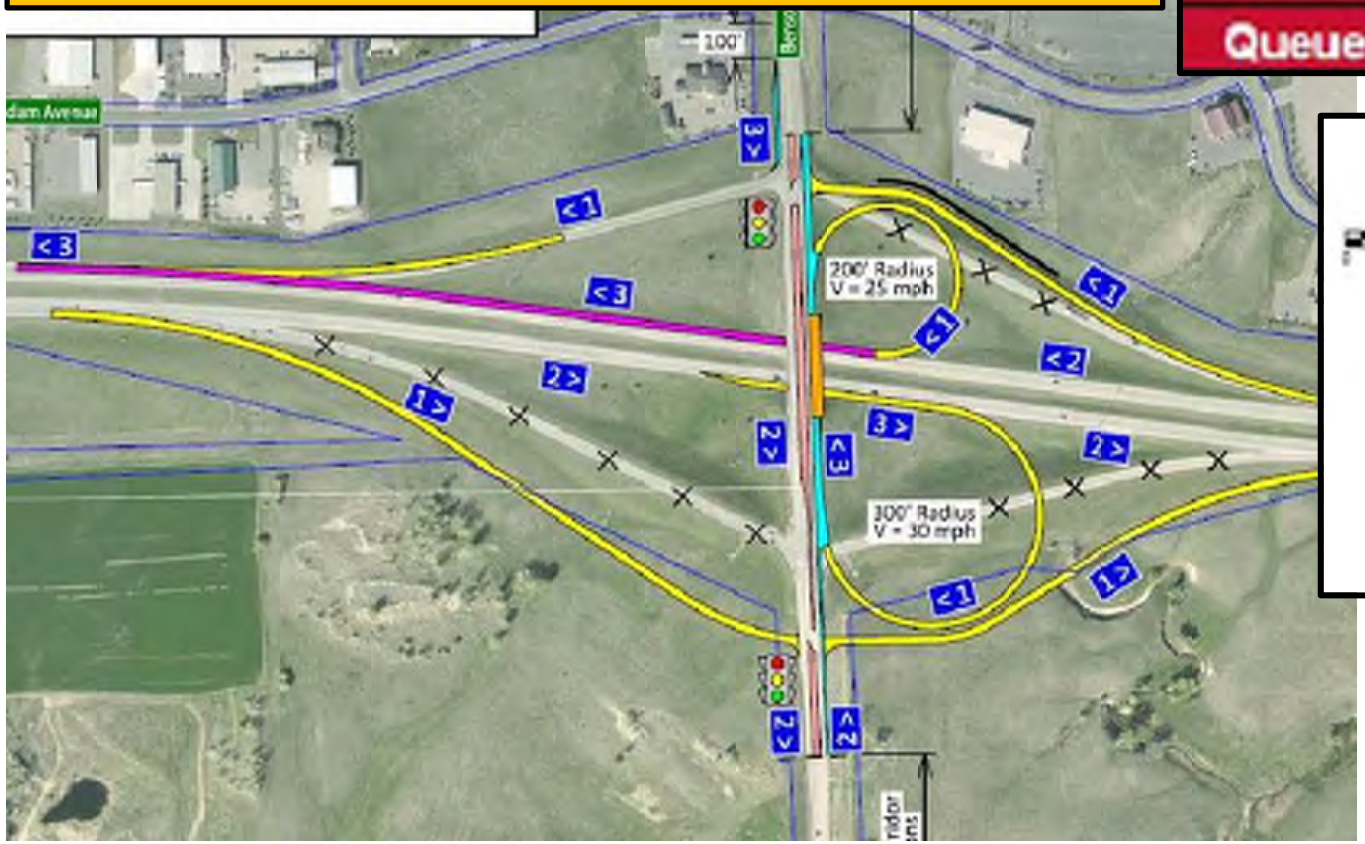
- **4 Interchange Conceptual Options**
- **1 Corridor Option**

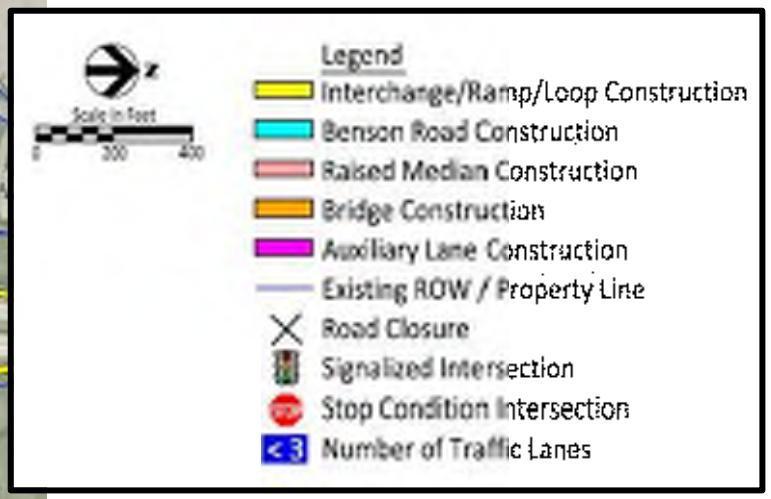


Traffic Assessment

Queues	Delay	Travel Time

Benson Road / I-229 Interchange Folded Diamond Option

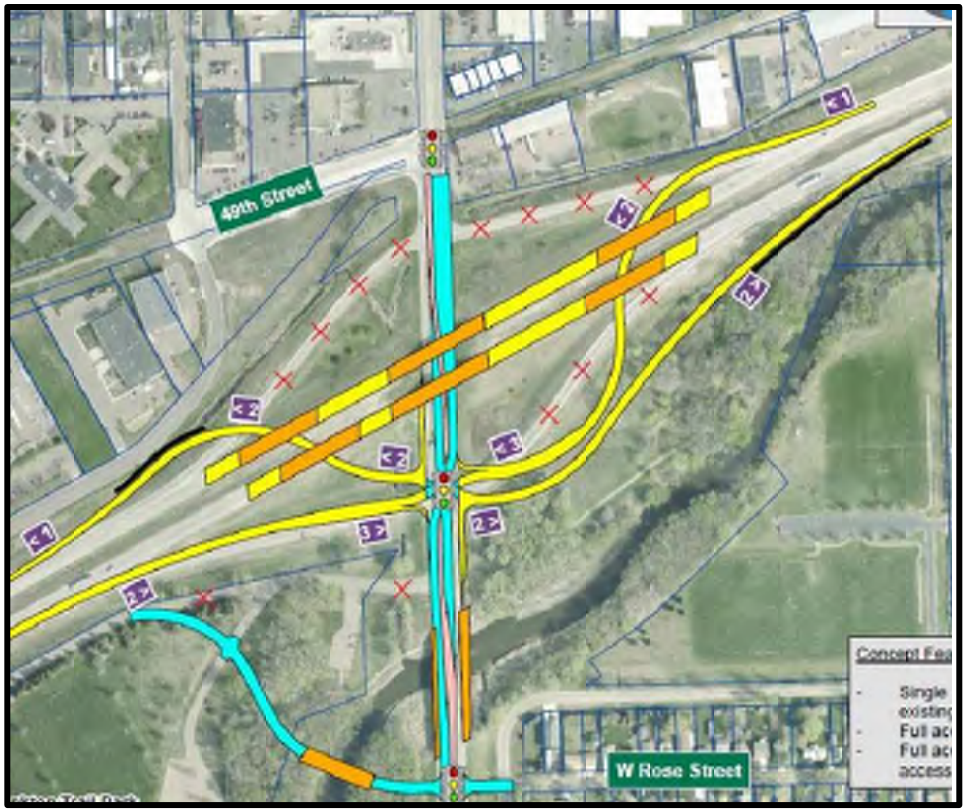




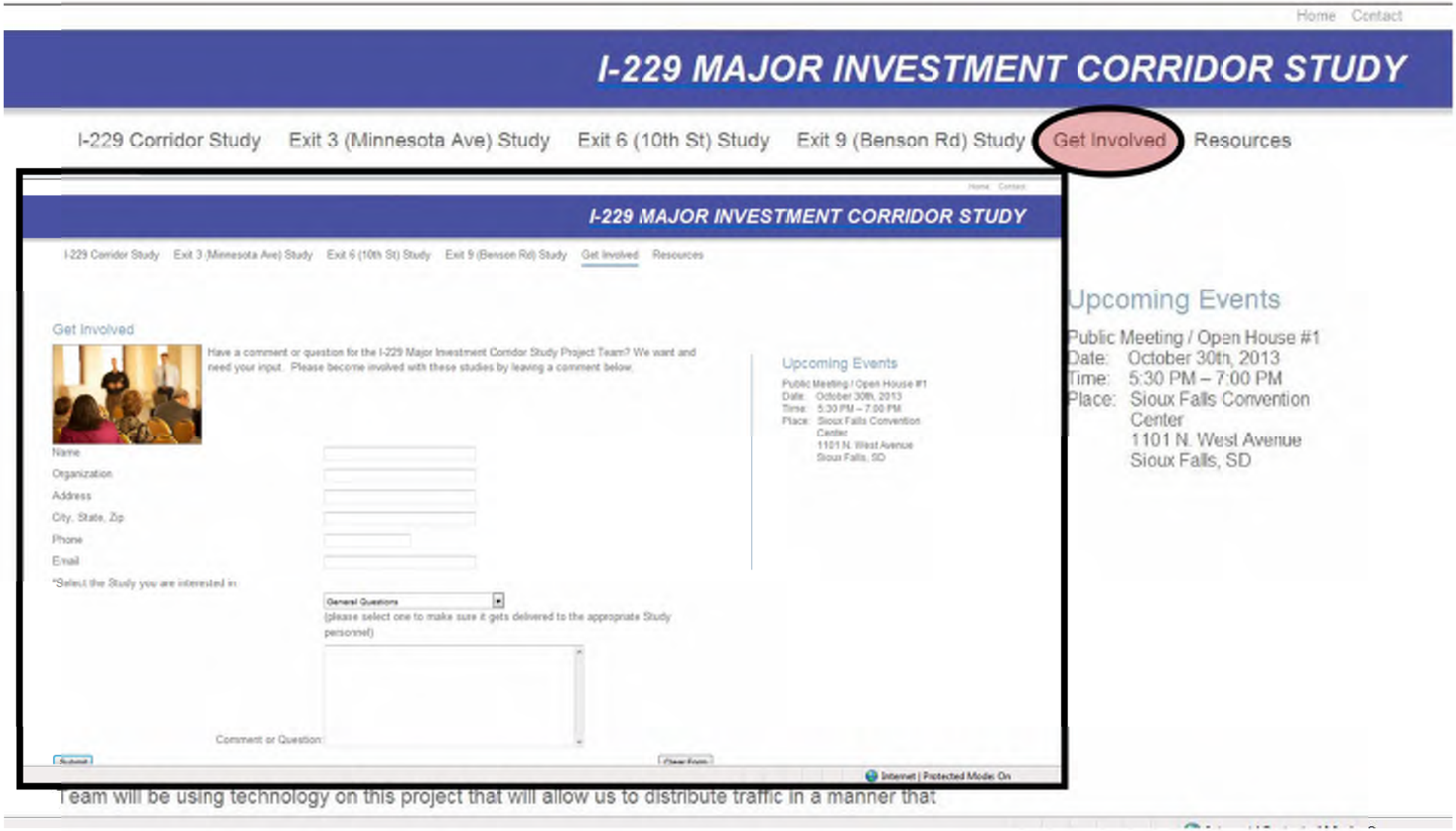
Next Steps for I-229

- 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:

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

Mainline I-229 Sub-Study 1

Thanks for Attending!!!!!

HDR

HRGreen

© 2014 HDR, all rights reserved.

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.

Sub-Study 3 - 10th Street:

- Potential noise issues with split diamond concepts due to added one way ramp connectors.

Sub-Study 4 – Benson Road:

- 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 alternate 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. The affects Ptsdam 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 ~~users~~ 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 diversing 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 into 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 chasing except at huge, High Speed intersections

ptional)

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 ~~vehicle~~ 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.

(optional)
Name: Address:
Phone: Email:

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

---

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

---

Comment 09

Comments

Please include me in any future planning around 10th Street. I am a commercial property owner 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 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	brad.jay.remmich@state.sd.us
2	Brigitte Faulks	1208 N Lowell Ave	605-310-7935	
3	Steve Gramm	700 E. Broadway Ave	773-6491	Steve.gramm@state.sd.us
4	Jason Ligenstad	6300 S. Old Village Pl	977-7740	jason.ligenstad@hdrinc.com
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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) 3618P, 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 Kjerstad	HDR	605-977-7740	jason.kjerstad@hdrinc.com
3	Josh Callahan	1501 N. Cleveland Ave Sioux Falls	605-521-6586	josh.callahan@smpsecurity.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	2105 Tricia Lane 57103	338-1870	jackie830n@yahoo.com
7	+4 Media			
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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 Lehnkuhl	700 E. Broadway	773.3721	tom.lehnkuhl@state.sd.us
4	DEAN DELASHMUTT	1207 N VIOLET PL	496 1108	
5	Dhan Khaptangi	1000 N Broken Bow Ave	605 360 3549	
6	Jesse Callahan	1501 N Cleveland Ave	334 9357	info@smpsecurity.com
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Comment Card

R3B LOOKS GOOD FOR CLEVELAND

I-229 Major Investment Corridor Study – Rice Street Sub-Study

Public Open House

PL 0100(87) 3616P, PCN 044K

June 22, 2016

Comments:

FUTURE: 4 LANES - HMMM?

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

HDR

© 2014 HDR, all rights reserved.

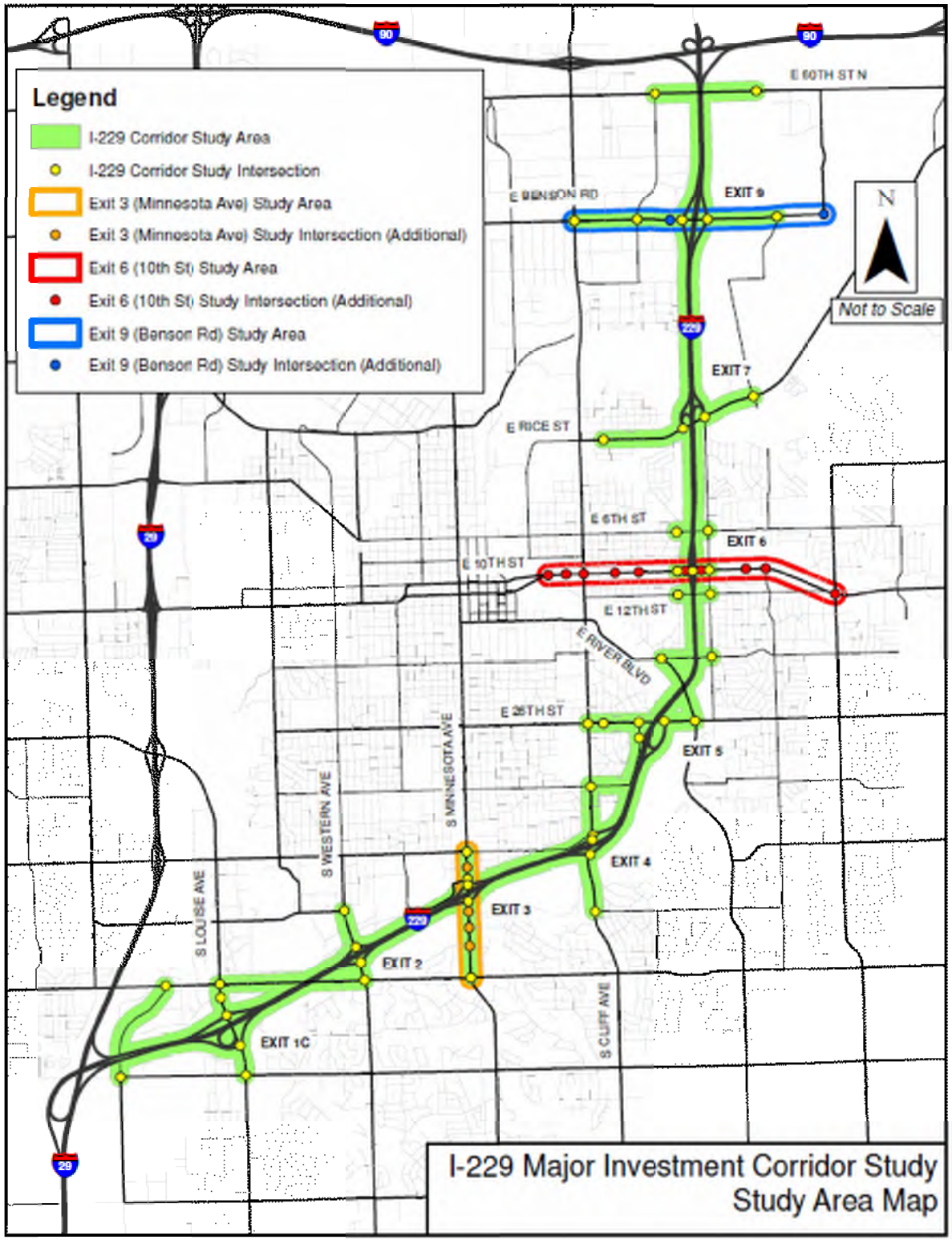
Study Area Map

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)

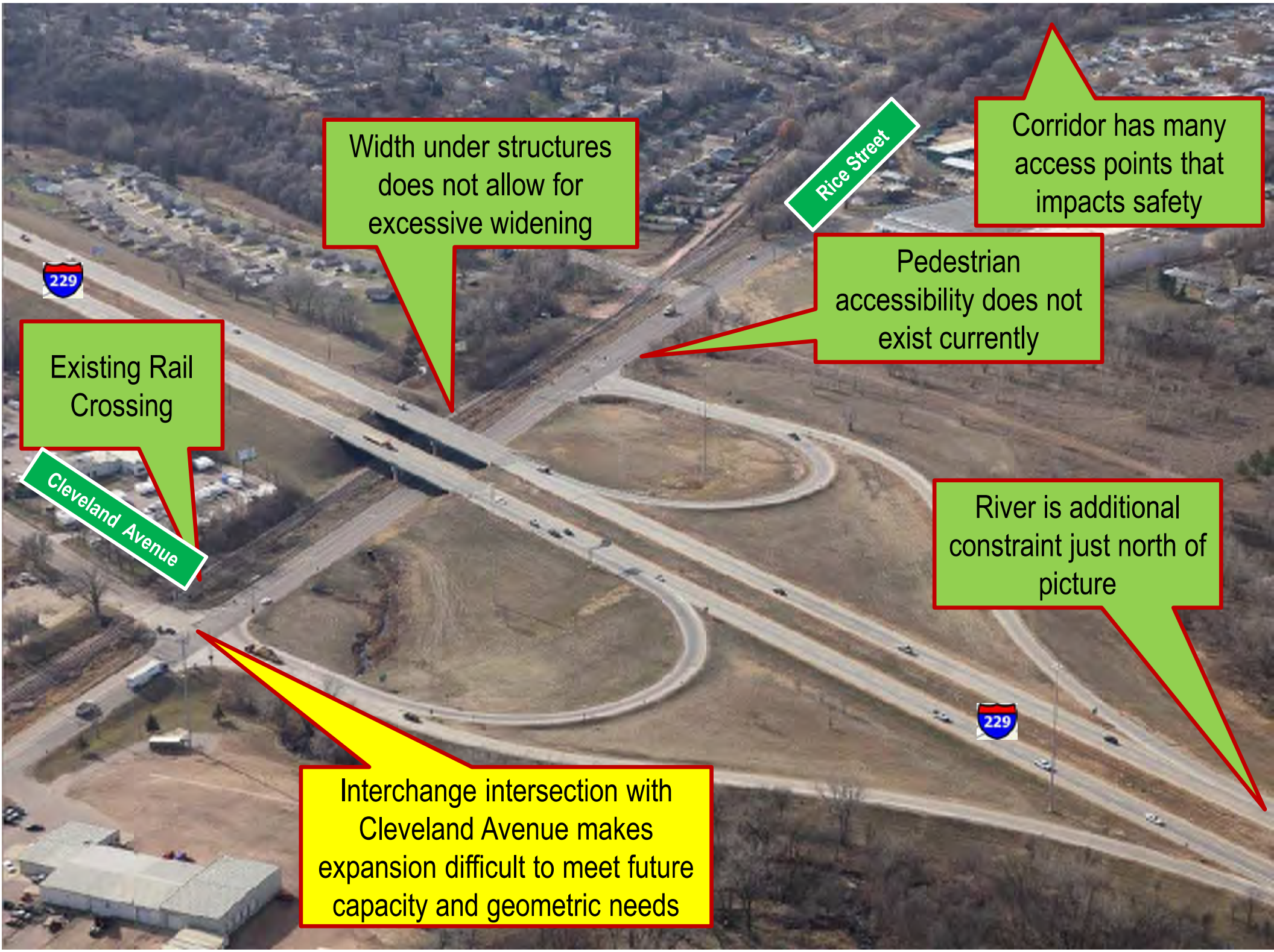
Exit 7 (Rice Street) Crossroad Study Goals

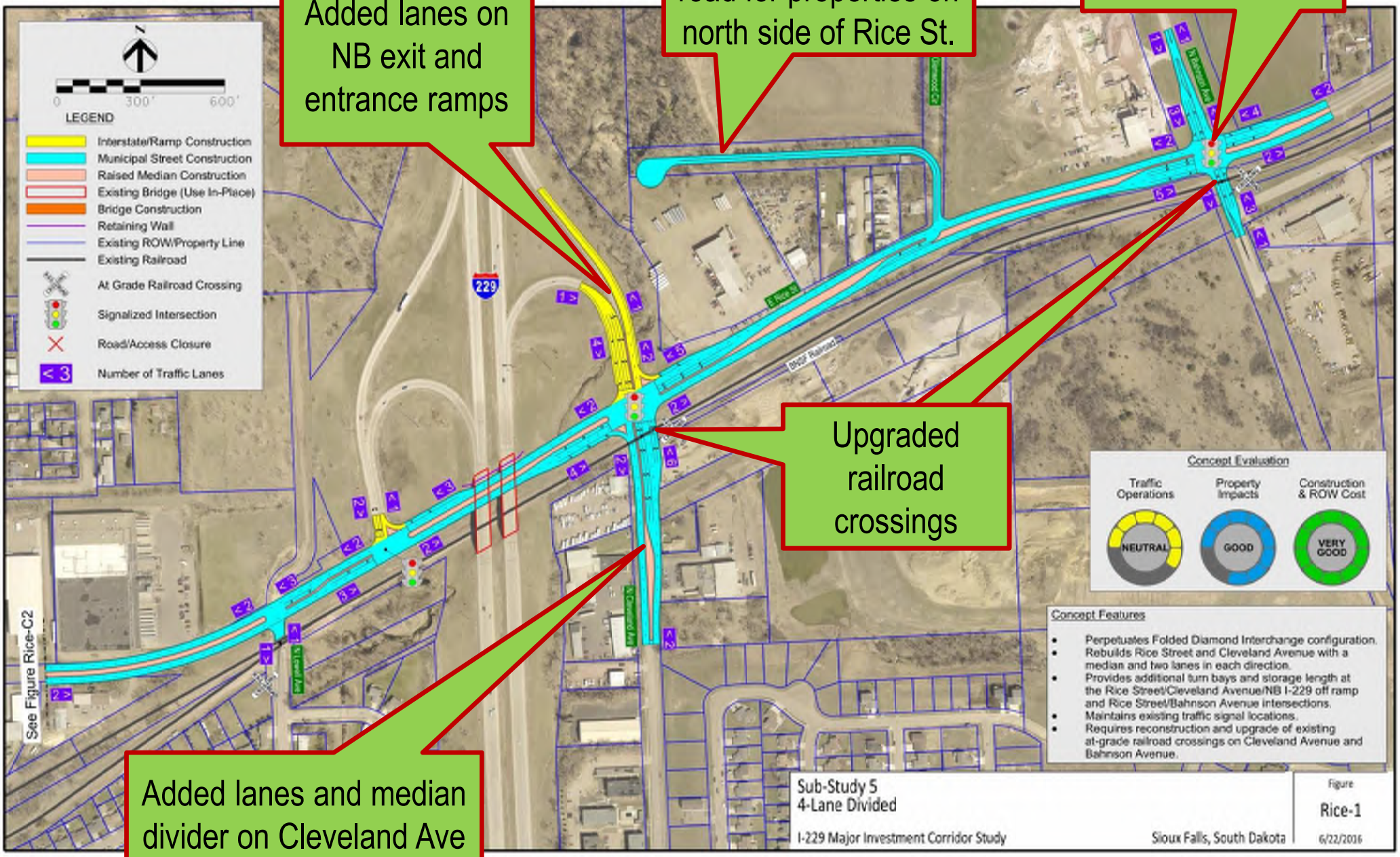
- Reduce traffic congestion
- Provide and Interchange that will meet the future capacity requirements
- Improve pedestrian mobility
- Improve safety for corridor users

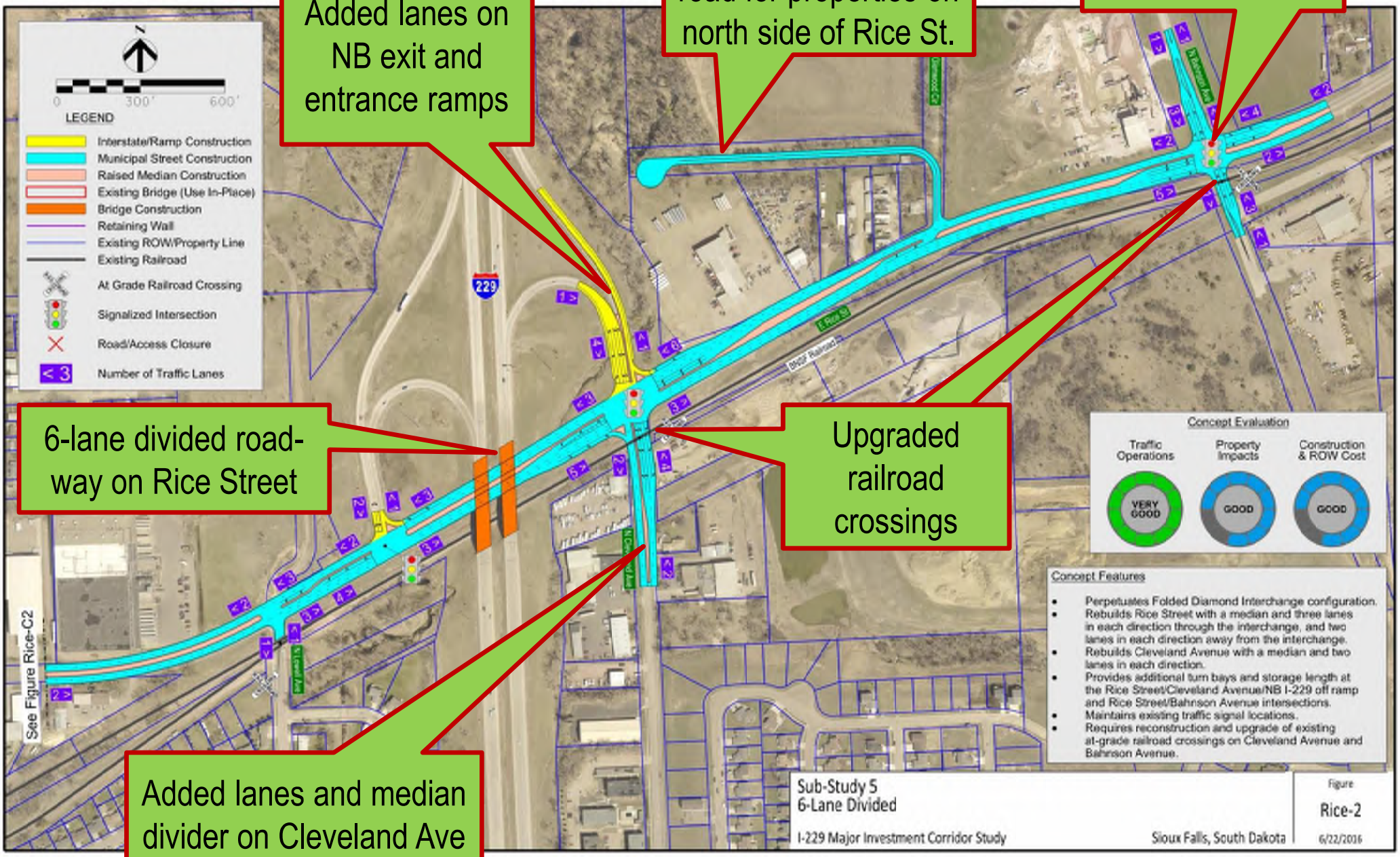


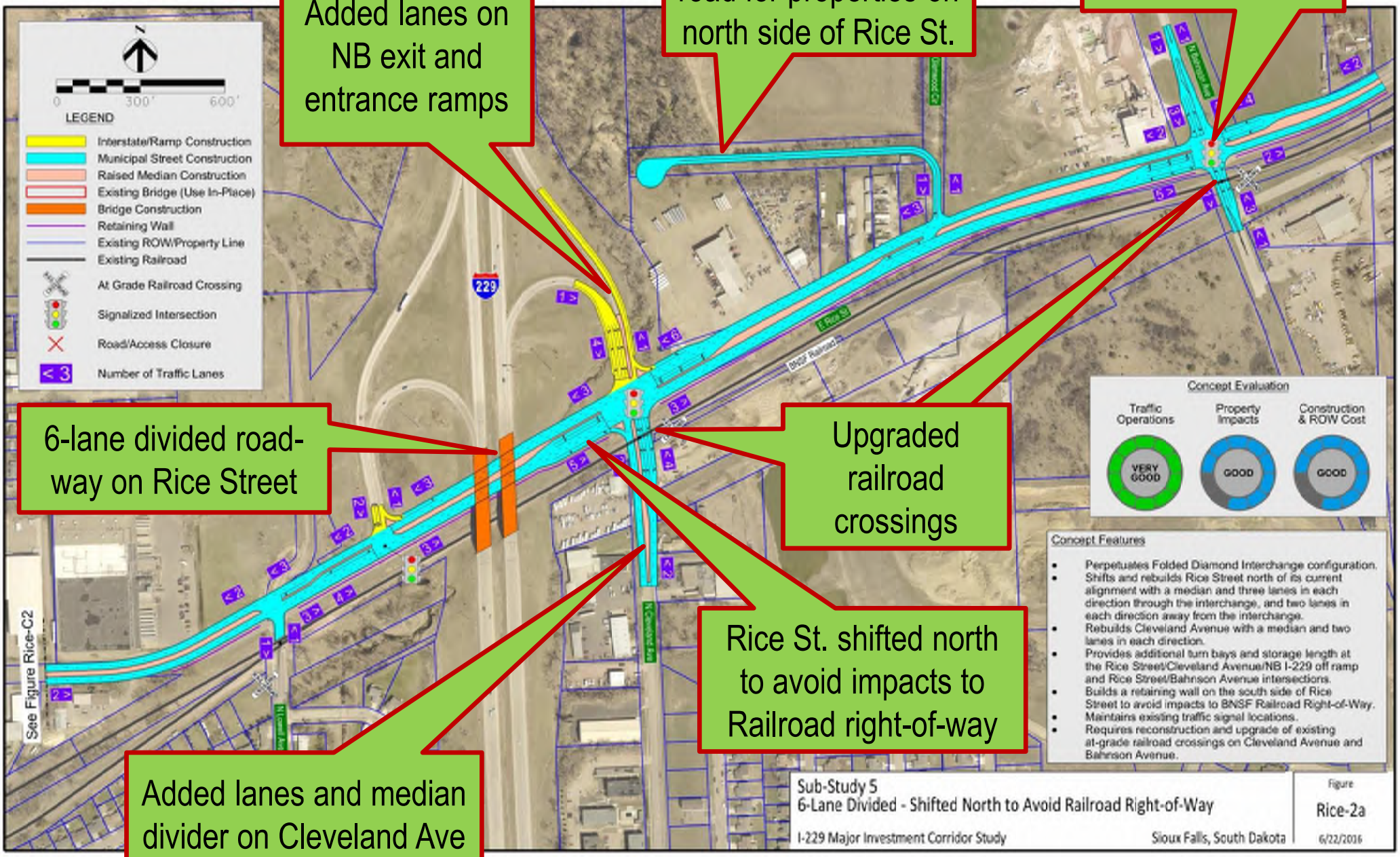


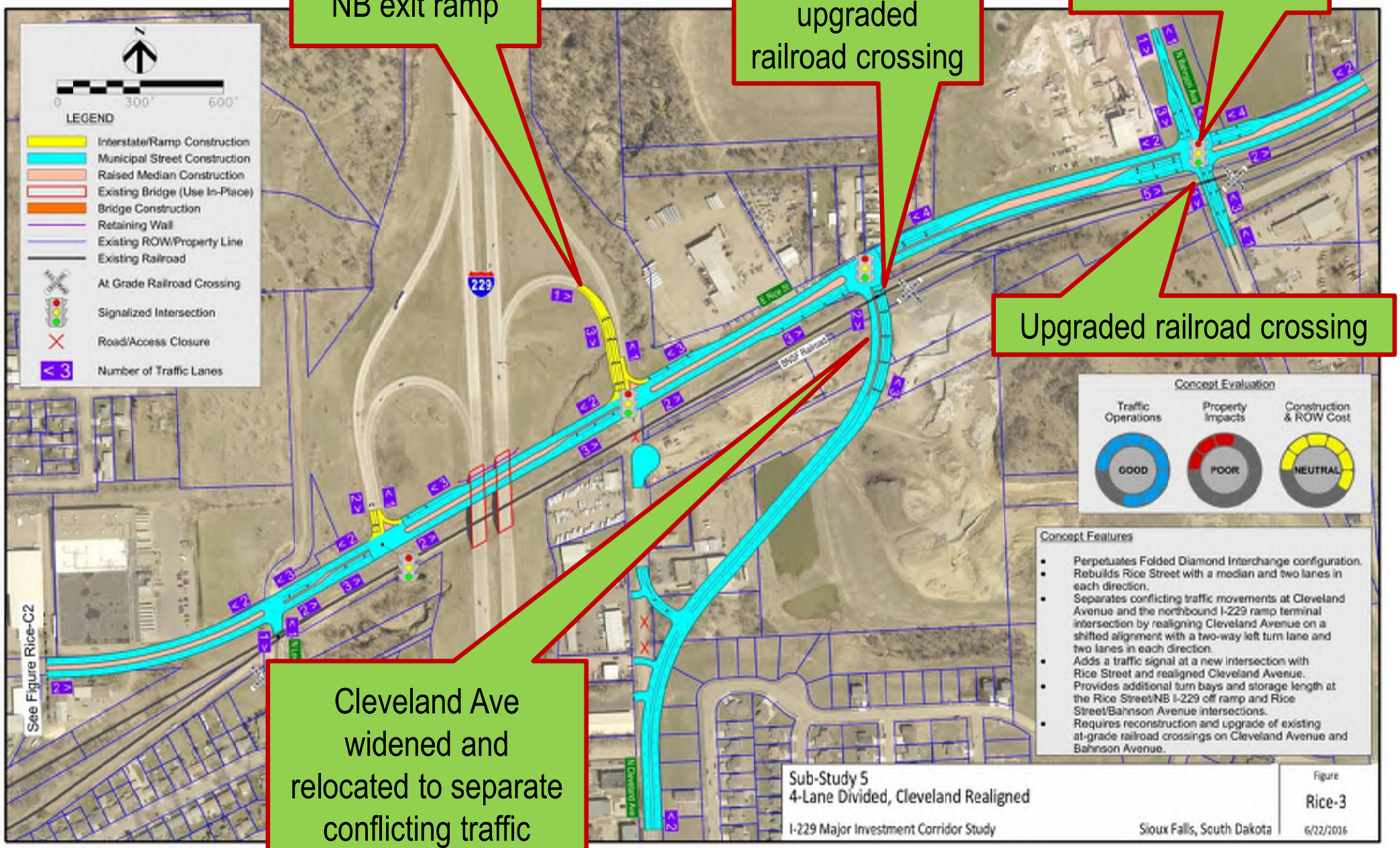


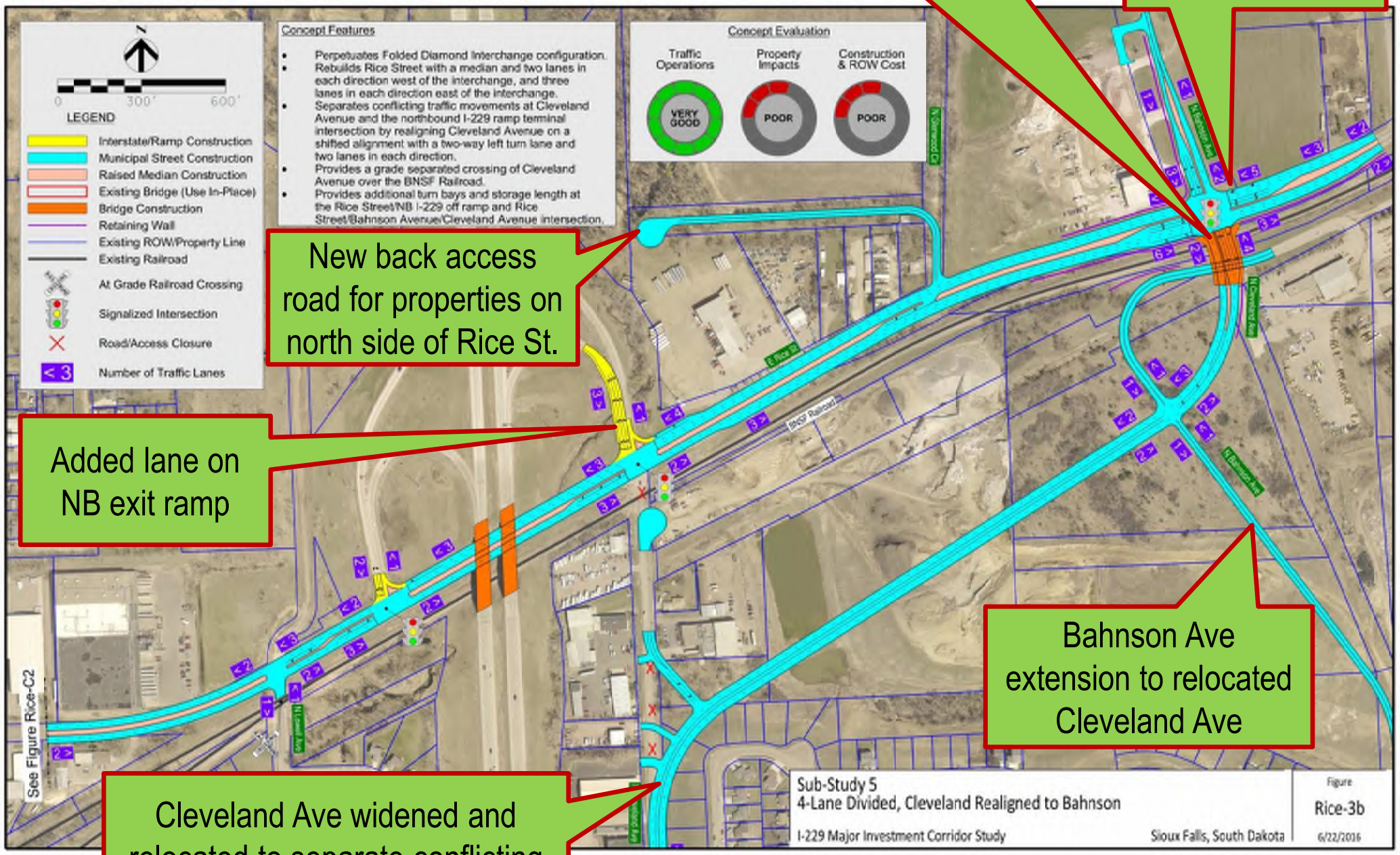

Width under structures does not allow for excessive widening
Rice Street
Corridor has many access points that impacts safety
229
Pedestrian accessibility does not exist currently
Existing Rail Crossing
Cleveland Avenue
River is additional constraint just north of picture
229
Interchange intersection with Cleveland Avenue makes expansion difficult to meet future capacity and geometric needs

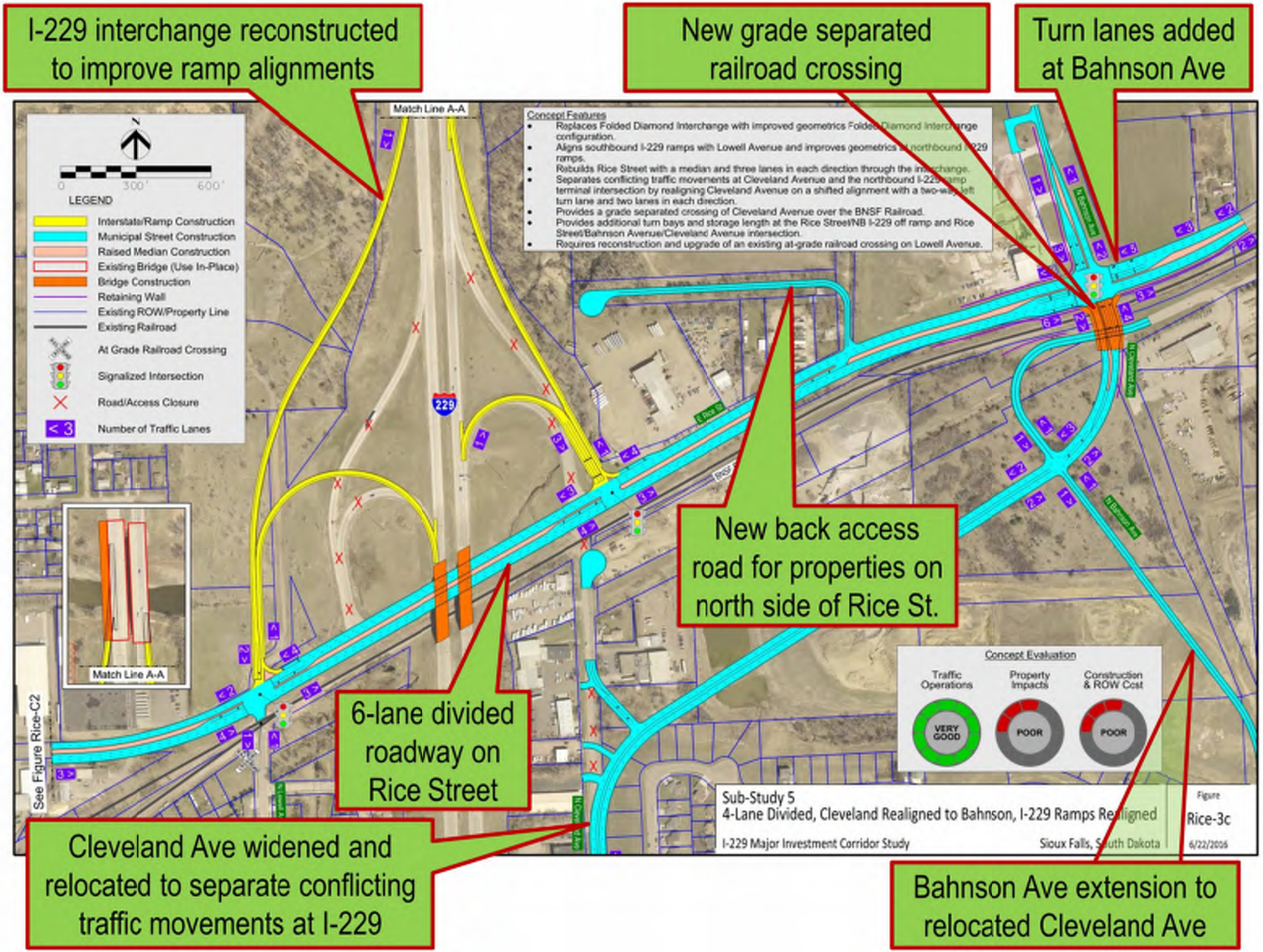

Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
Upgraded railroad crossings
Added lanes and median divider on Cleveland Ave
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
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
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.
See Figure Rice-C2
Sub-Study 5
4-Lane Divided
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-1
6/22/2016

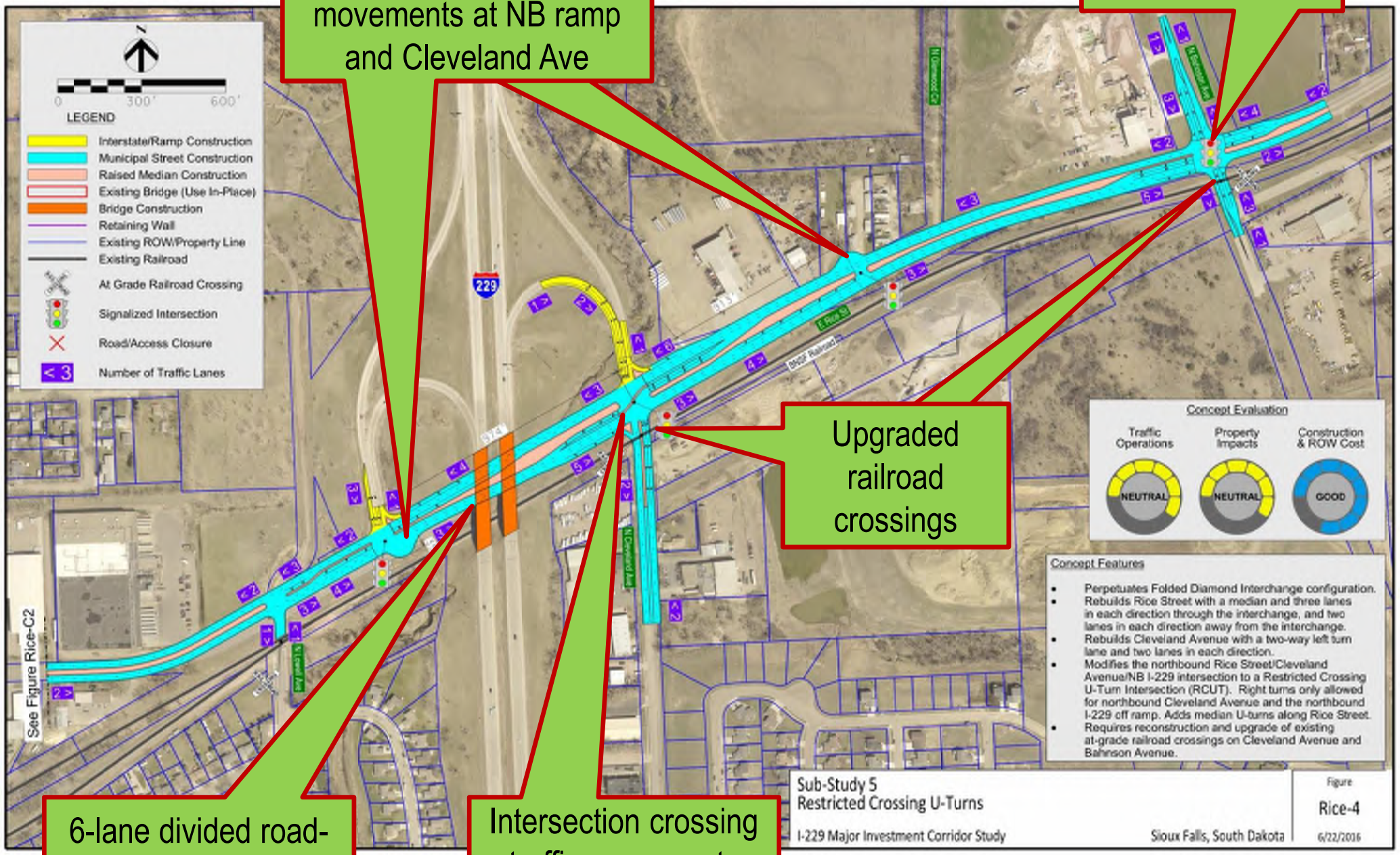

Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
6-lane divided road-way on Rice Street
Upgraded railroad crossings
Added lanes and median divider on Cleveland Ave
LEGEND
Interstate/Ramp Construction
Municipal Street 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
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.
See Figure Rice-C2
Sub-Study 5
6-Lane Divided
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-2
6/22/2016

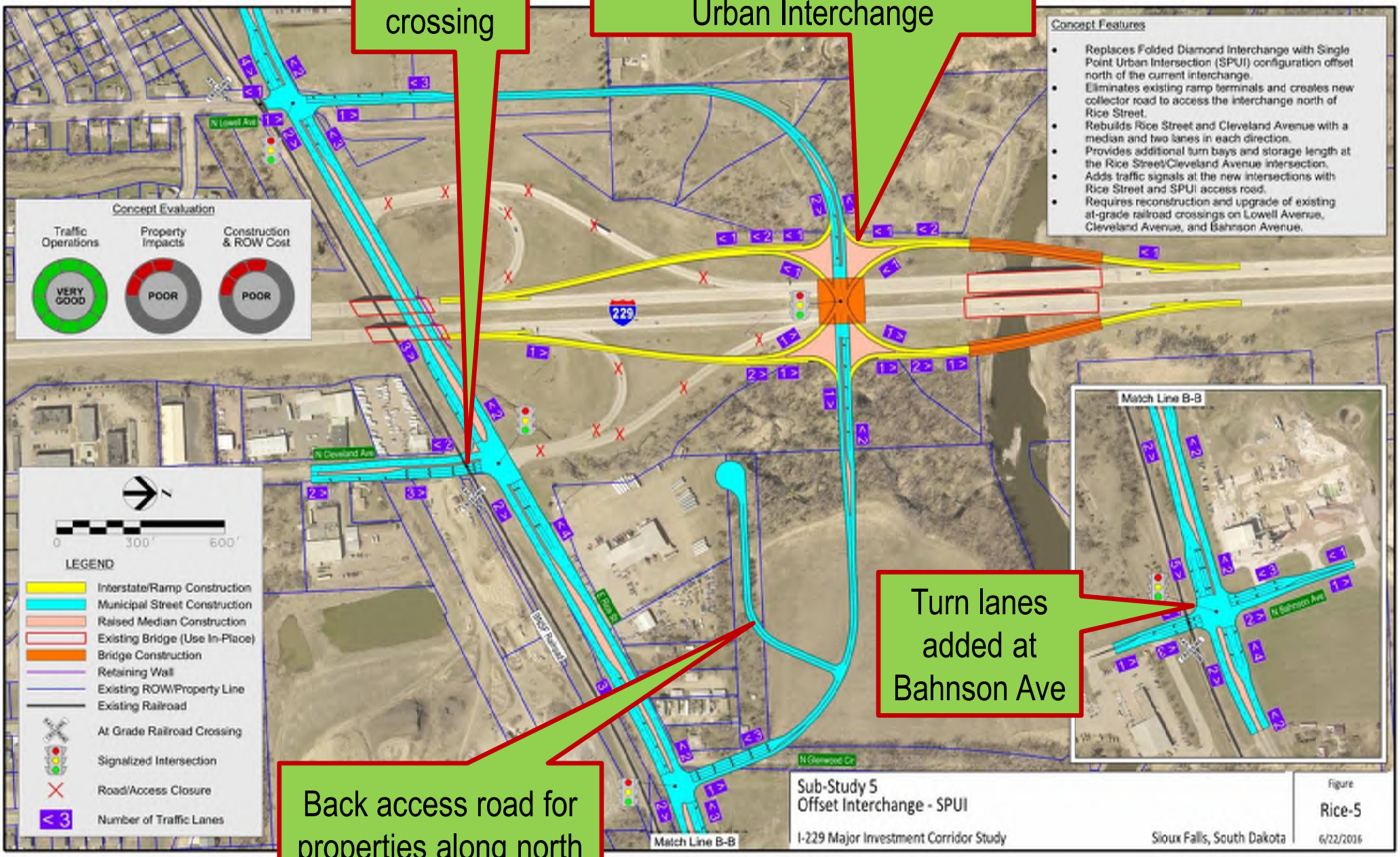

Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
6-lane divided road-way on Rice Street
Upgraded railroad crossings
Rice St. shifted north to avoid impacts to Railroad right-of-way
Added lanes and median divider on Cleveland Ave
LEGEND
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
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.
See Figure Rice-C2
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

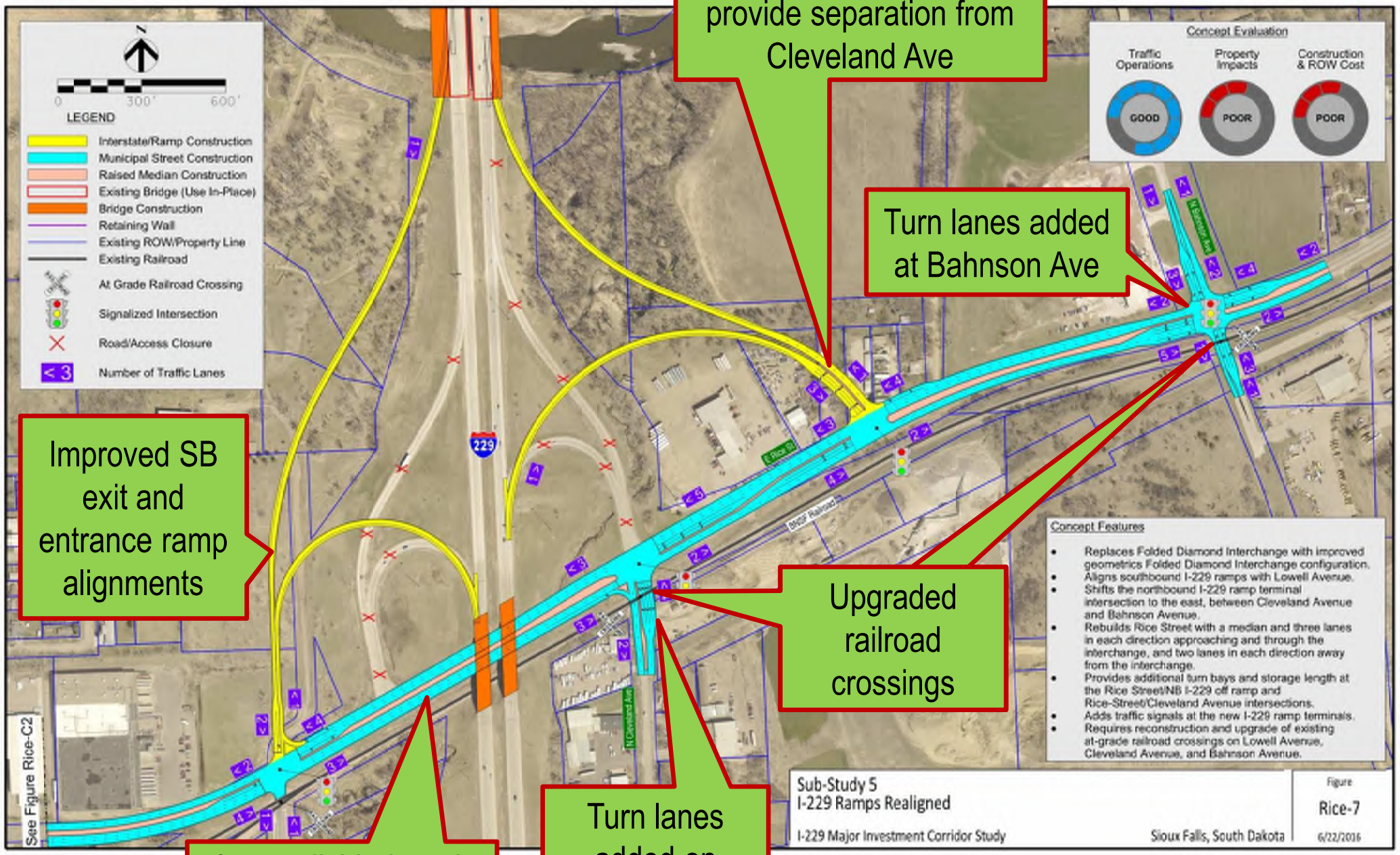

Added lane on NB exit ramp
Relocated and upgraded railroad crossing
Turn lanes added at Bahnson Ave
Upgraded railroad crossing
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
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
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.
See Figure Rice-C2
Sub-Study 5
4-Lane Divided, Cleveland Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3
6/22/2016

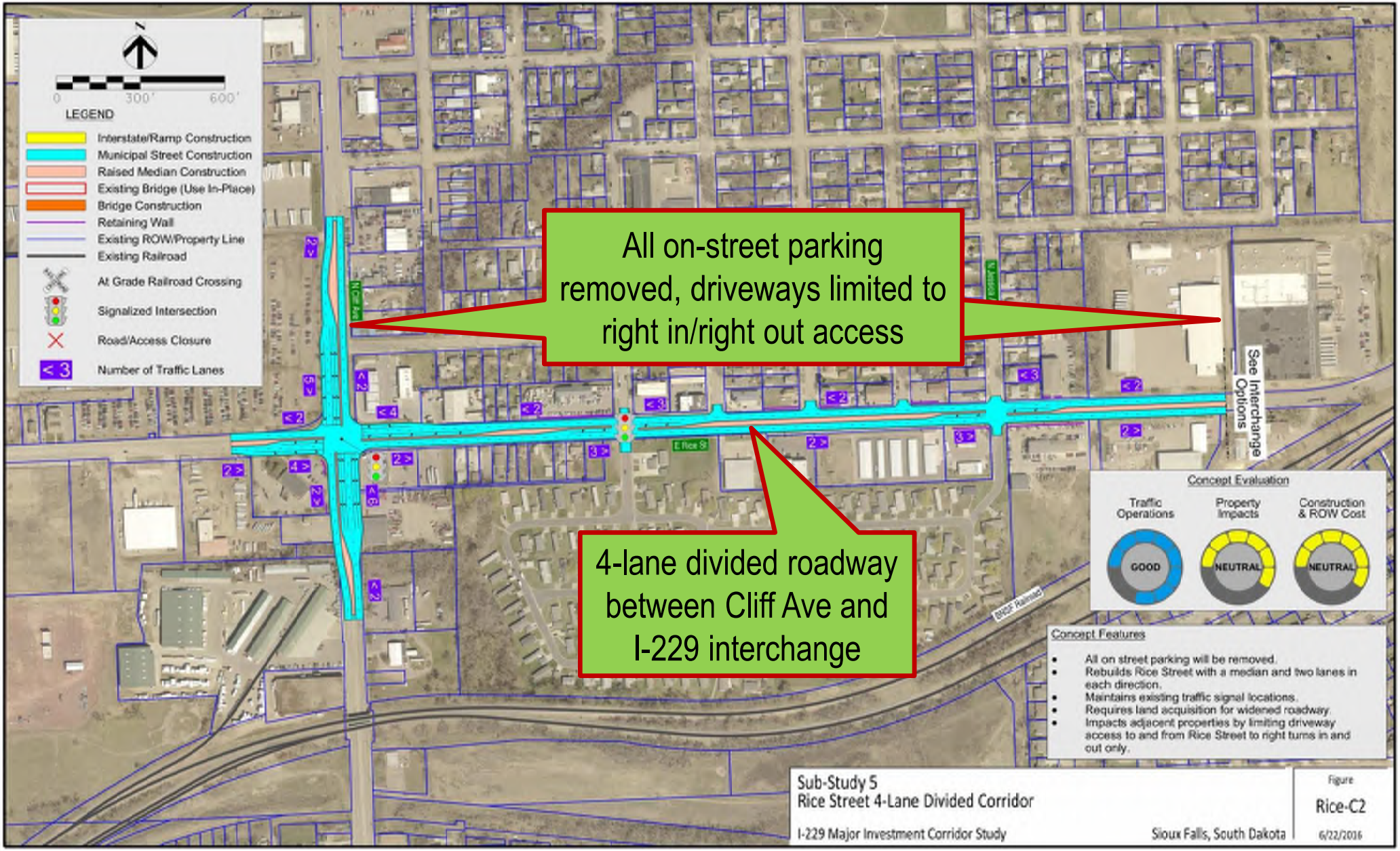

New grade separated railroad crossing
Turn lanes added at Bahnson Ave
New back access road for properties on north side of Rice St.
Added lane on NB exit ramp
Bahnson Ave extension to relocated Cleveland Ave
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
LEGEND
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
New back access road for properties on north side of Rice St.
6-lane divided roadway on Rice Street
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
Bahnson Ave extension to relocated Cleveland 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.
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
< 3 Number of Traffic Lanes
229
E Rice St
BNSF
N Cleveland Ave
N Bahnson Ave
N Lowell Ave
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 Ramps Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3c
6/22/2016


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
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
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.
See Figure Rice-C2
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
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
Turn lanes added at Bahnson Ave
Back access road for properties along north side of Rice St.
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
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
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
See Figure Rice-C2


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
See Interchange Options
E Rice St
BNSF Railway
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!!!!!

© 2014 HDR, all rights reserved.

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.:** 207090

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	773-4759	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		
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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 Kjenstad	6700 S. Old Village Pl, SF, SD	977-7740	jason.kjenstad@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	331-5074	
5	Courtney & Jerry Telke	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	Judy Peterson	1109 S Laurie		
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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

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

HDR

© 2014 HDR, all rights reserved.

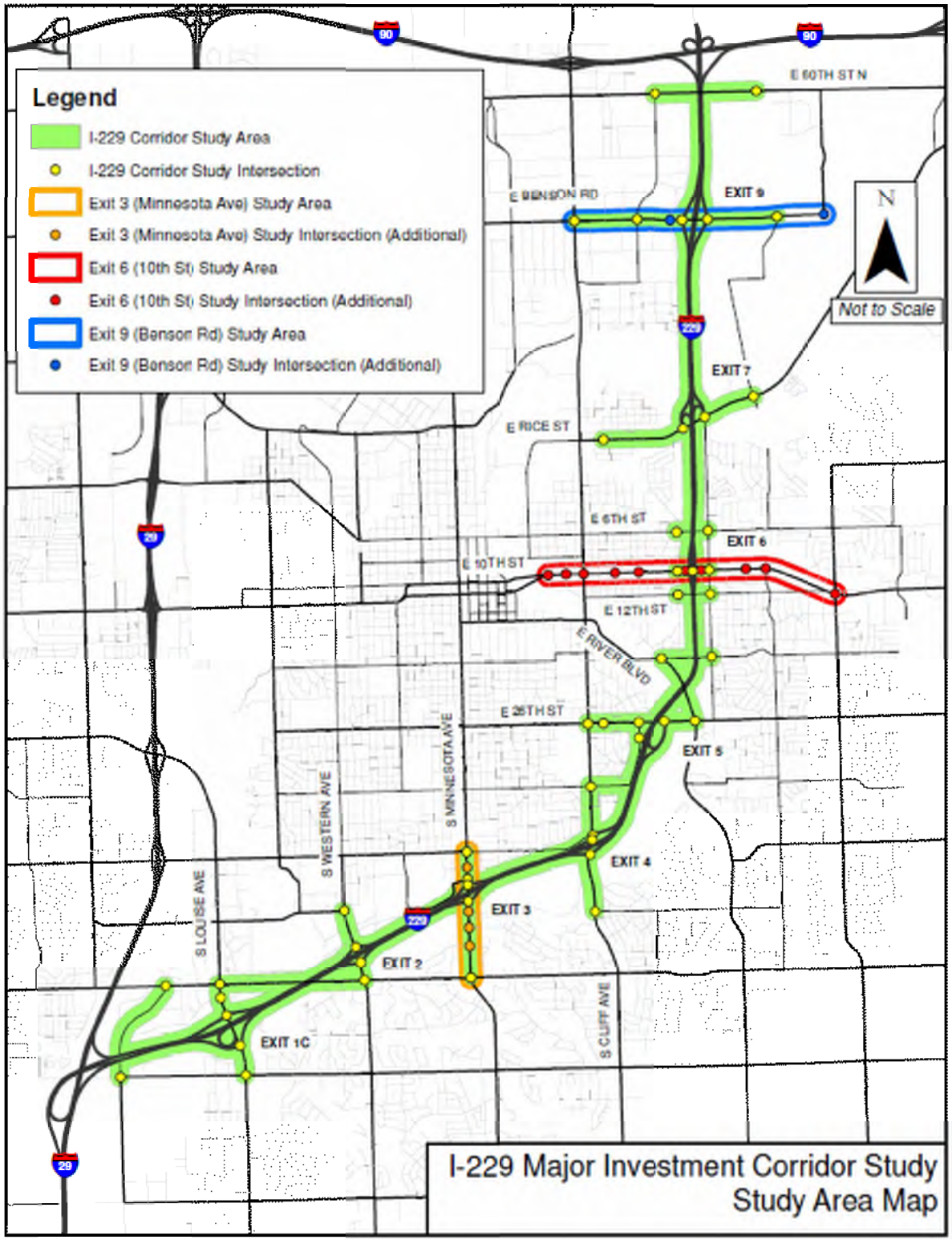
Study Area Map

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

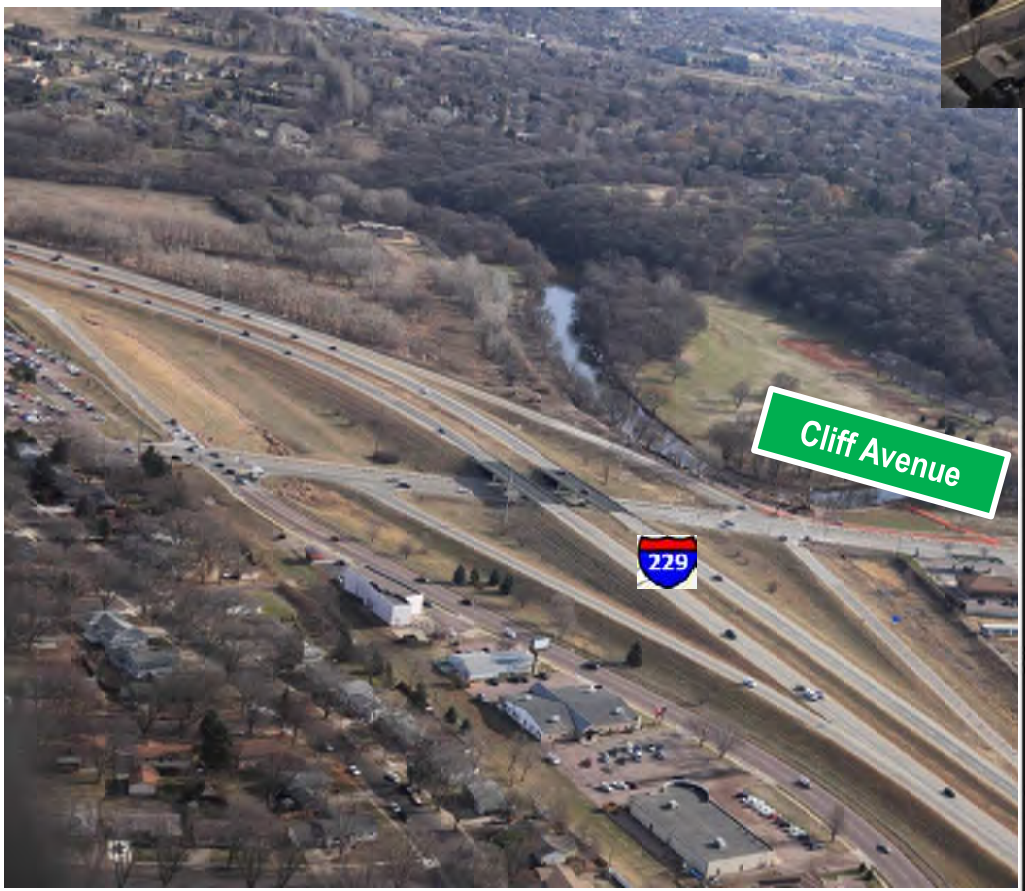
Sioux Falls Metropolitan Planning Organization (MPO)

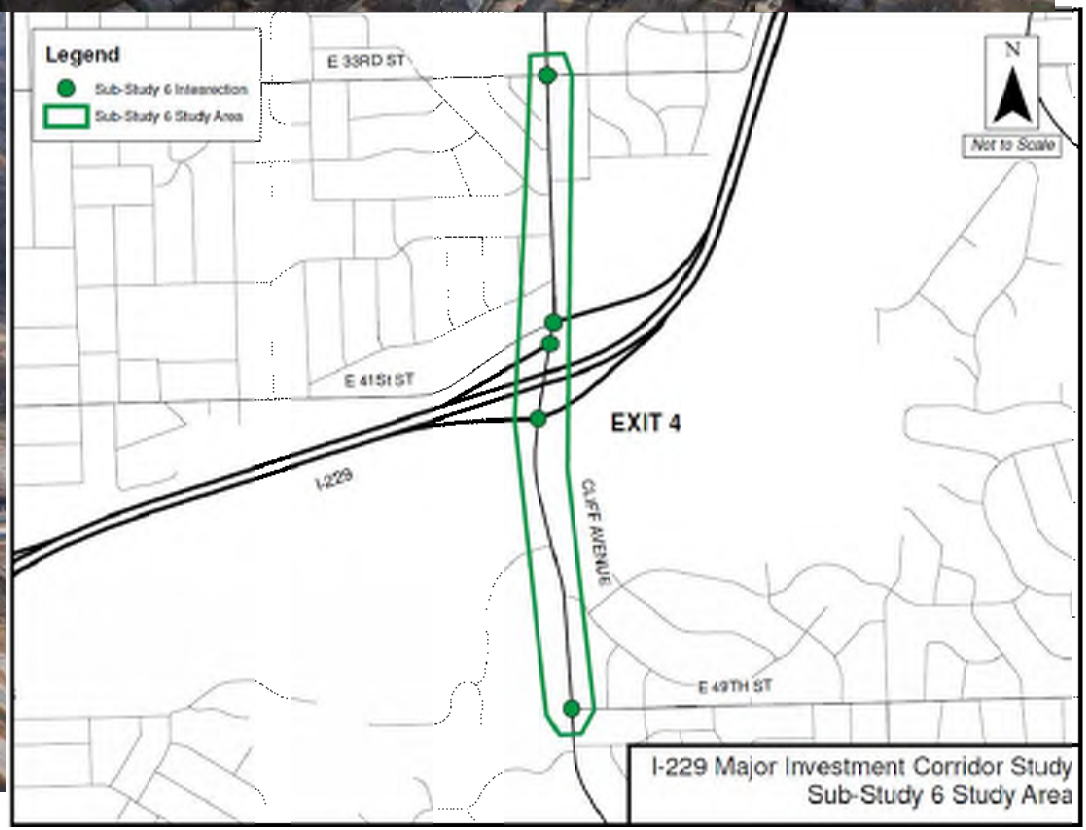
Federal Highway Administration (FHWA)

Exit 4 (Cliff Avenue) Sub - Study Goals

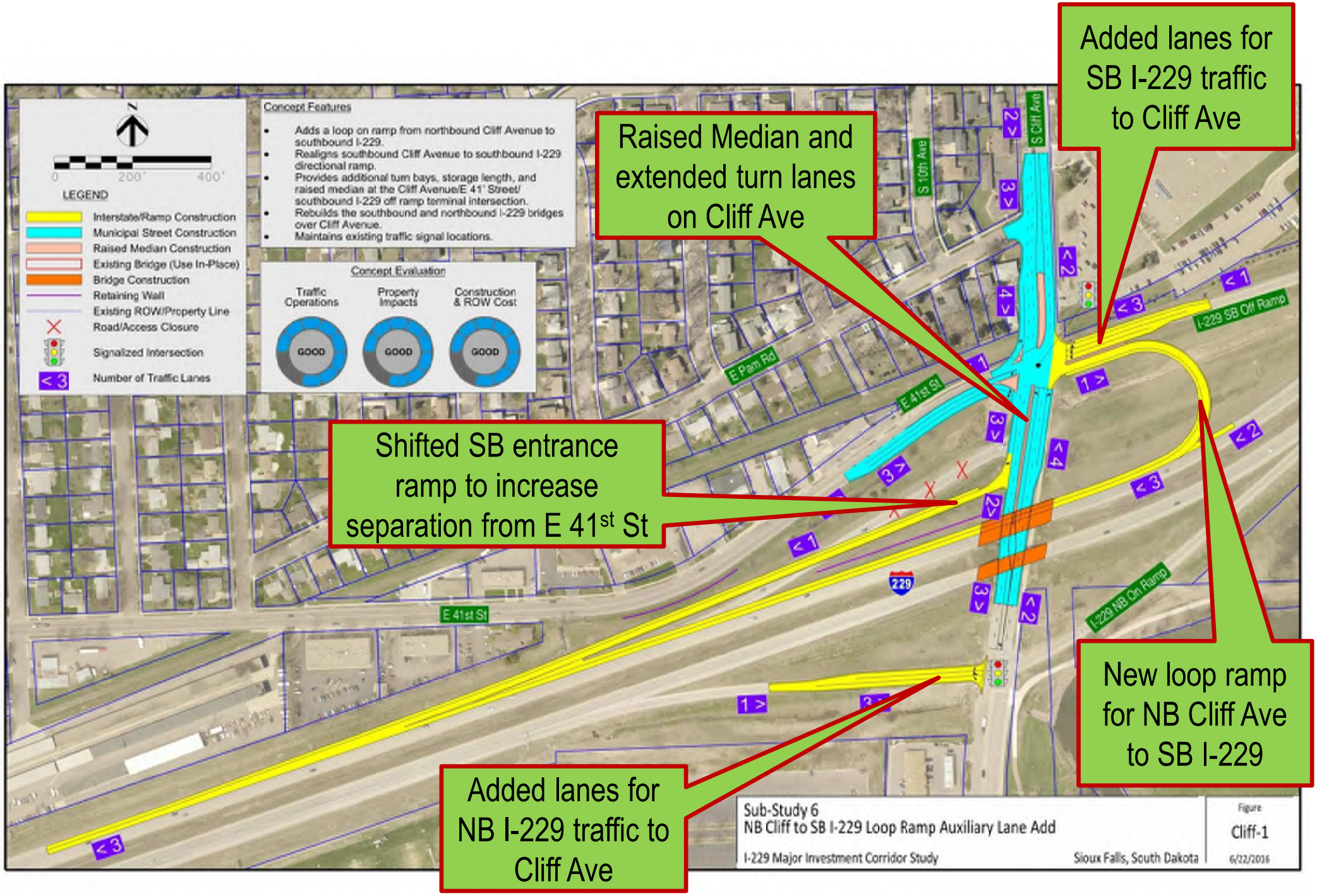
- Reduce traffic congestion
- Develop new geometrics to improve capacity at 41st Street and Interchange
- Improve pedestrian mobility
- Improve safety for corridor users

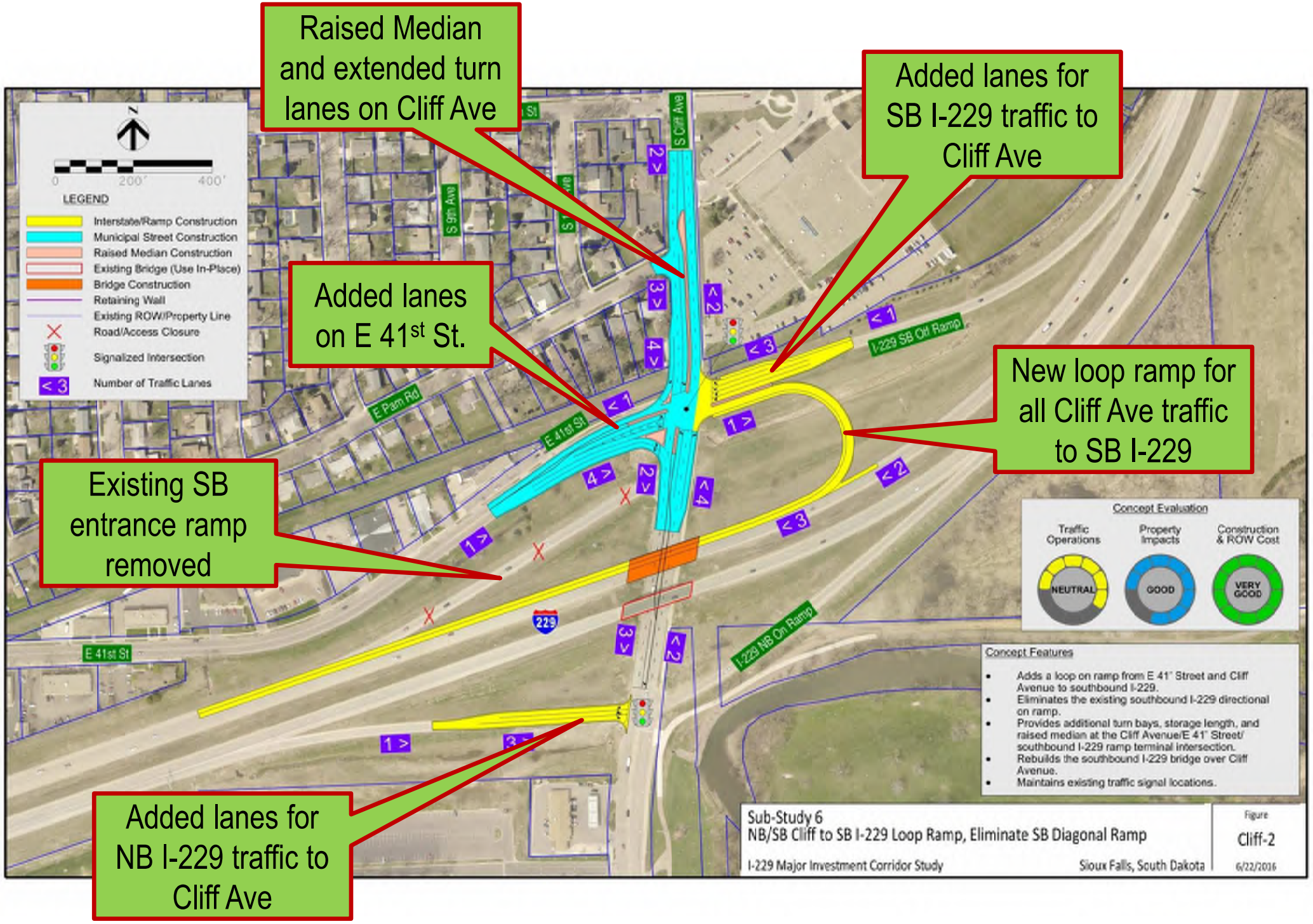


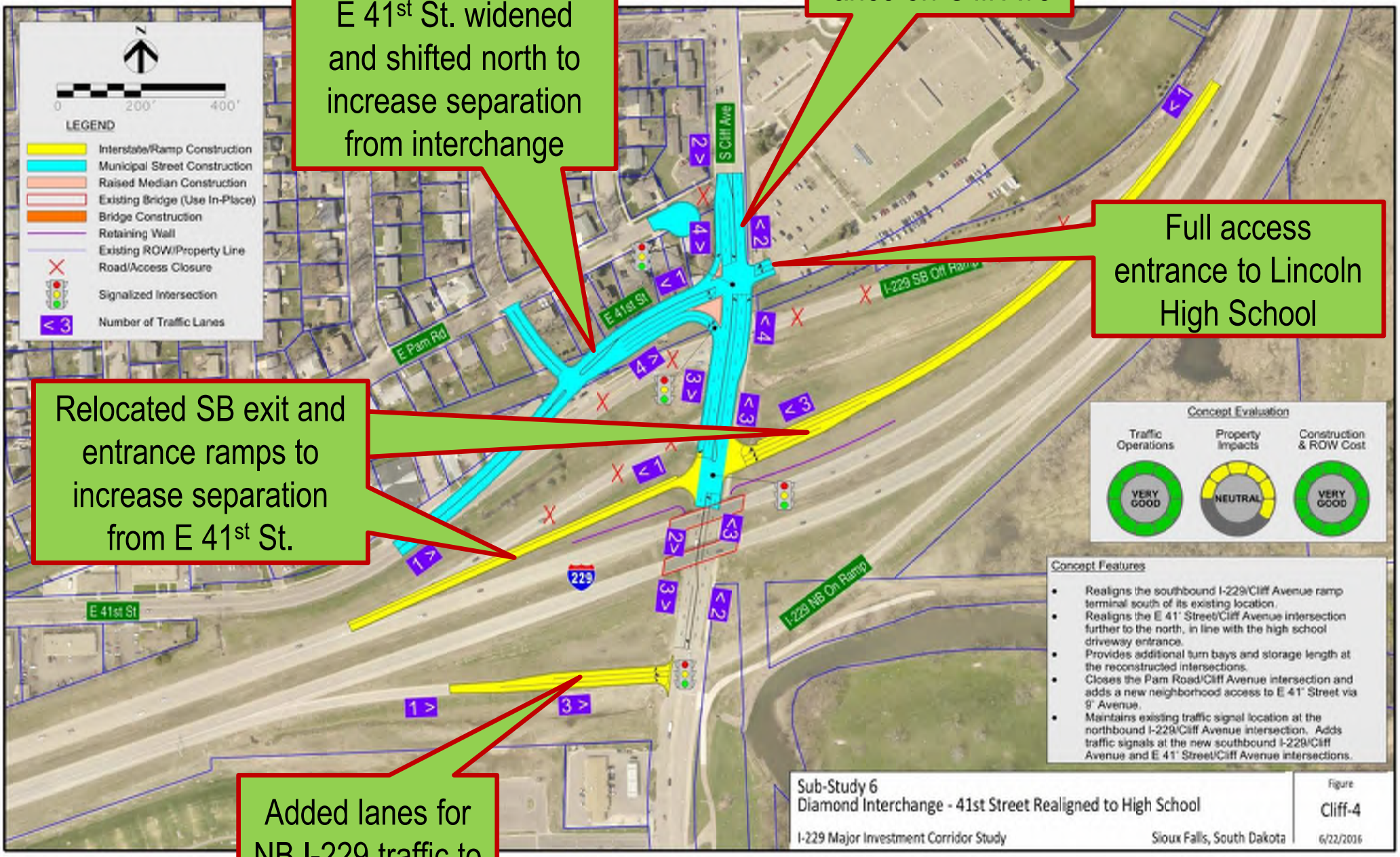


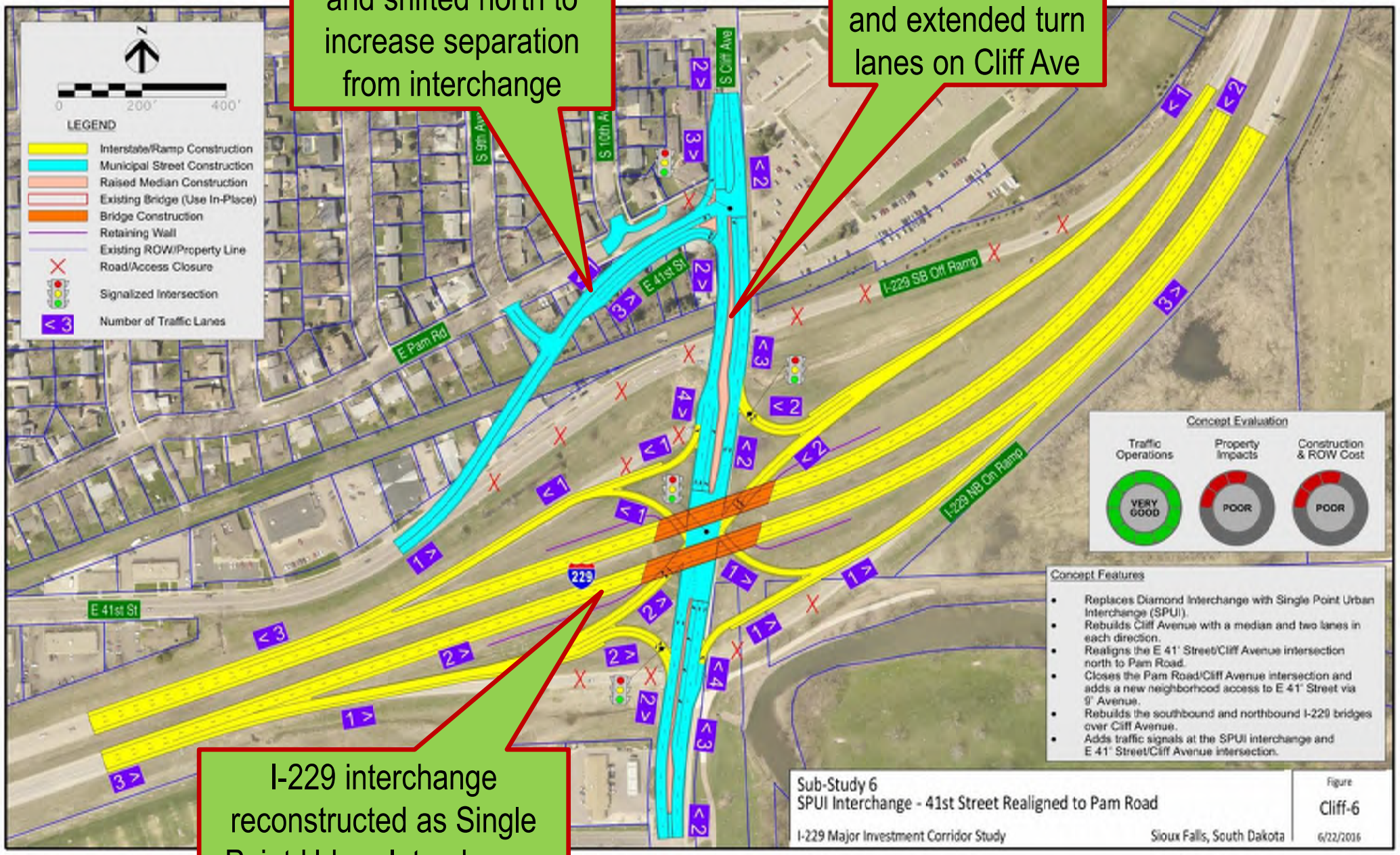


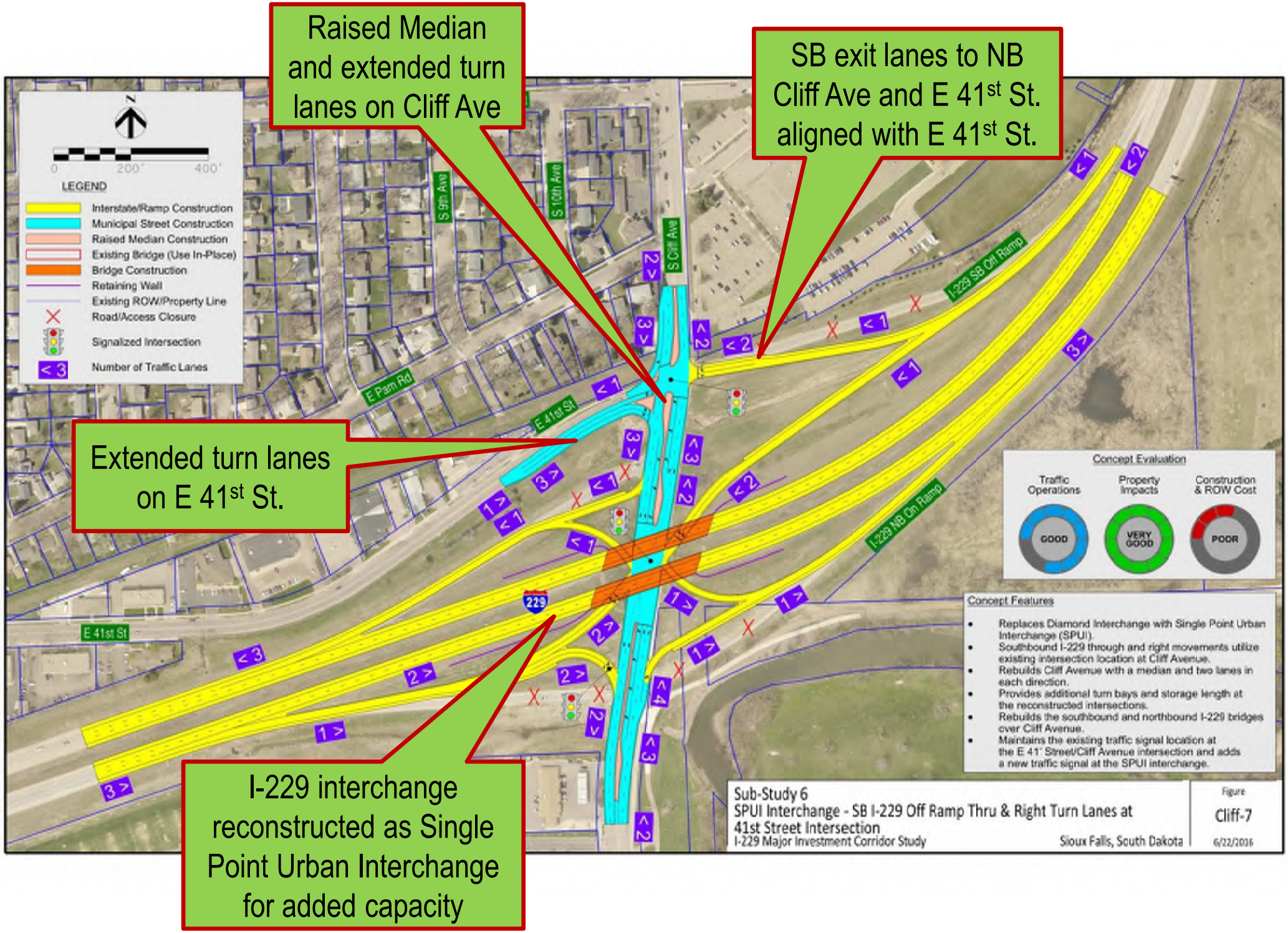

Access to Park close to interchange makes it difficult to exit during peak hour periods
Turn Lane short and few gaps exist to complete left turn movement
Cliff Avenue
229
Cliff Avenue
High Right Turn Volume in the PM Peak Hour
Congestion due to close proximity of 41st Street to I229 SB ON Ramp

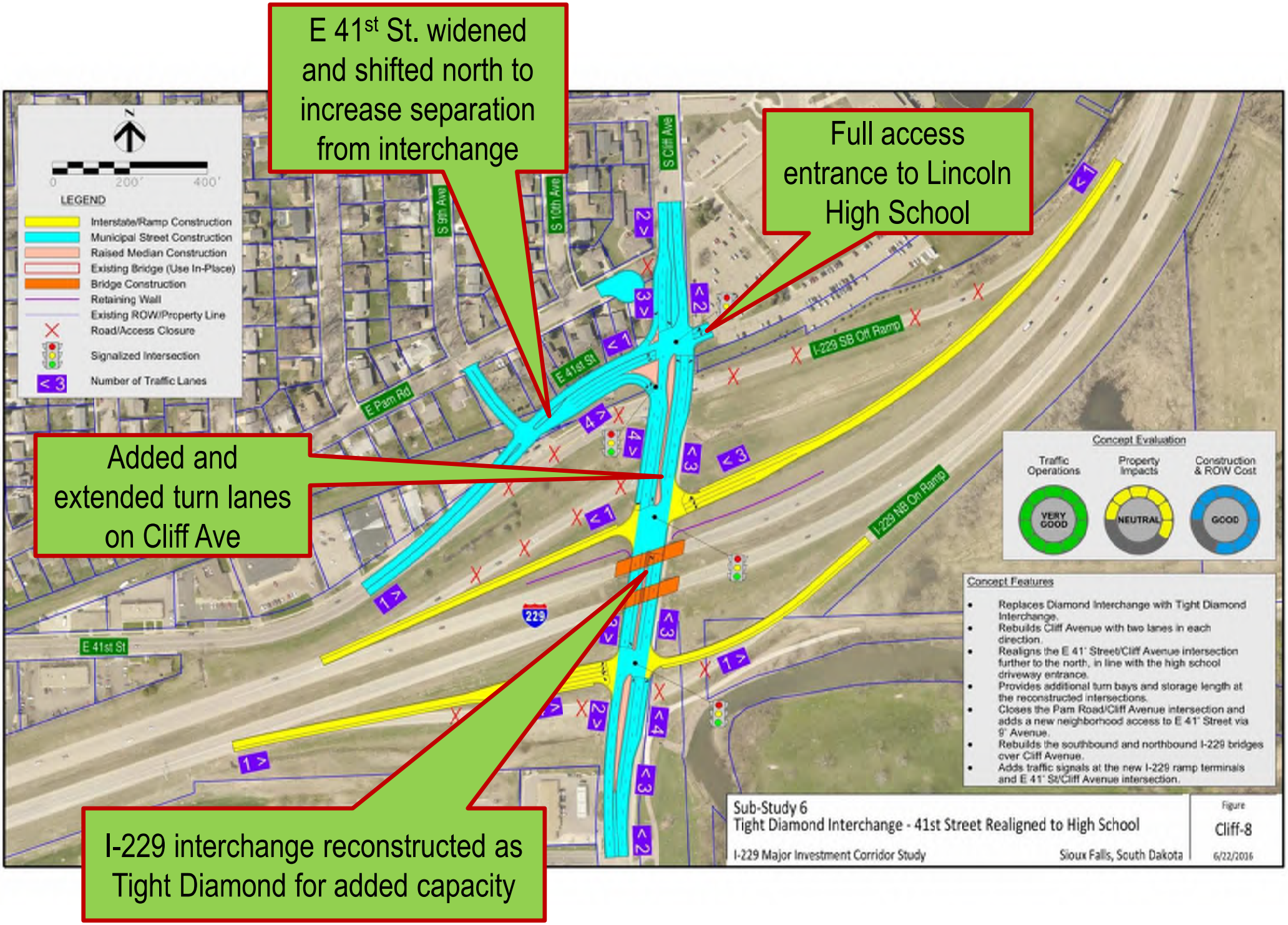

Added lanes for SB I-229 traffic to Cliff Ave
Raised Median and extended turn lanes on Cliff Ave
Shifted SB entrance ramp to increase separation from E 41st St
New loop ramp for NB Cliff Ave to SB I-229
Added lanes for NB I-229 traffic to Cliff Ave
LEGEND
Interstate/Ramp Construction
Municipal Street 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
E Pam Rd
E 41st St
S 10th Ave
S Cliff Ave
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
S Cliff Ave
S 9th Ave
E Pam Rd
E 41st St
I-229 SB On 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
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
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
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
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 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 41' 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
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
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

© 2014 HDR, all rights reserved.

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 SHERMAN TR	605-254-4375	
2	Le Miller	905 E 34th St.	605-310-9643	
3	Mark Elliason	101 S Cleveland	605-338-6221	
4	Pete Longman	SDDOT Pierre	773-6488	
5	Joe Boyt	2533 E HARRIET LEA	206-454-2698	
6	Jo Wahle		605-351-0658	
7	Luke Henriksen	2200 S Shirley Ave 57106	605 321-5040	
8	Riley Hosman	Brandon, SD	951-5391	rhos1205@gmail.com
9	Bob Booth	1116 64th Ave	605 334 4220	
10	Gerald TEunissen	808 Jana Lane	605-366-1979	gerald@benderco.com
11	Judy Mickalowski		605-521-0345	
12	Carsen Bower	25225 476th Ave Dell Rapids SD	605-594-6431	
13	Joe Painter	3512 S Alpine SF		
14	Mark Meyer	1504 W. Mosby ST SF	605 275 2607	
15	Travis Kreba	2405 S Glendale Ln	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	Ahan 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 & So Le Chateau SF, SD 57105	201-9810	

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	1207 N Violet Pl	4961108	
3	Paul Nikolas	5314 W 60th St. N.	367-5680	Paul.Nikolas@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 E Madison ST Sioux Falls SD 57110	605 334 5692	gary@garybuss.com
7	Bruce Card	4815 E Haverhill Dr. S F SD 57110	605-261-1627	bcard@amenstest.com
8	Amber Gibson	500 N Weldon Ave Ste 100 SFSD 57104	605-367-5370	amber@secog.org
9	Bart Brost	4800 S Oak Trail Pl SF, SD 57108	605-310-8628	brosbart@showplacewood.com
10	Lanny Bleem	6300 E 2 Fty SF SD 57110	605 332-7391	
11	Kim Blackburn	2708 E 10	940-7908	Fryn Penmrsguy@Hot Mail.com
12	Mark Skadsen	25952 476th Ave	351-9512	
13	Jason Kjenstad	6200 S. Old Village Pl Suite 100	977-7740	jason.kjenstad@hdrinc.com
14				
15				
16				
17				
18				
19				
20				

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) 3518P, 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 Haines	116 E. Dakota Ave Pierre, SD	776-1010	mark.haines@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	Charles Knefp	3066 W. Benning Sioux Falls	359-9451	charles.knefp@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	605-271-1607	jshnedavid@hotmail.com
10	Debi Schafer	23005 Jefferson SF SD	605 310 2698	—
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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*

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 H.S. 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 timed place for bus + paratransit drivers + commuters.

(optional)
Name: Wendy Butler-Boyesen Address: 1104 E. Pam Rd.

Phone: 605-906-1203 Email: wbutlerboyesen@gmail.com

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

Website very useful → advertise on marquee sign please!

Thanks for making considerations for cyclists!

(optional)
Name: Riley Hasman Address: 1205 Parkview blvd, Brandon

Phone: 951-5391 Email: rhos1205@gmail.com

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*

DONT INSTALL A DIVIDED MEDIAN ON BASON. PREVENTS LEFT TURNS FROM THE SOUTH

(optional)
Name: CHRIS RANS Address: 3412 N. POTSDAM

Phone: 338-9110 Email: CHRIS@SUNKOTACONSTRUCTION.COM

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*

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 STAPES / Dollar Tree

(optional)
Name: Dave McElroy Address: 3310 S Minn Ave

Phone: 605-338-9515 Email: mcelroy.dave@gmail.com

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*

DO NOT INSTALL A RAISED Median ON BENSON to ELIMINATE LEFT TURNS FROM the SOUTH

(optional)
Name: CHRIS RAWS
Address: 3412 N. POTSDAM AVE.
Phone: 338-9110
Email: CHRIS@SUNKOTACONSTRUCTION AVE.

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*

Like Maple Ave 2D
" 10th 2 B/C
" Benson 1A — Suggest doing Southbound Ramp prior to working about NB Ramp
" Rice 3C — no need to move SB 229 Ramp
" Cliff 1

(optional)
Name: Lanny Boom
Address: 6300 E 26th St
Phone: 332-7391
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

DOT
ing 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:

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 tenet 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 bushnesses and customer access.

Name: Jeff Mindt

Phone: 360-6108

Address: 804 E. 38th St. SF, SD 57105

Email: jmindt68@gmail.com

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*

No Build -
Keep 43rd Street open to Minnesota Ave for N + S Bound traffic
No Median

(optional)
Name: Tim Hein

Address:

Phone: 361-8400

Email: theinmail@gmail.com

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*

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: 4heinmail@gmail.com

I-229 Major Investment Corridor Study

PL 0100 (87) 3616P, PCN 044K

www.i229study.com

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*

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: 605-334-5692

Email: gary@garybuss.com

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

HDR HRGreen

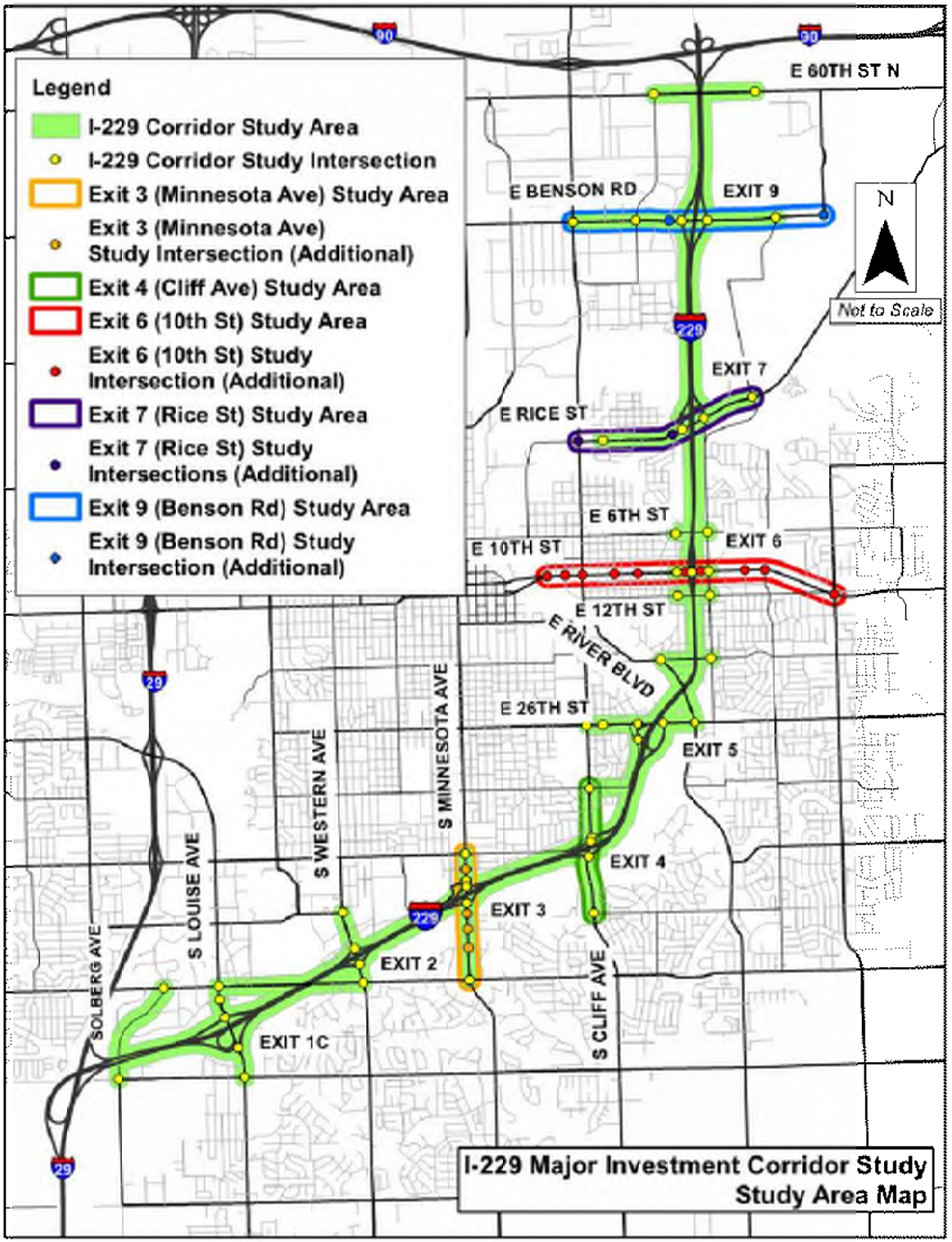
STUDY AREA MAP

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)

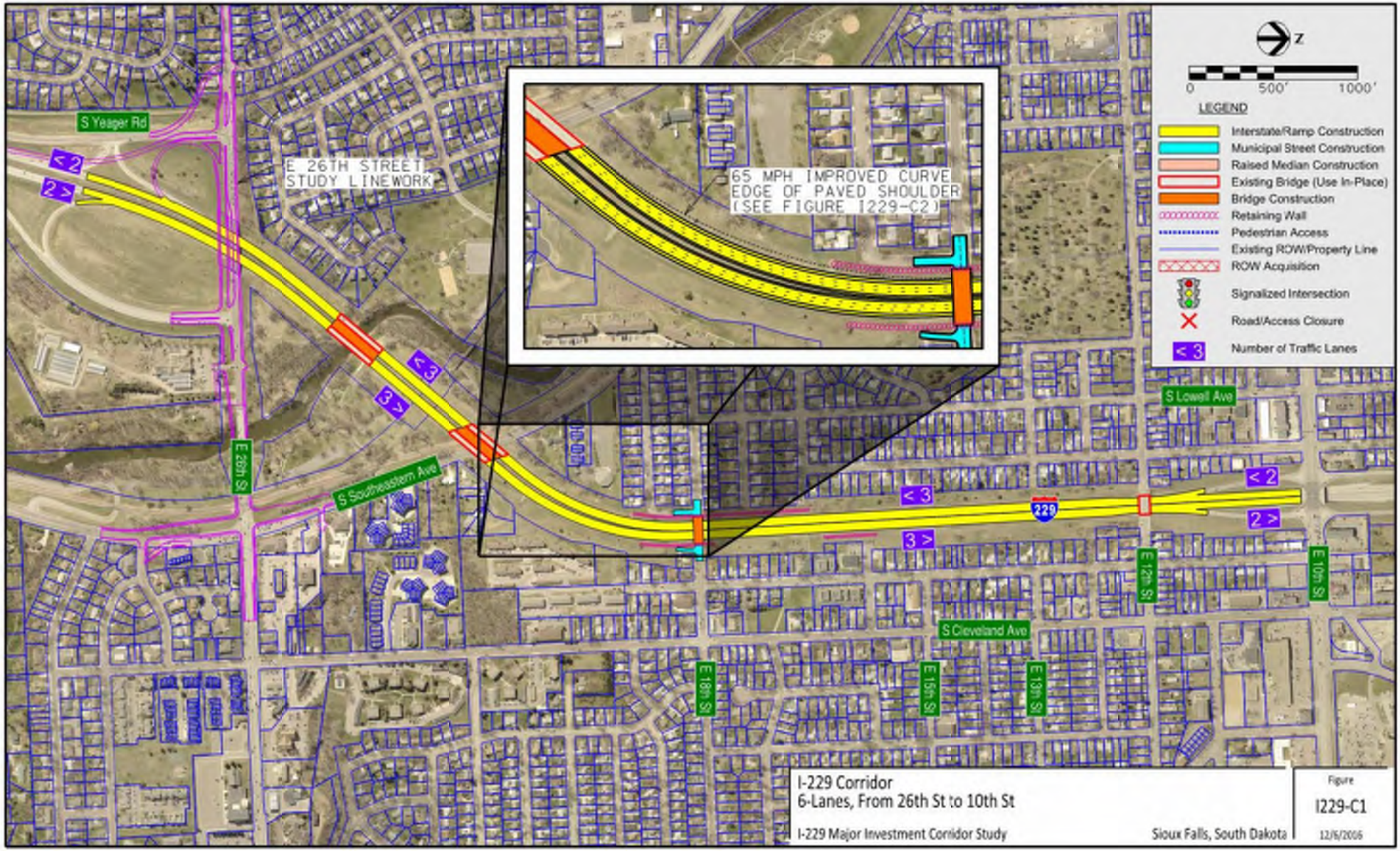
Federal Highway Administration (FHWA)

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

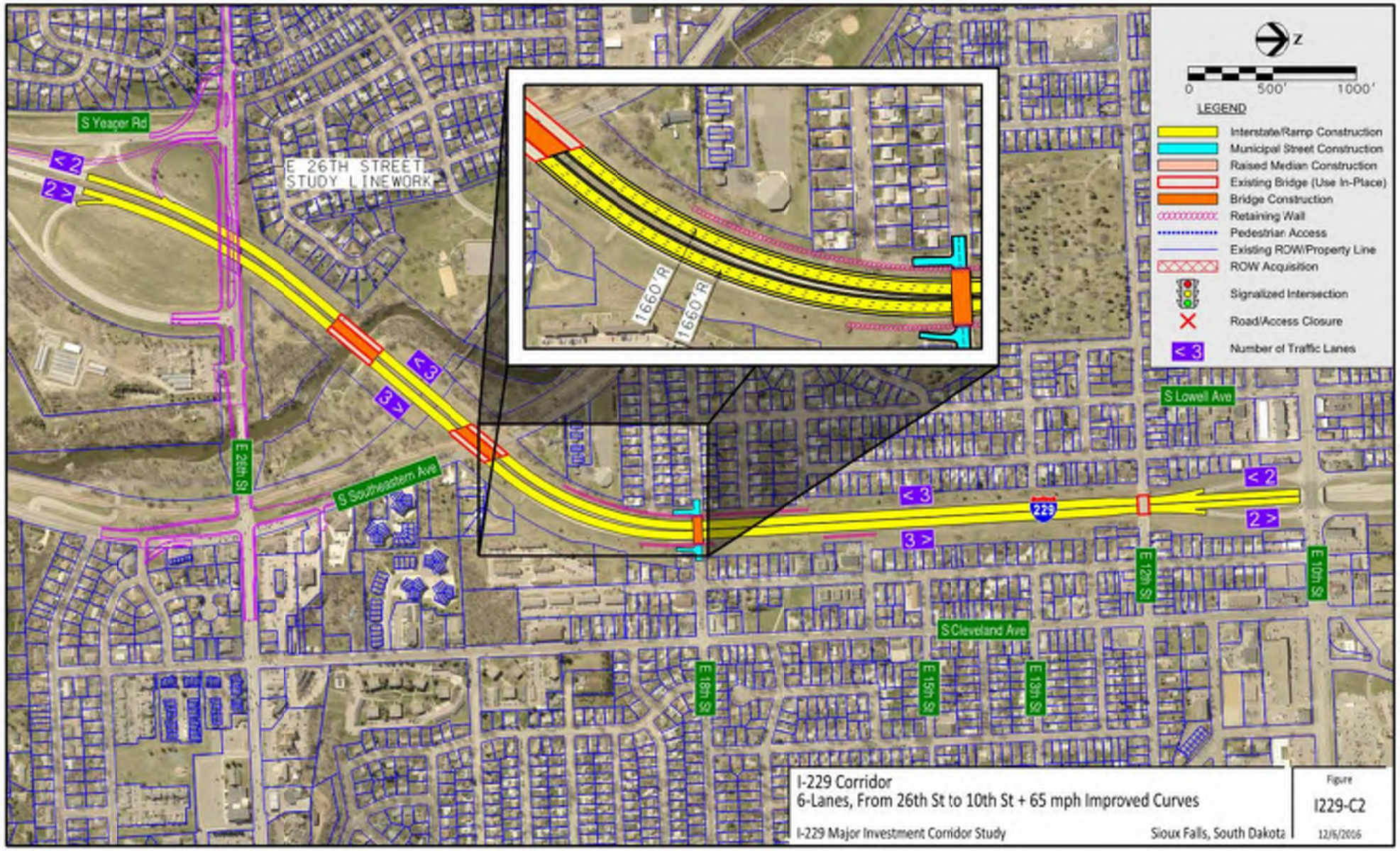
I-229 CORRIDOR IMPROVEMENTS

ADD 3RD LANE EACH DIRECTION
BETWEEN 26TH STREET AND 10TH STREET



I-229 CORRIDOR IMPROVEMENTS

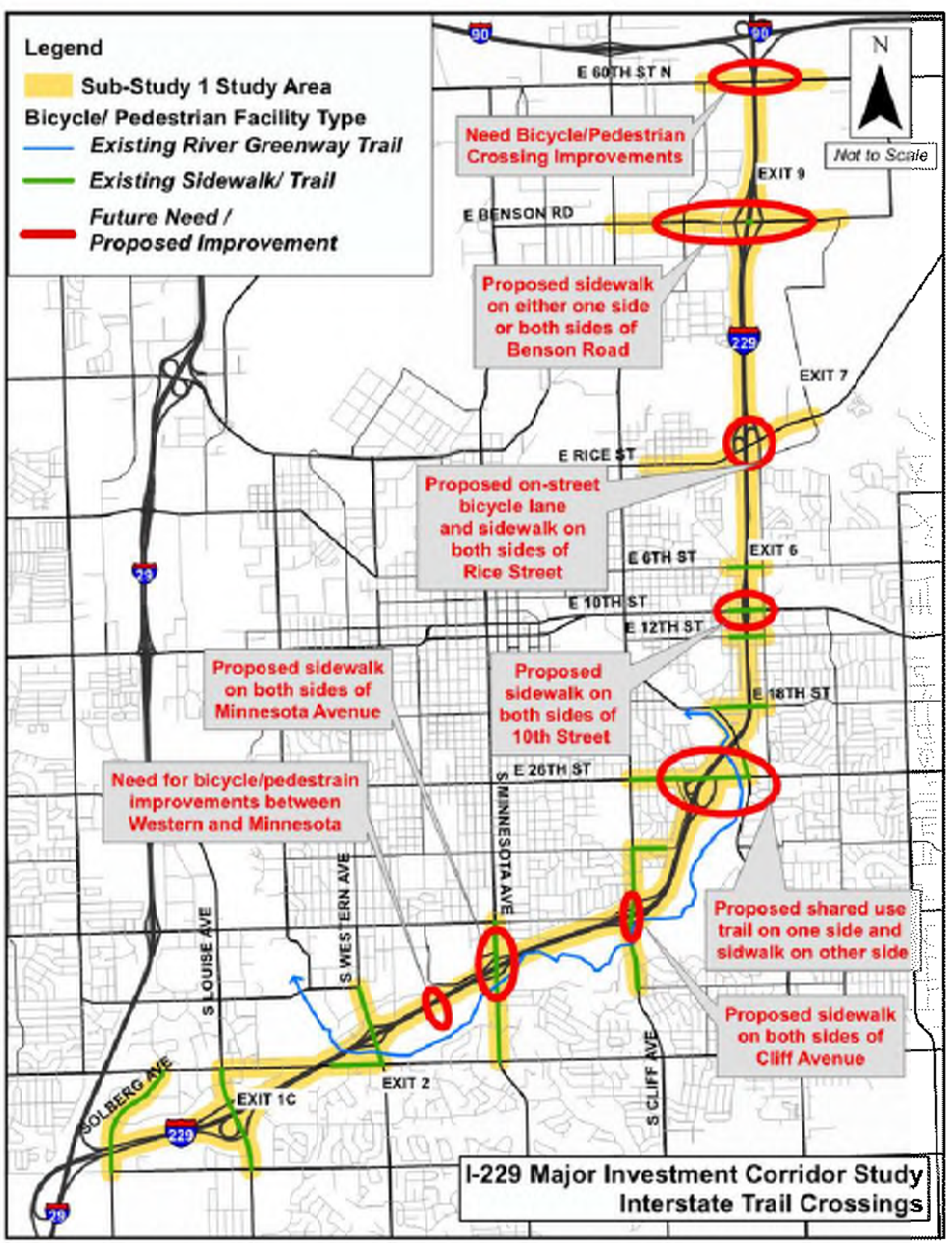
MODIFY CURVE RADIUS BETWEEN SOUTHEASTERN AVE & 18TH ST TO ALLOW 65 MPH DESIGN SPEED



I-229 CORRIDOR IMPROVEMENTS

PEDESTRIAN / BICYCLE CROSSING NEEDS & IMPROVEMENTS

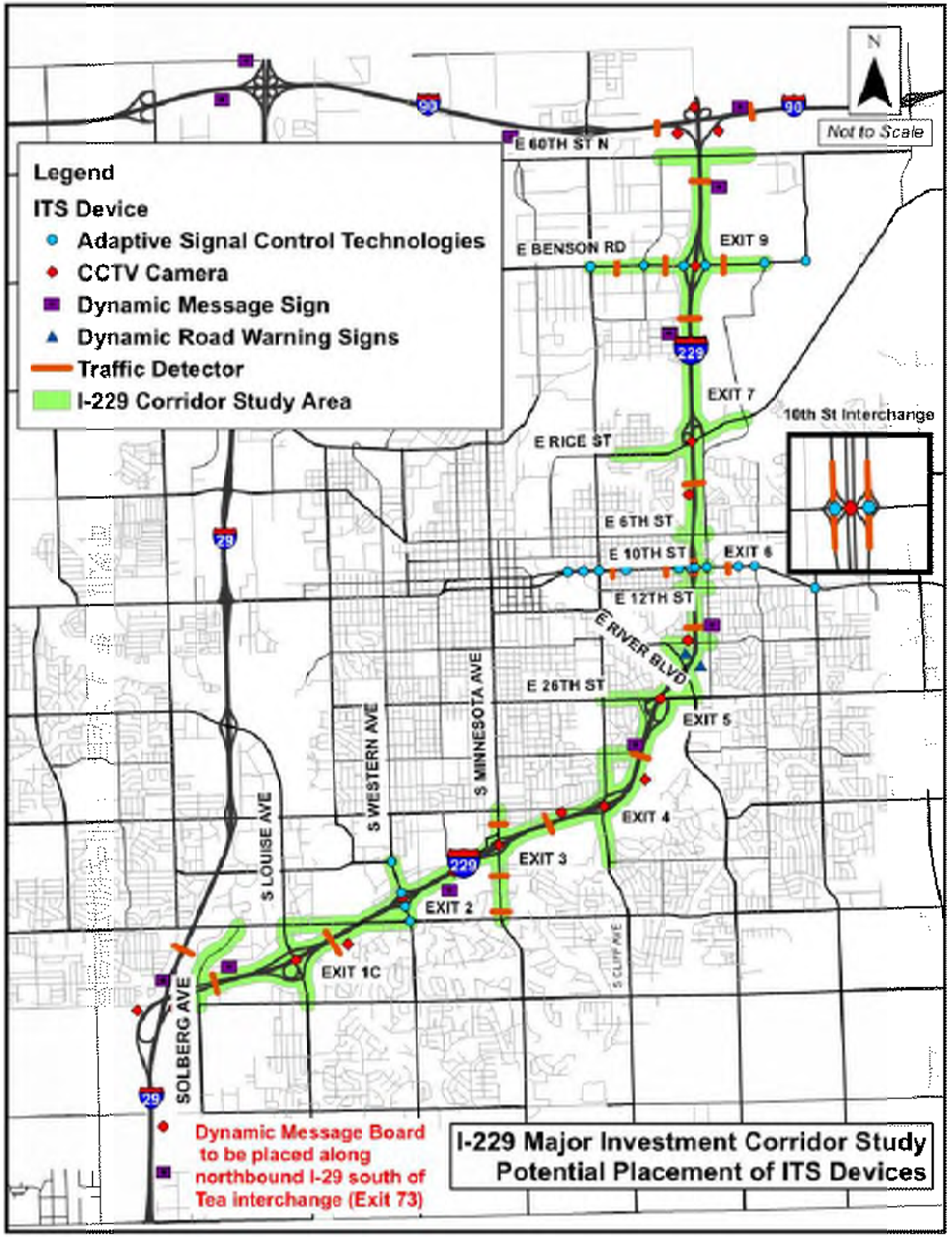
- Sub-study Proposed Improvements
  - Minnesota Avenue
  - Cliff Avenue
  - 10th Street
  - Rice Street
  - Benson Road
- Other Need Locations



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:

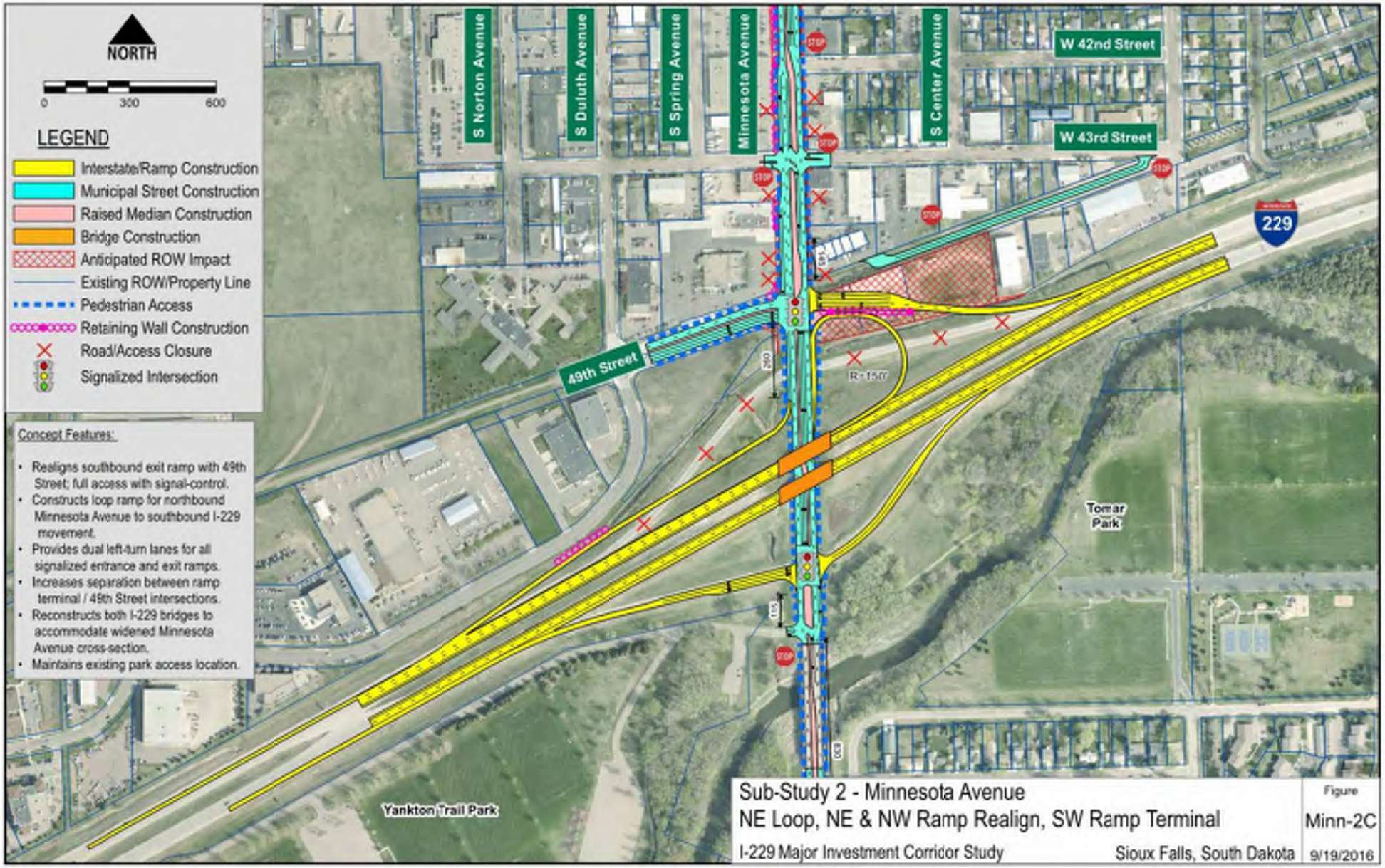
Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
Concept ID	Interchange and Corridor Type	•Traffic Delay •Level of Service •Interchange Year of Failure	Predicted Crash Reduction during 2012-2035	Potential impact to wetlands, historical 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

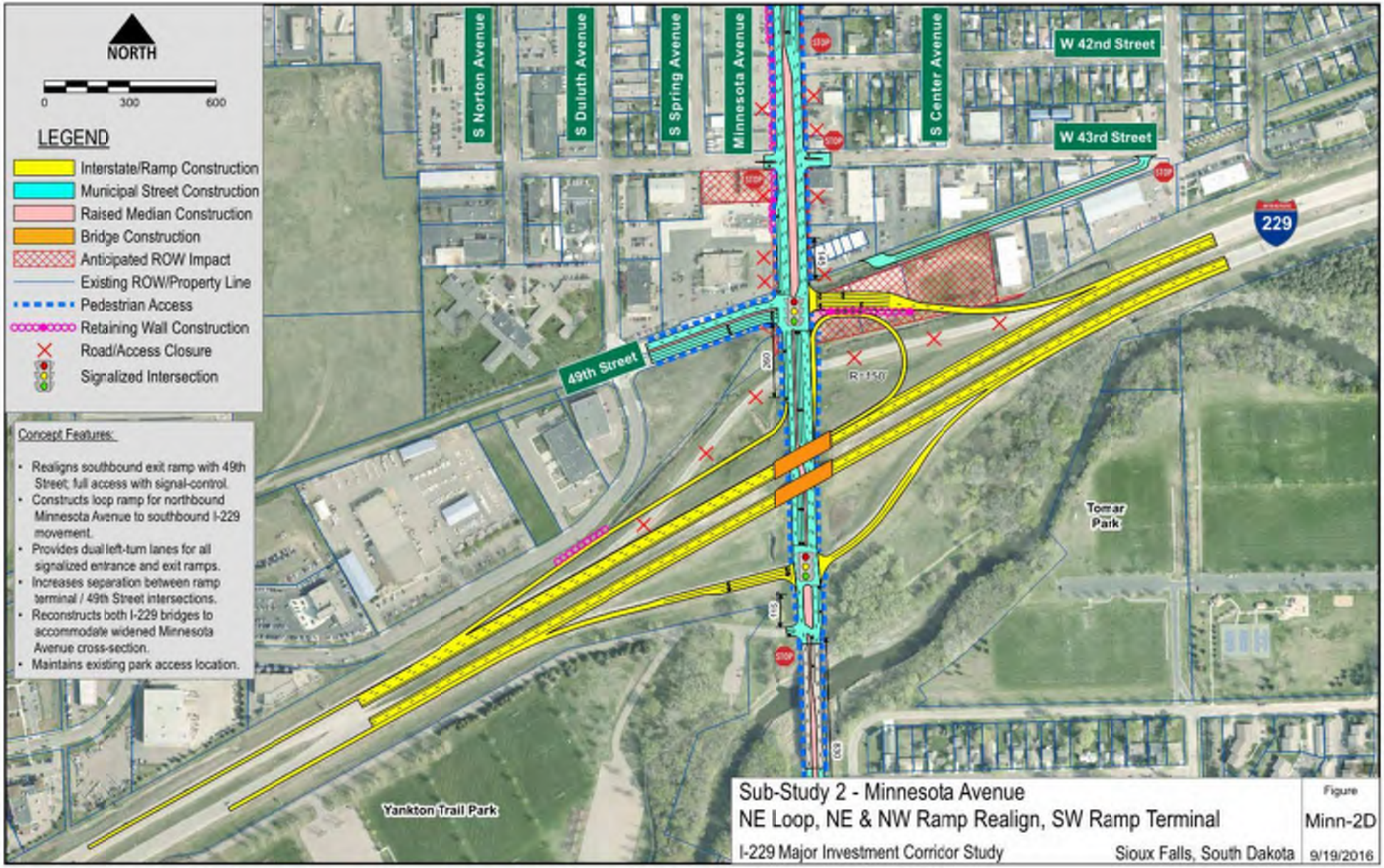
CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 2C



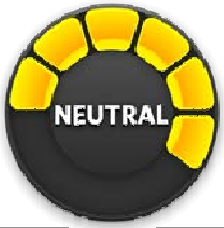
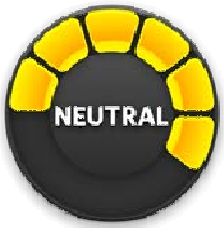
CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 2D



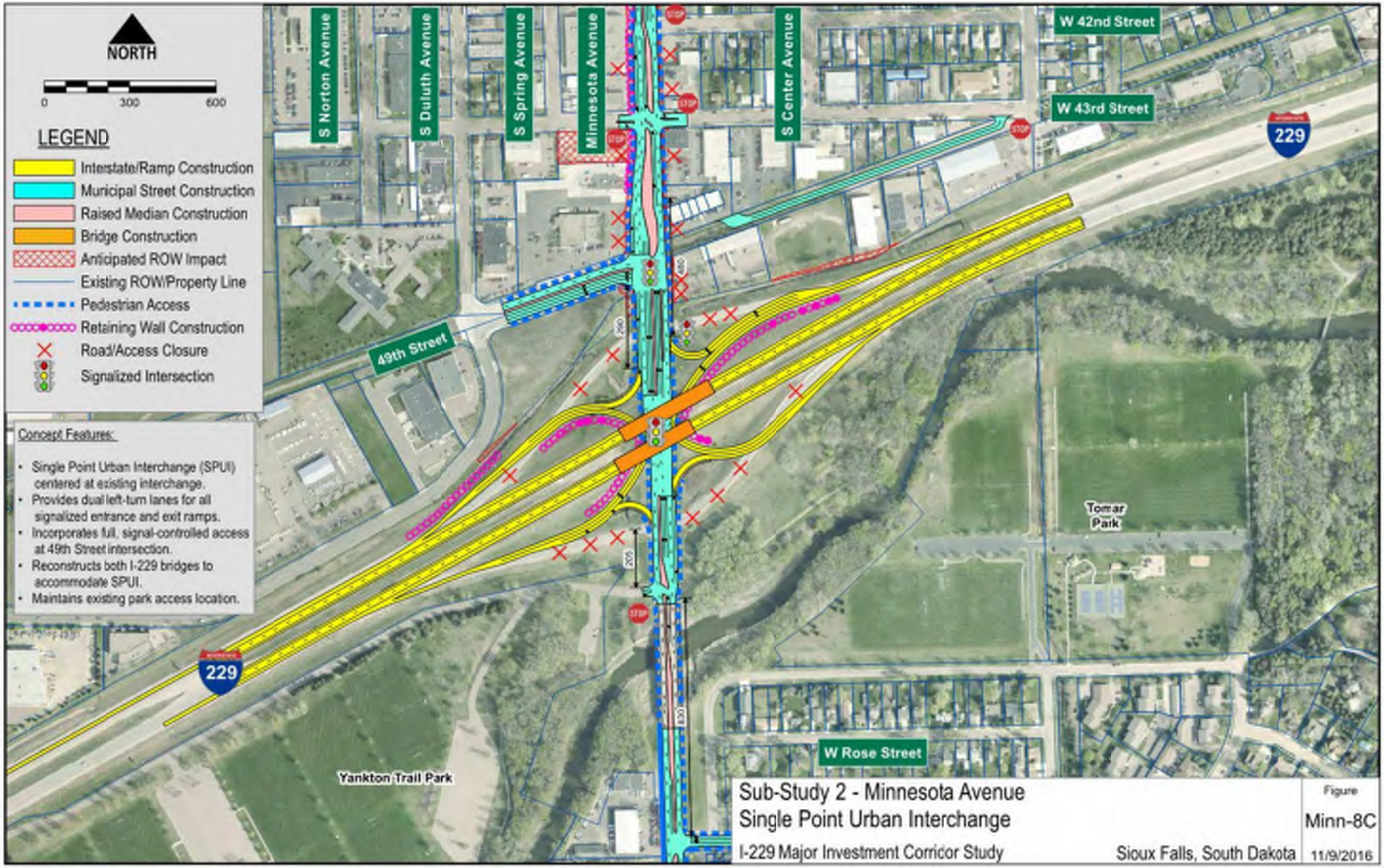
CONCEPT EVALUATION RESULTS

MINNESOTA AVENUE

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						Advance
Minn-2C	Diamond with Loop, Direct Connect to 49th St, 5-Lane Big Sioux River to 41st St						Advance
Minn-2D	Diamond with Loop, Direct Connect to 49th St, 6-Lane Big Sioux River to 41st St						Advance
Minn-5D	Diverging Diamond Interchange, 6-Lane Big Sioux River to 41st St, 49th St Right-In Right-Out						Eliminate Closure of 49th Street Access

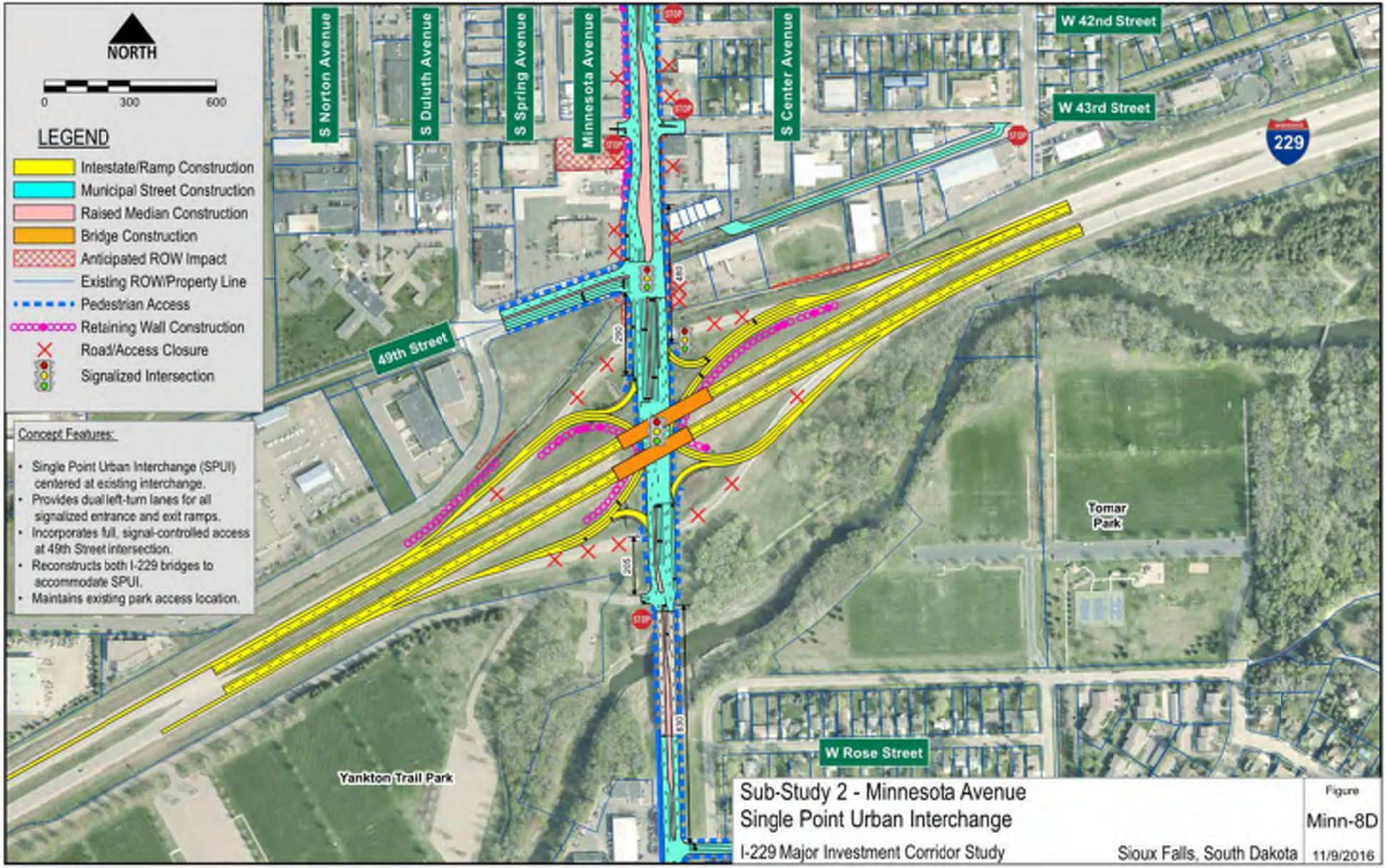
CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 8C



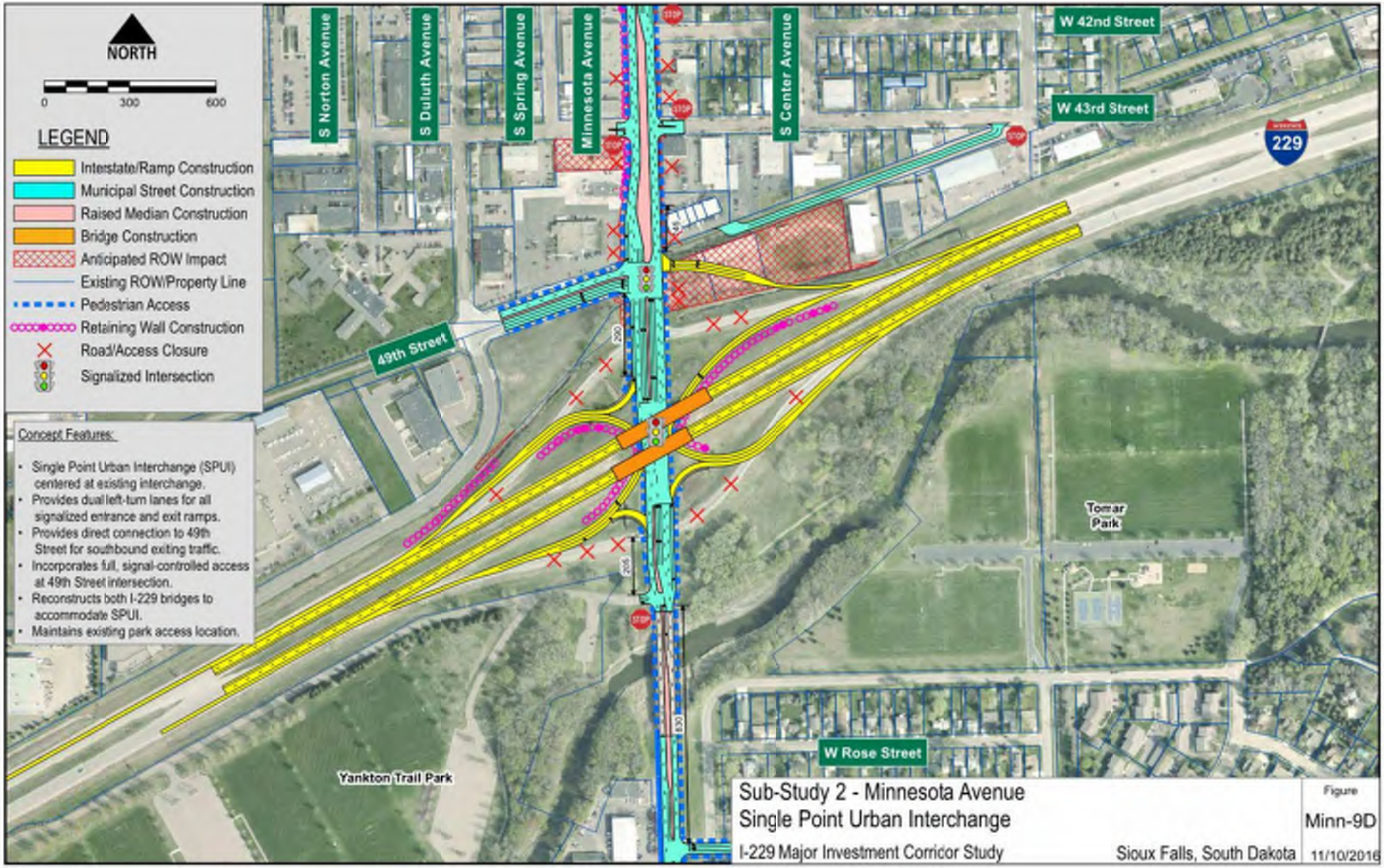
CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 8D



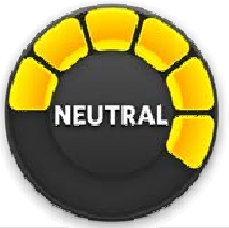
CONCEPTS FOR FURTHER CONSIDERATION

MINNESOTA AVENUE – 9D



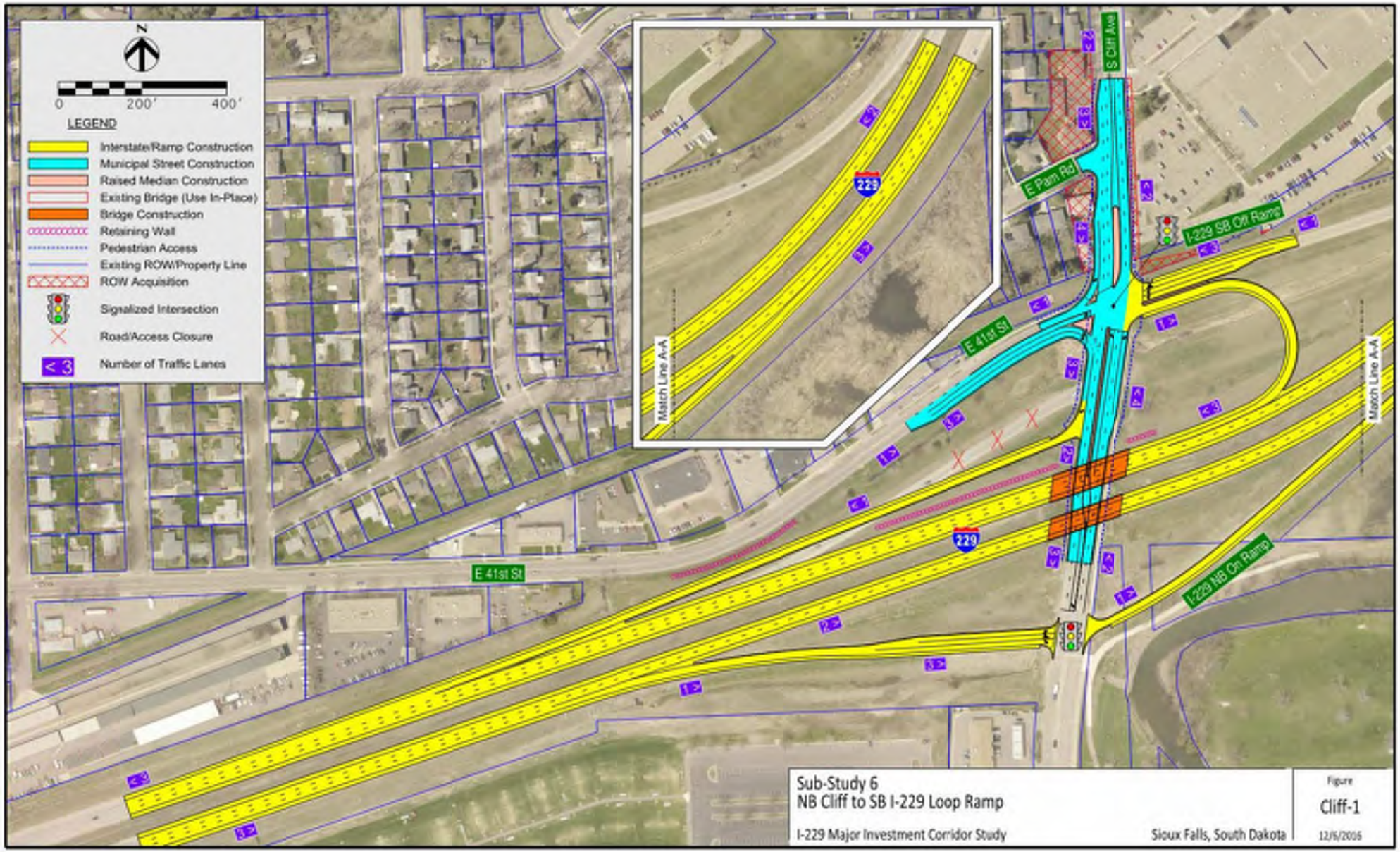
CONCEPT EVALUATION RESULTS

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						Advance
Minn-8D	Single Point Urban Interchange, 6-Lane Big Sioux River to 41st St, 49th St Full Access						Advance
Minn-9	Single Point Urban Interchange, Exit Ramp Connection to 49th St, 5-Lane Big Sioux River to 41st St						Advance

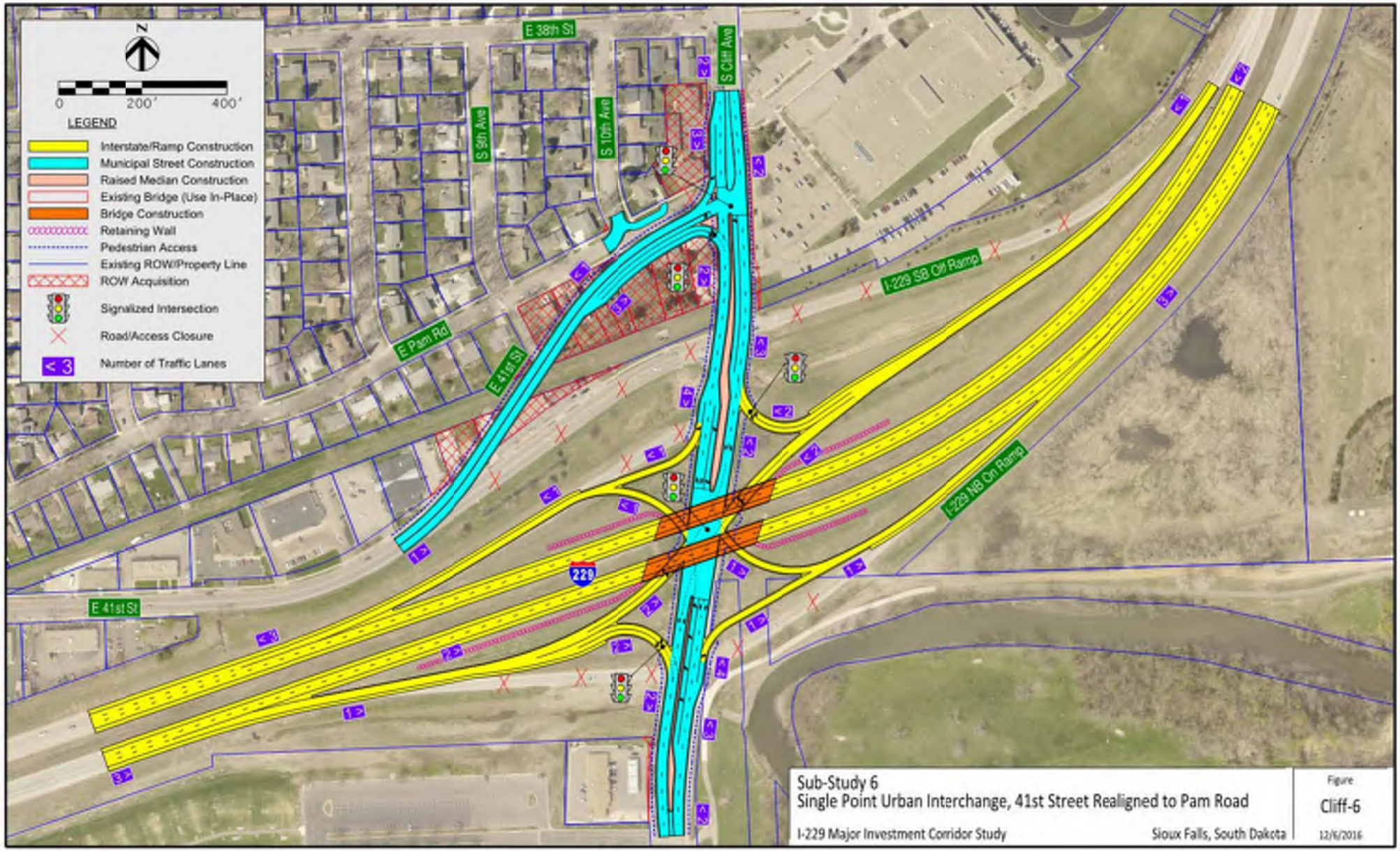
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 1



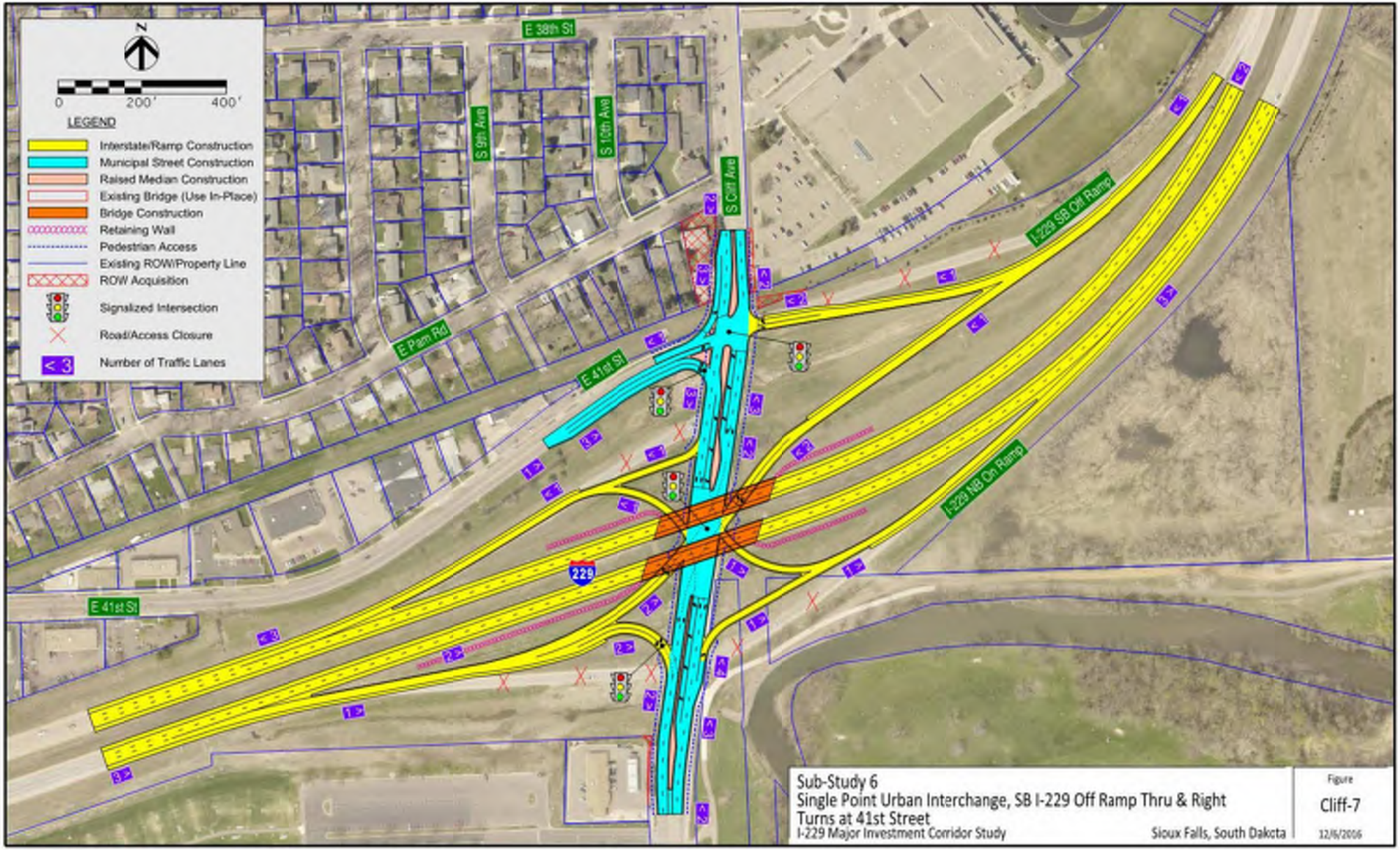
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 6



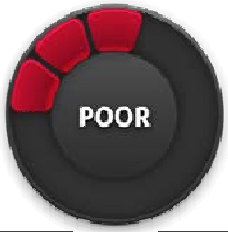
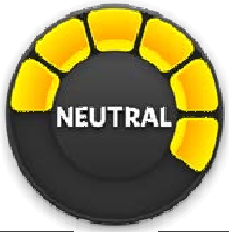
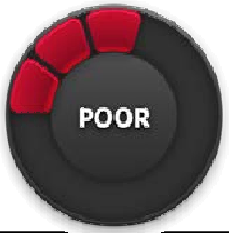
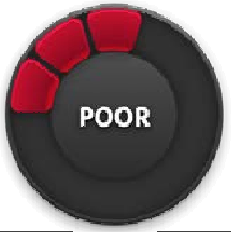
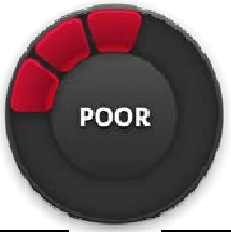
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF AVENUE – 7



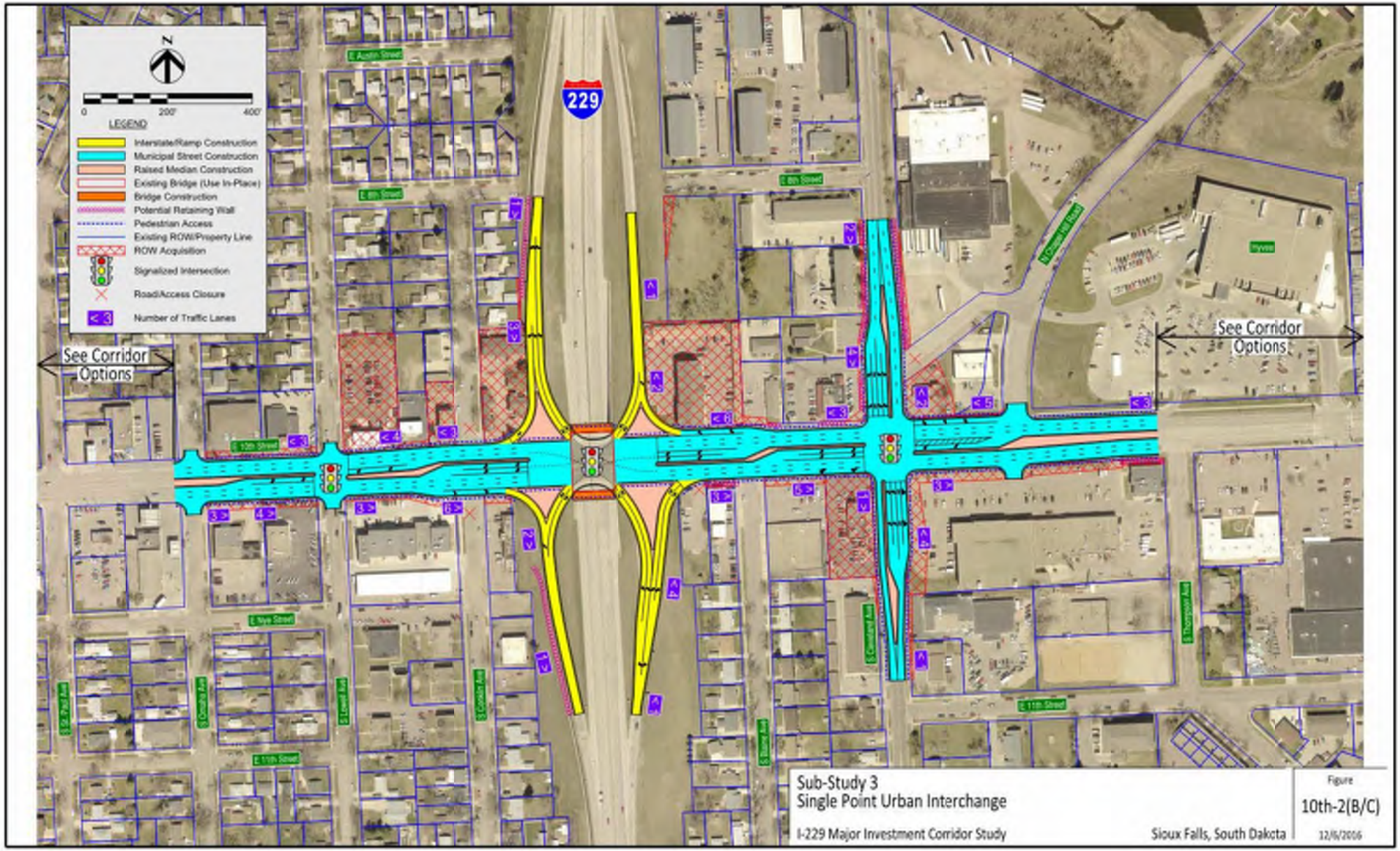
CONCEPT EVALUATION RESULTS

CLIFF AVENUE

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						Advance
Cliff-1	NB Cliff to SB I-229 Loop Ramp						Advance
Cliff-6	Single Point Urban Interchange, 41st St Realigned to Pam Rd						Advance
Cliff-7	Single Point Urban Interchange, SB I-229 Off-Ramp Thru & Right Turns at 41st St						Advance

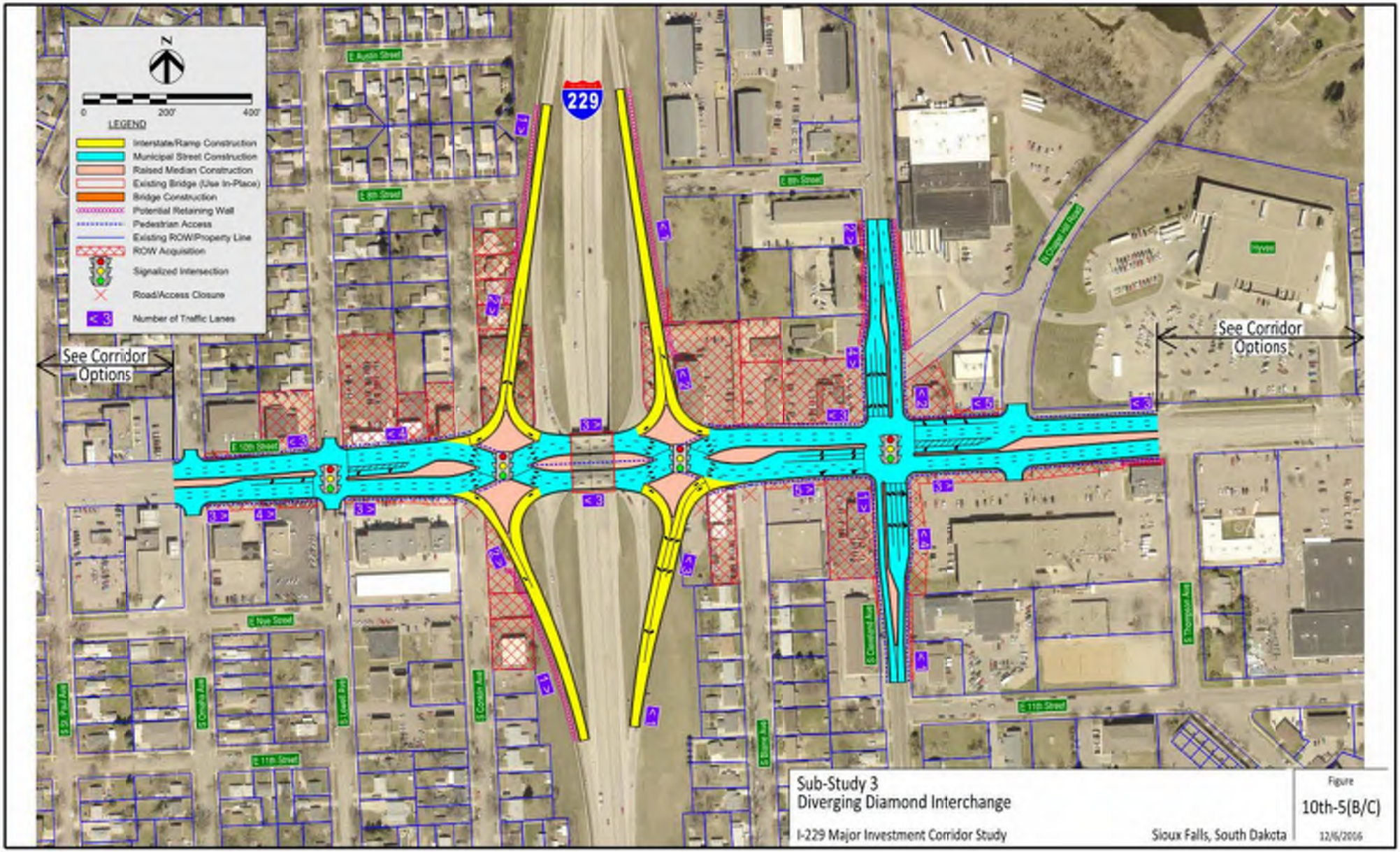
CONCEPTS FOR FURTHER CONSIDERATION

10TH STREET – 2 (B/C)



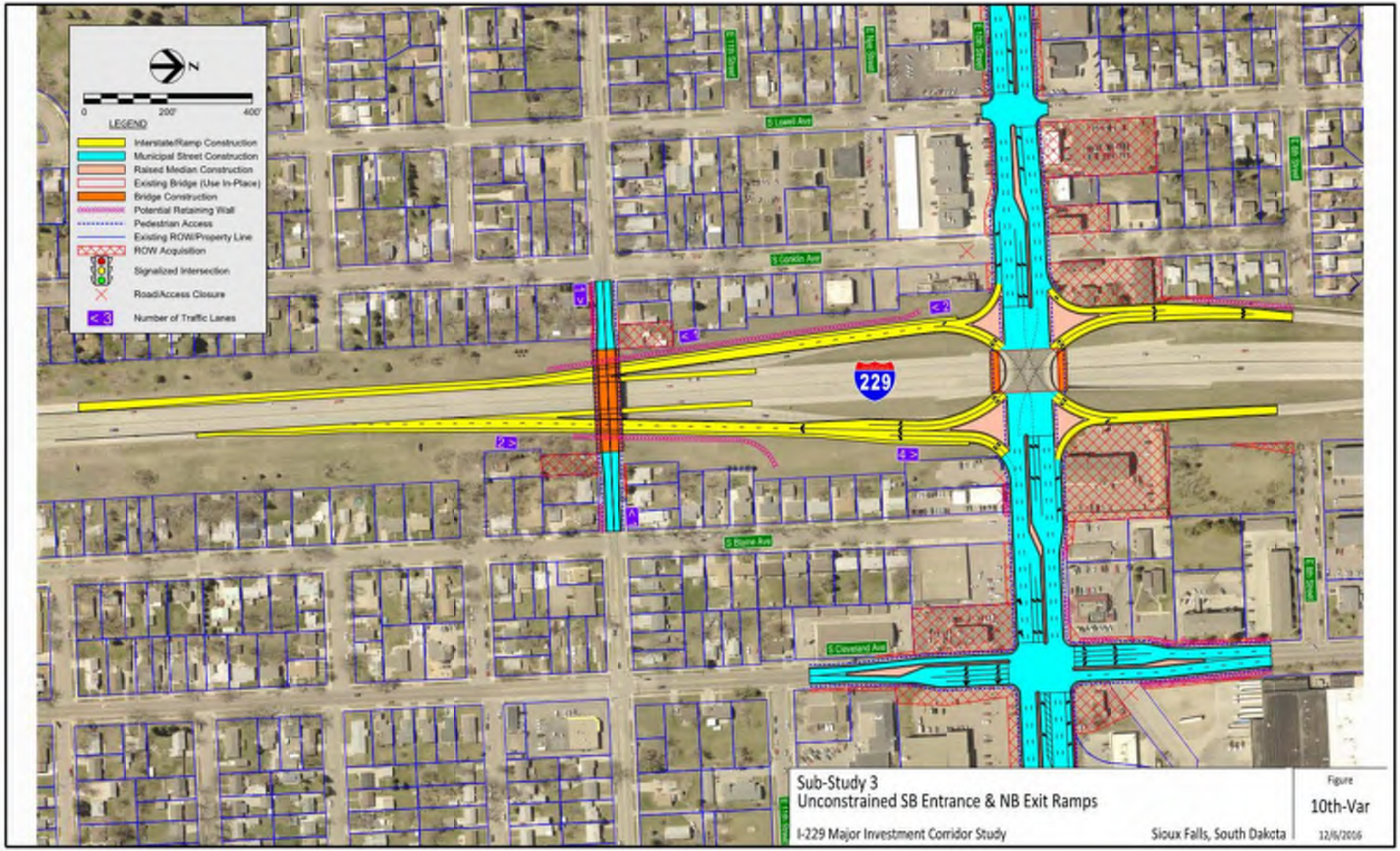
CONCEPTS FOR FURTHER CONSIDERATION

10TH STREET – 5 (B/C)

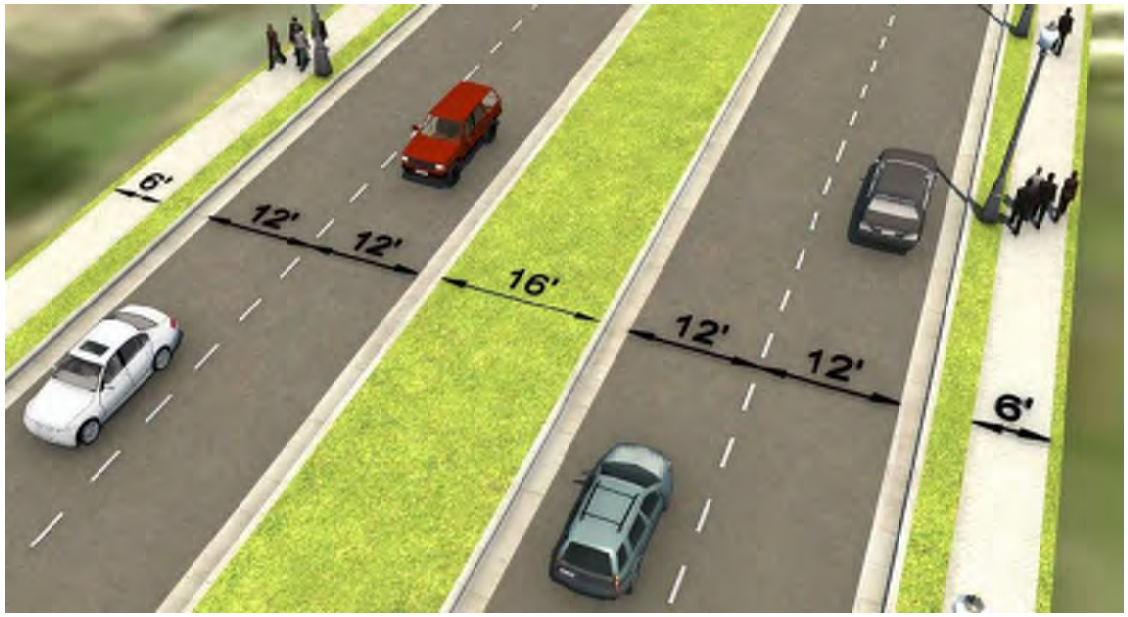


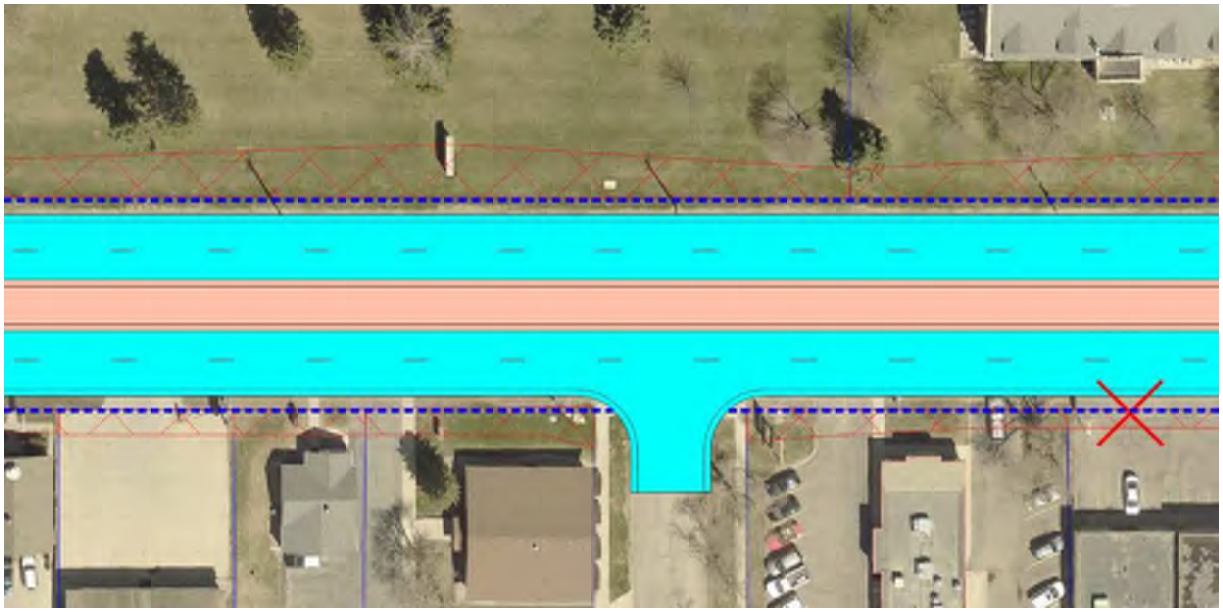
CONCEPTS FOR FURTHER CONSIDERATION

10TH STREET – VAR

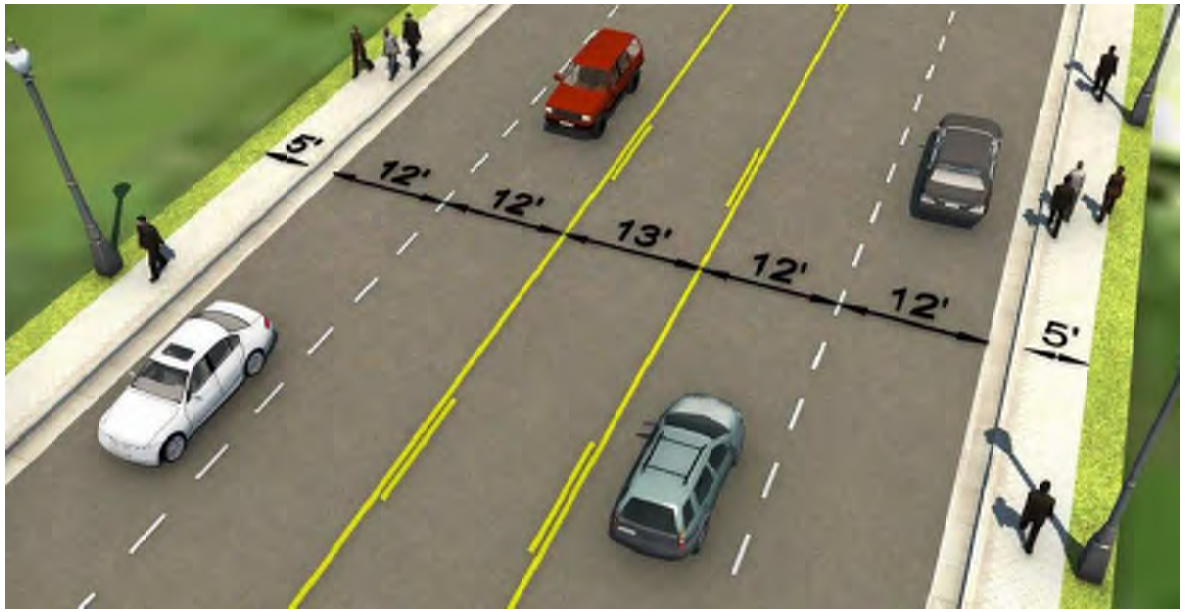


4-Lane Divided Corridor





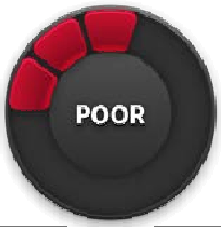
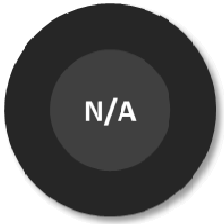
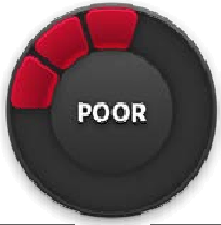
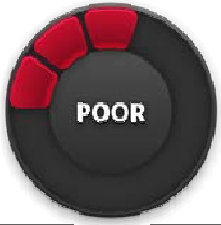
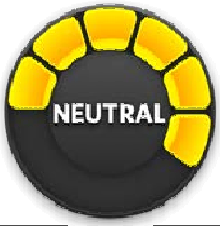
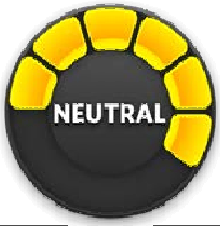
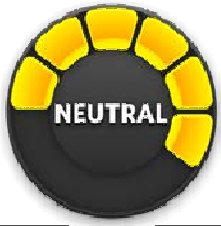
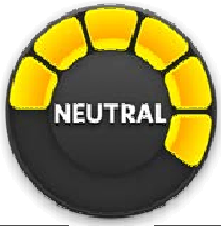
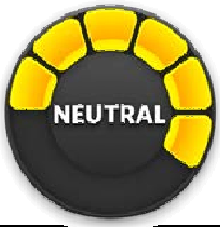
5-Lane Undivided Corridor



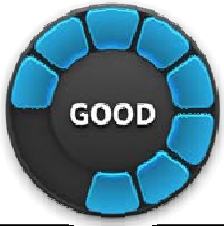
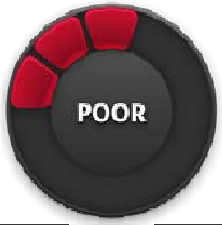
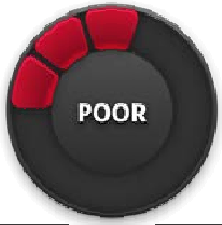
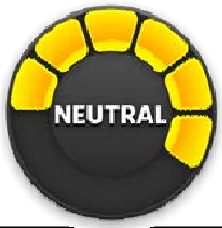
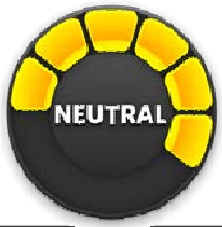
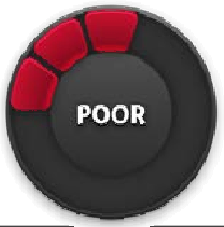
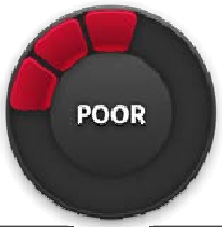
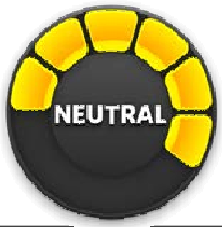
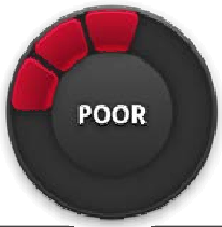
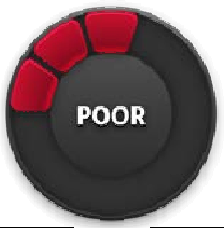
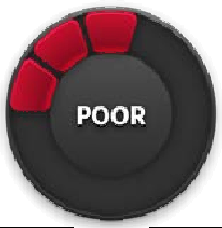


CONCEPT EVALUATION RESULTS

10TH STREET

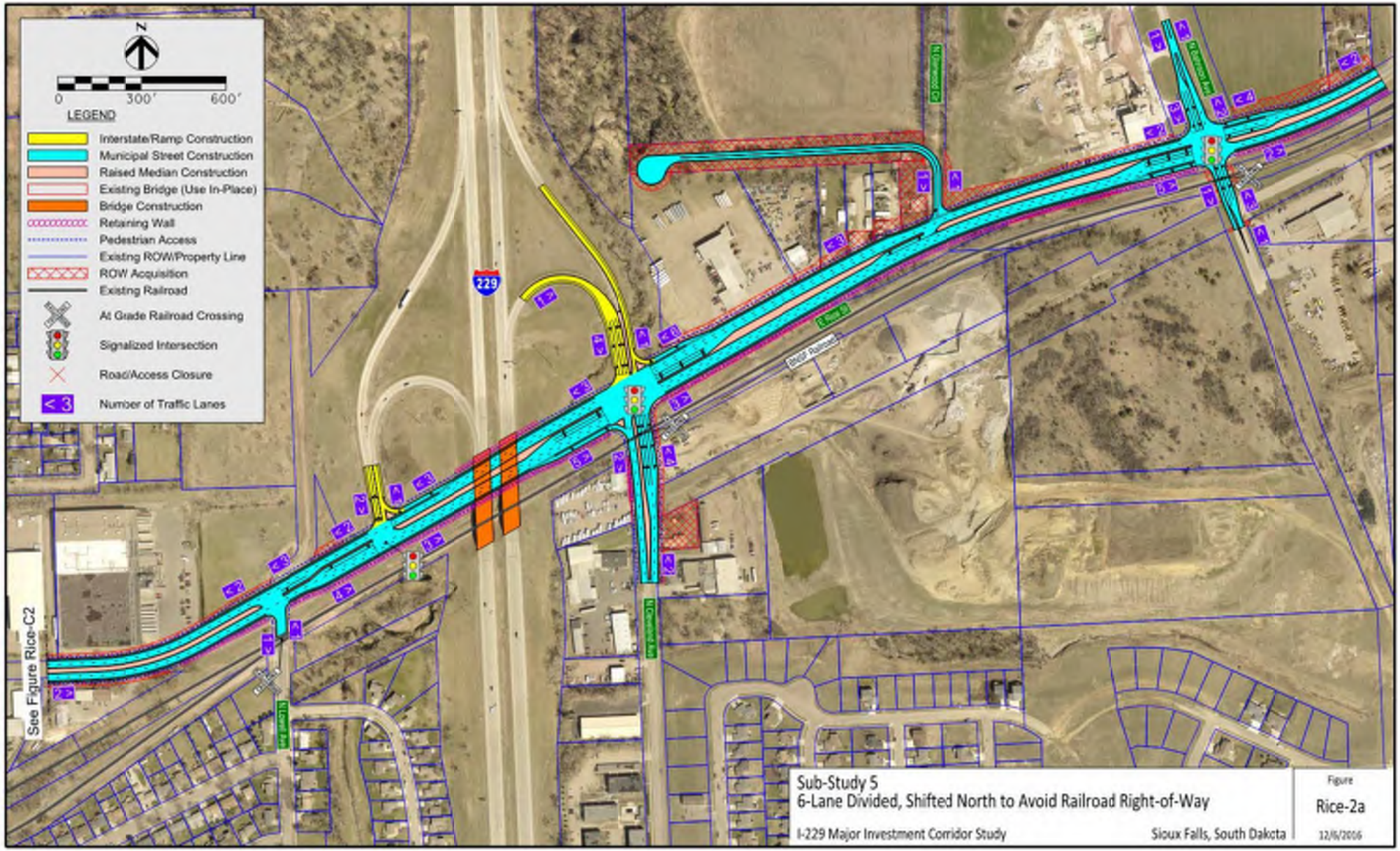
Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						**Advance**
10th-2A	Single Point Urban Interchange, 6-Lane Divided Corridor						**Eliminate** Property impacts, environmental impacts, and cost
10th-2B	Single Point Urban Interchange, 4-Lane Divided Corridor						**Advance**
10th-2C	Single Point Urban Interchange, 5-Lane Undivided Corridor						**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						**Eliminate** Property impacts, environmental impacts, and cost
10th-5B	Diverging Diamond Interchange, 4-Lane Divided Corridor						**Advance**
10th-5C	Diverging Diamond Interchange, 5-Lane Undivided Corridor						**Advance**
10th-9A	Tight Split Diamond, 6th St/10th St with 4-Lane Divided Corridor						**Eliminate** Environmental impacts, cost, and lower traffic & safety benefits
10th-9B	Tight Split Diamond, 6th St/10th St with 5-Lane Undivided Corridor						**Eliminate** Environmental impacts and lower traffic & safety benefits
10th-Var							**Advance**

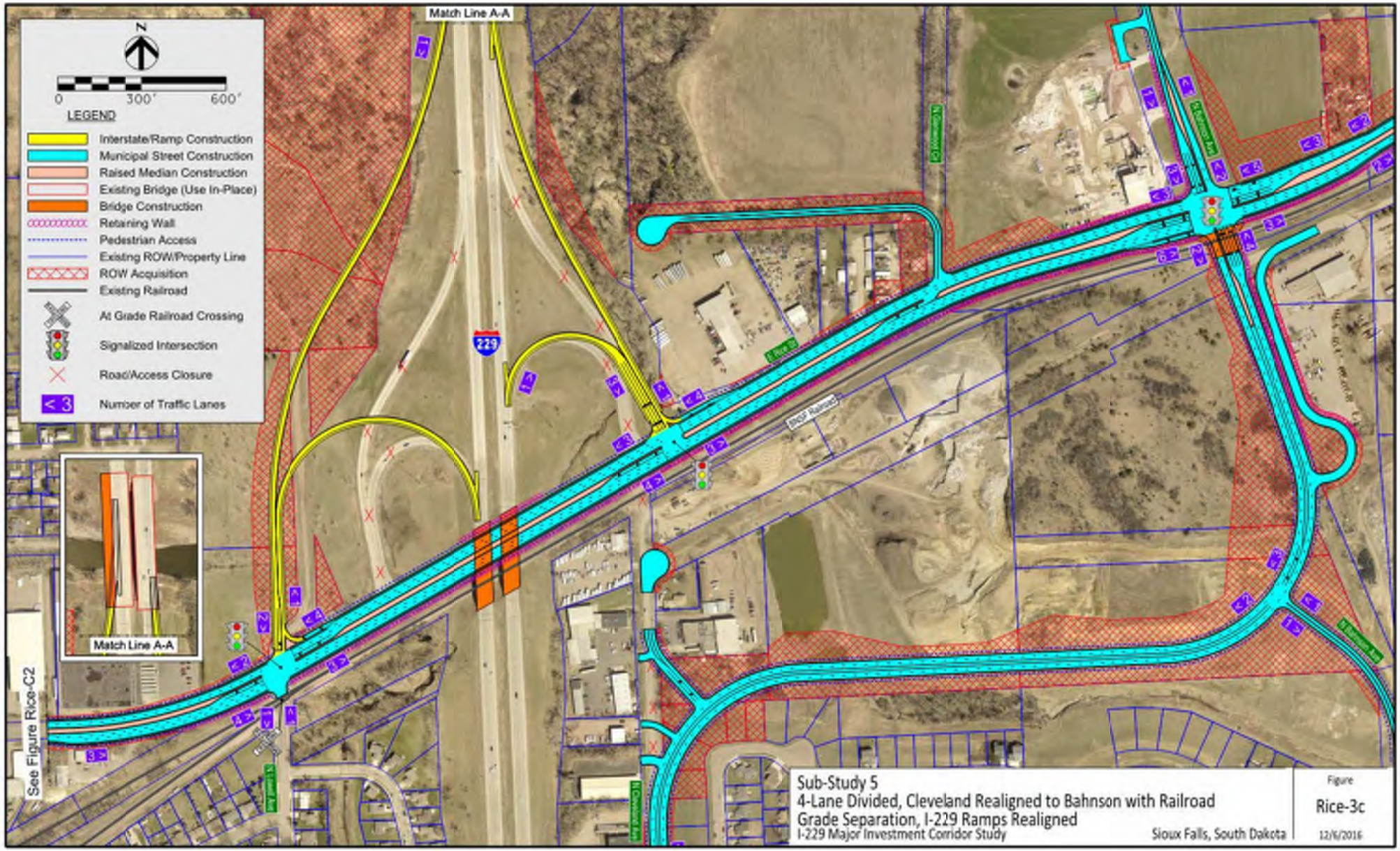
CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – 2A



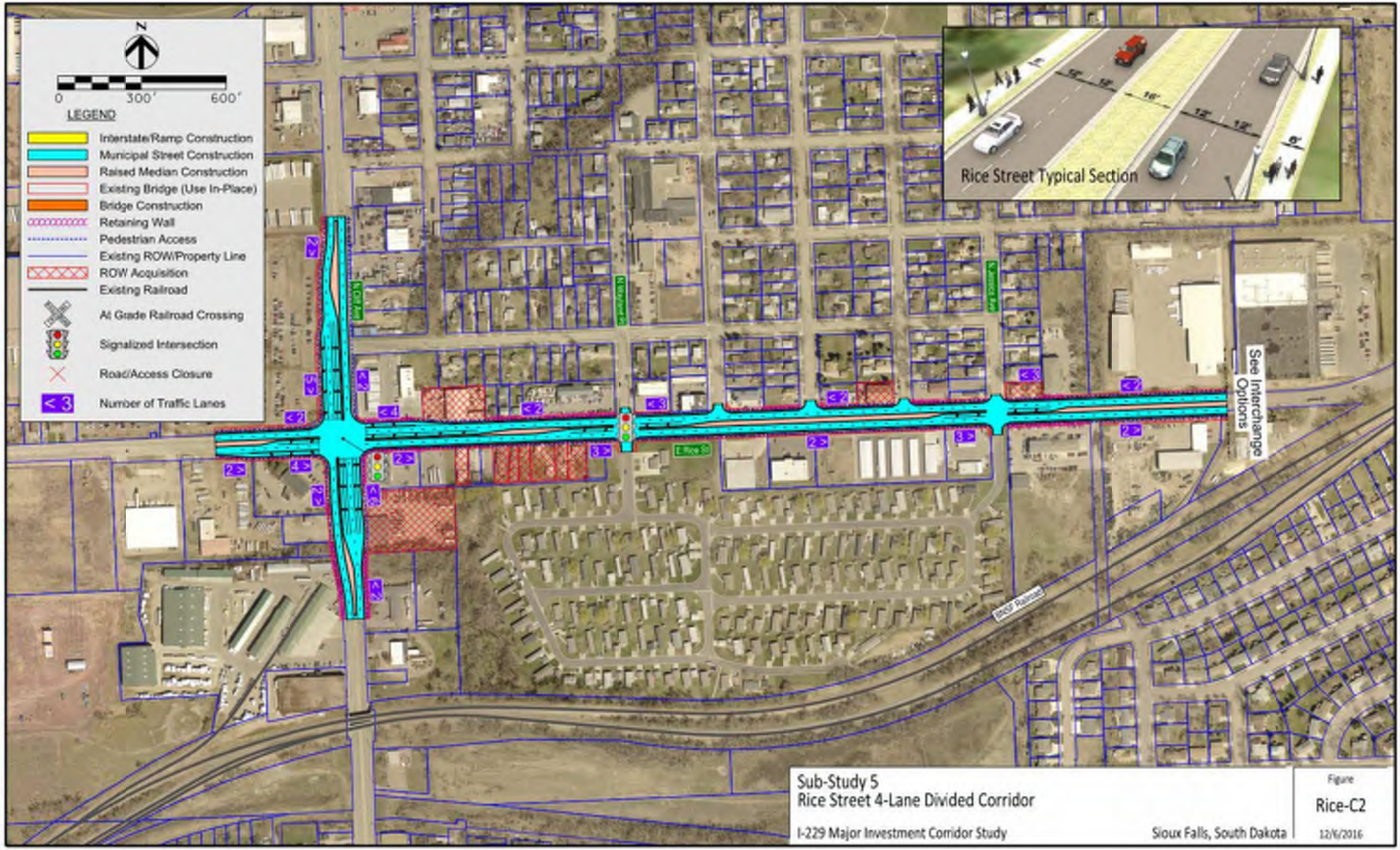
CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – 3C



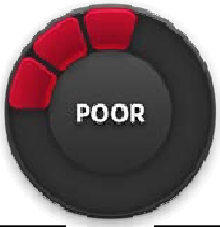
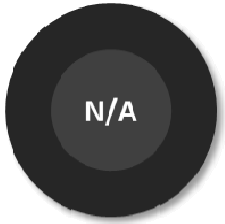
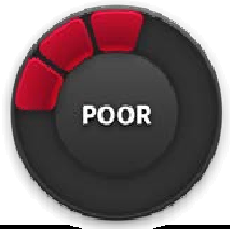
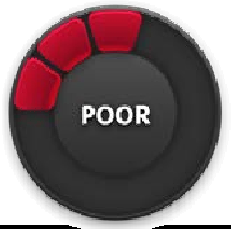
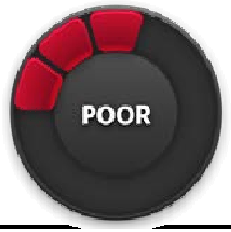
CONCEPTS FOR FURTHER CONSIDERATION

RICE STREET – C2



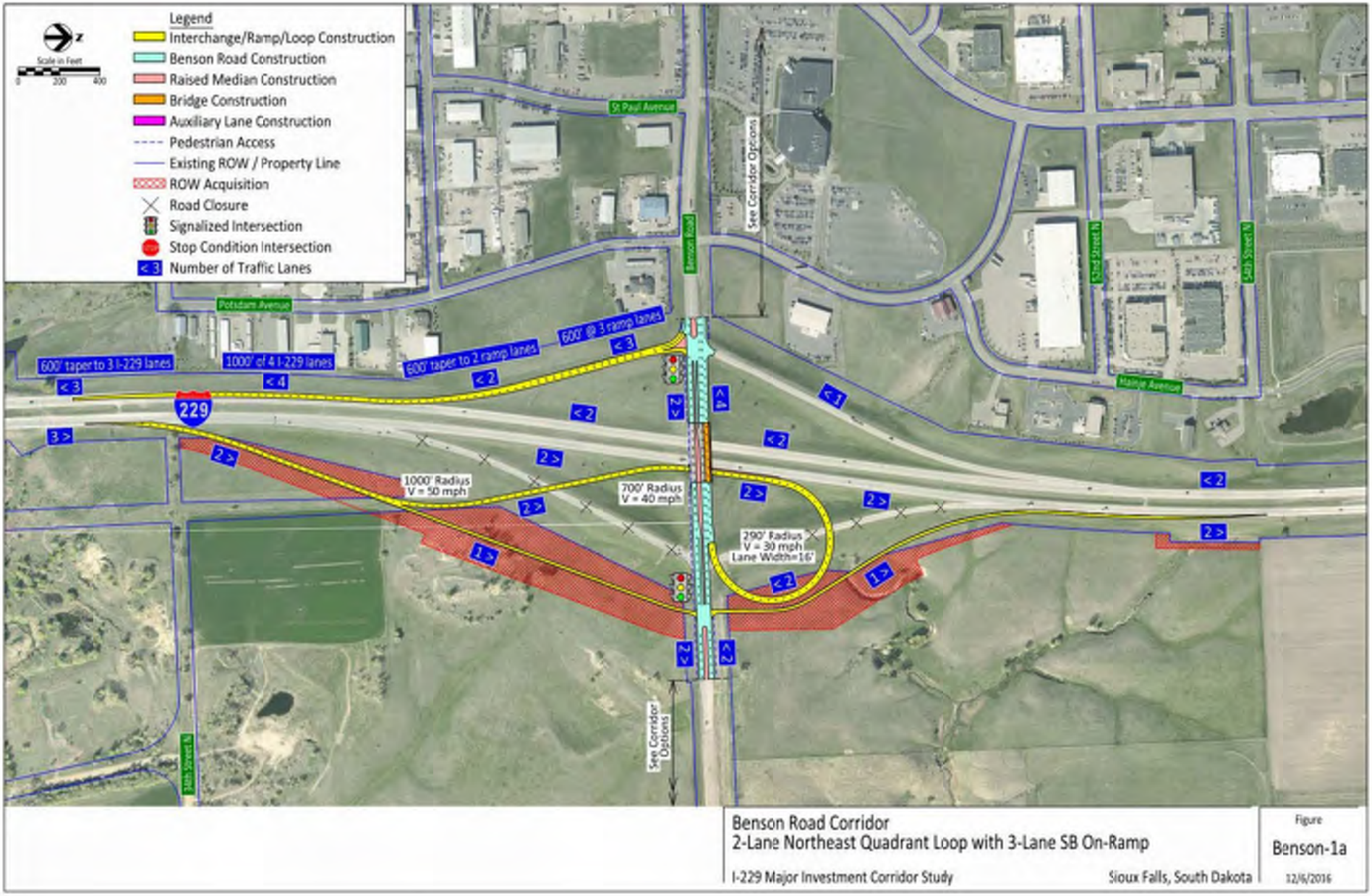
CONCEPT EVALUATION RESULTS

RICE STREET

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						Advance
Rice-2	6-Lane Divided						Advance
Rice-2A	6-Lane Divided, Shifted North to Avoid Railroad Right-of-Way						Advance
Rice-3C	4-Lane Divided, Cleveland Realigned to Bahnson with Railroad Grade Separation, I-229 Ramps Realigned						Advance

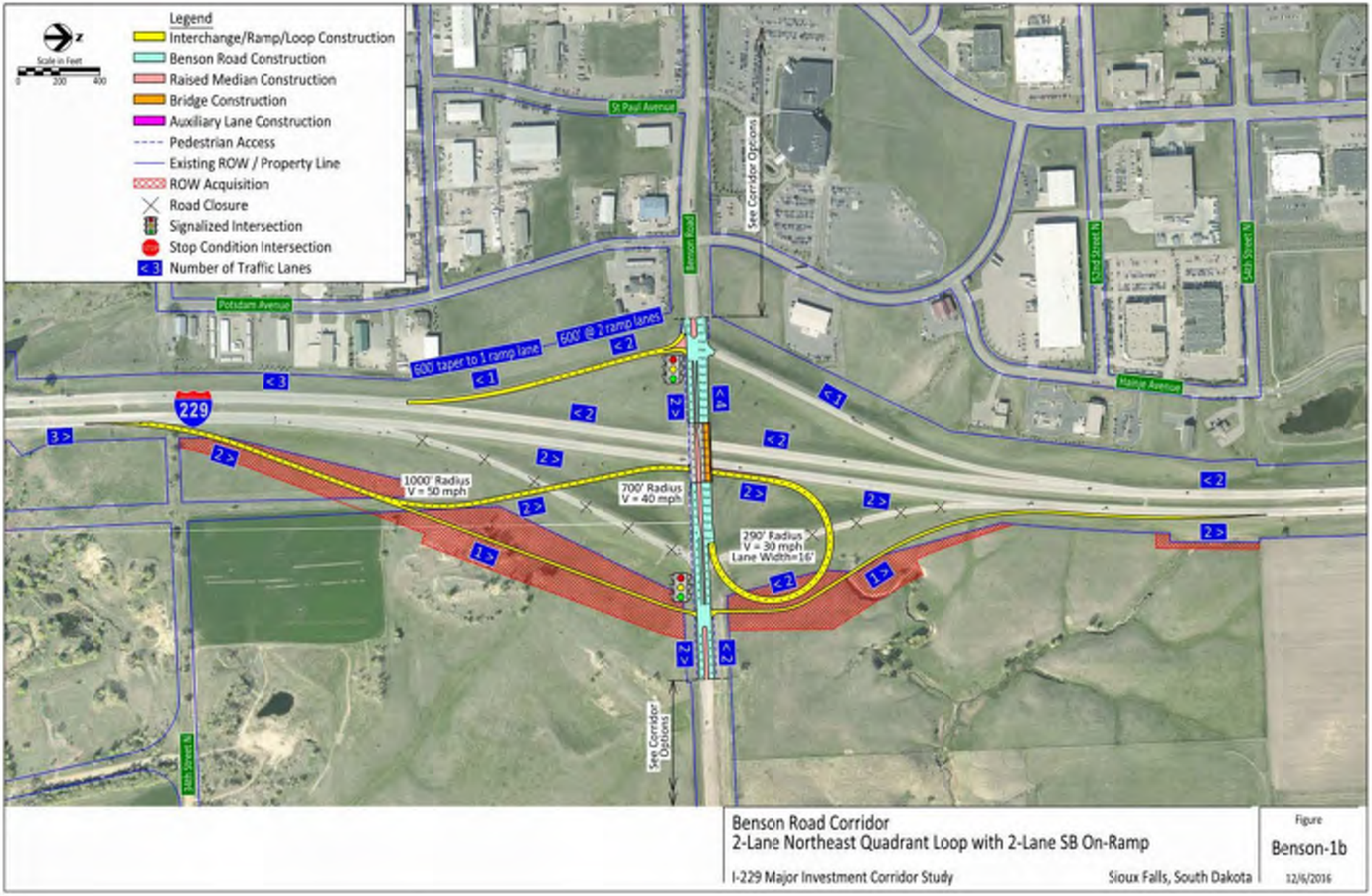
CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 1A



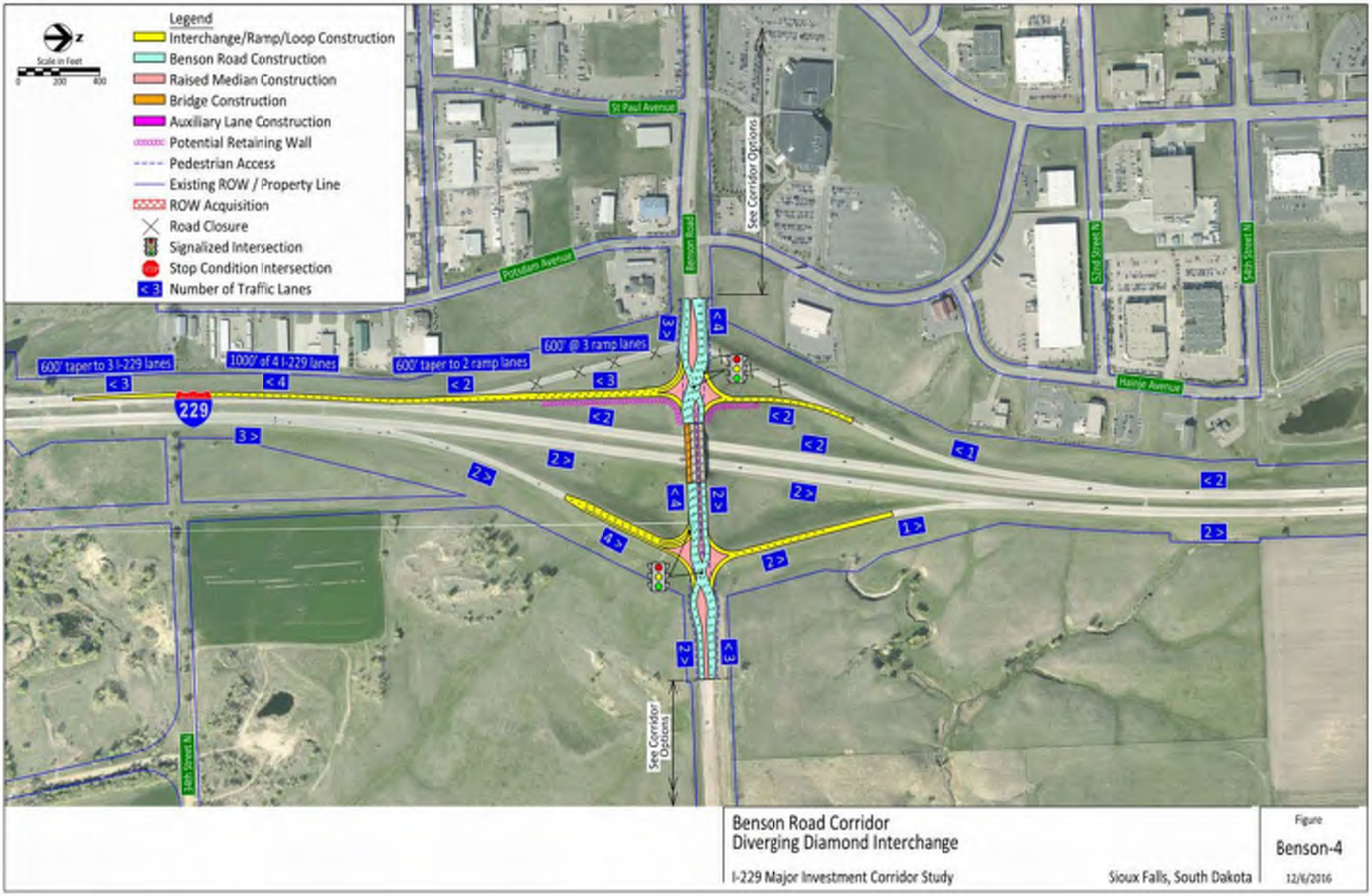
CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 1B



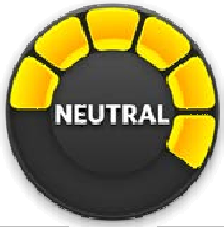
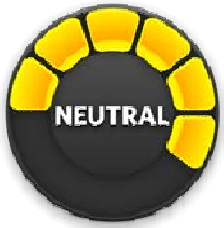
CONCEPTS FOR FURTHER CONSIDERATION

BENSON ROAD – 4



CONCEPT EVALUATION RESULTS

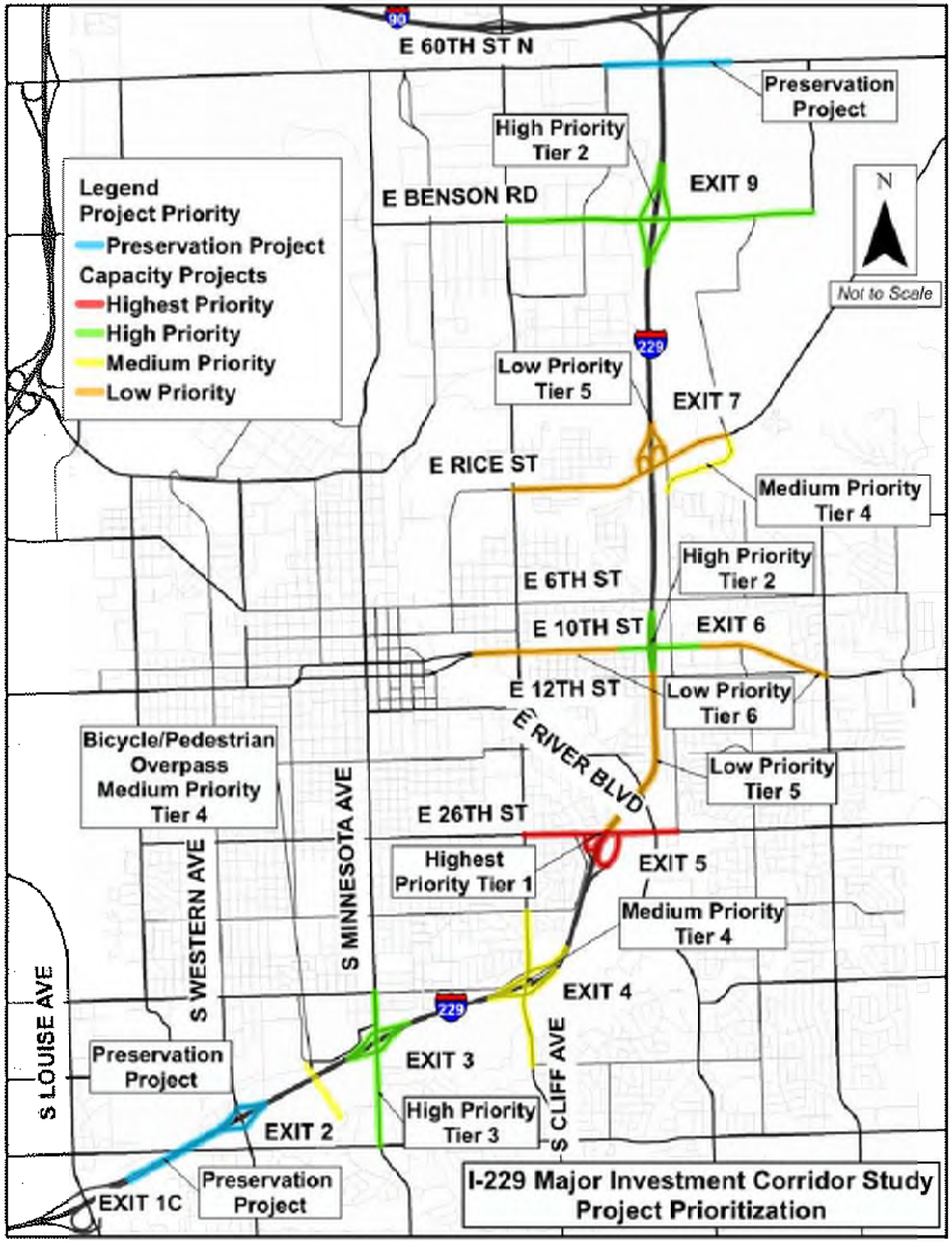
BENSON ROAD

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						Advance
Benson-1A	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp						Advance
Benson-1B	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp						Advance
Benson-4	Diverging Diamond Interchange						Advance

FUTURE I-229 CORRIDOR PROJECTS

PRELIMINARY PRIORITIZATION

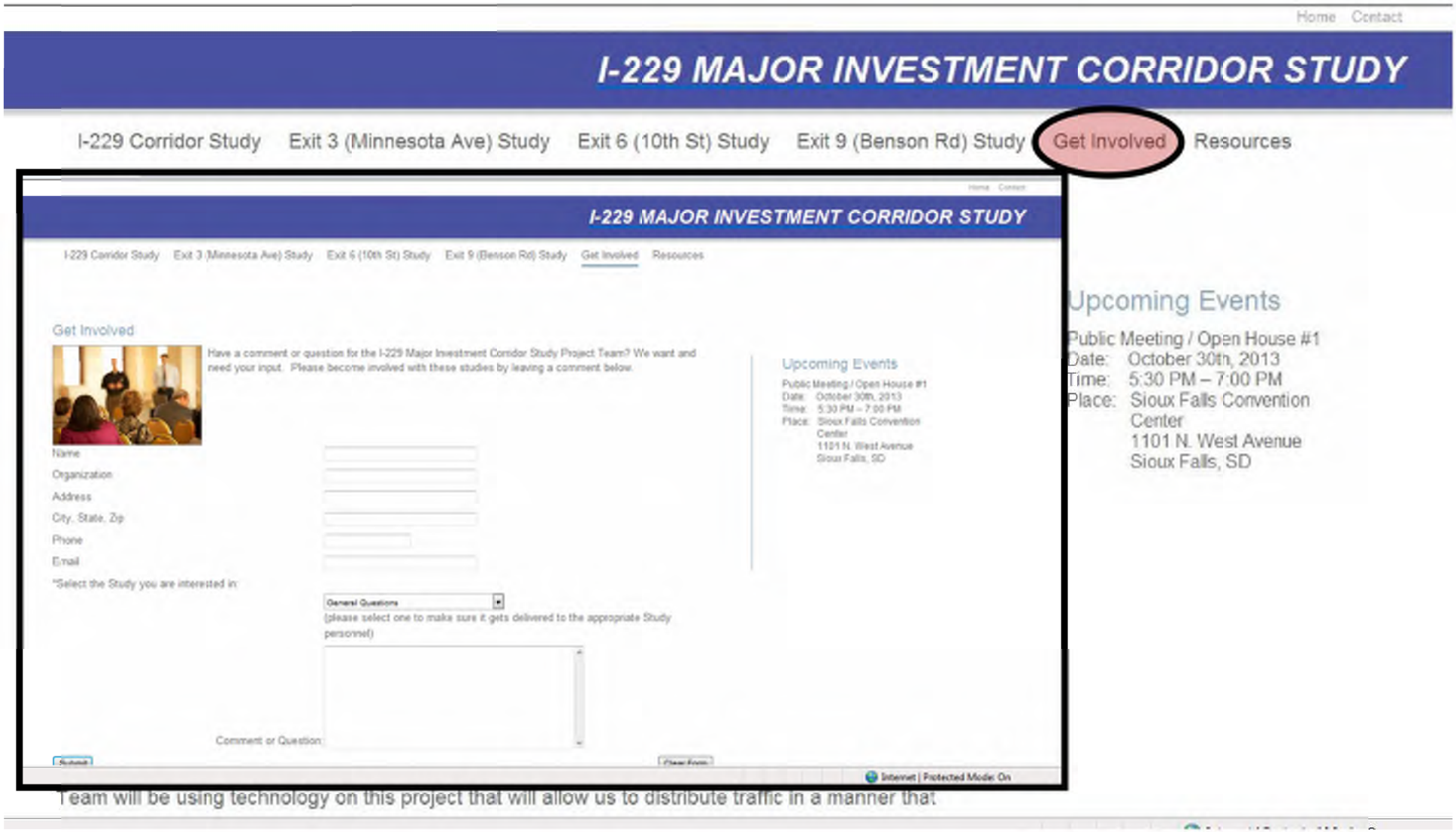
- Minnesota Avenue
- Cliff Avenue
- 10th Street
- Rice Street
- Benson Road
- Other projects list



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:

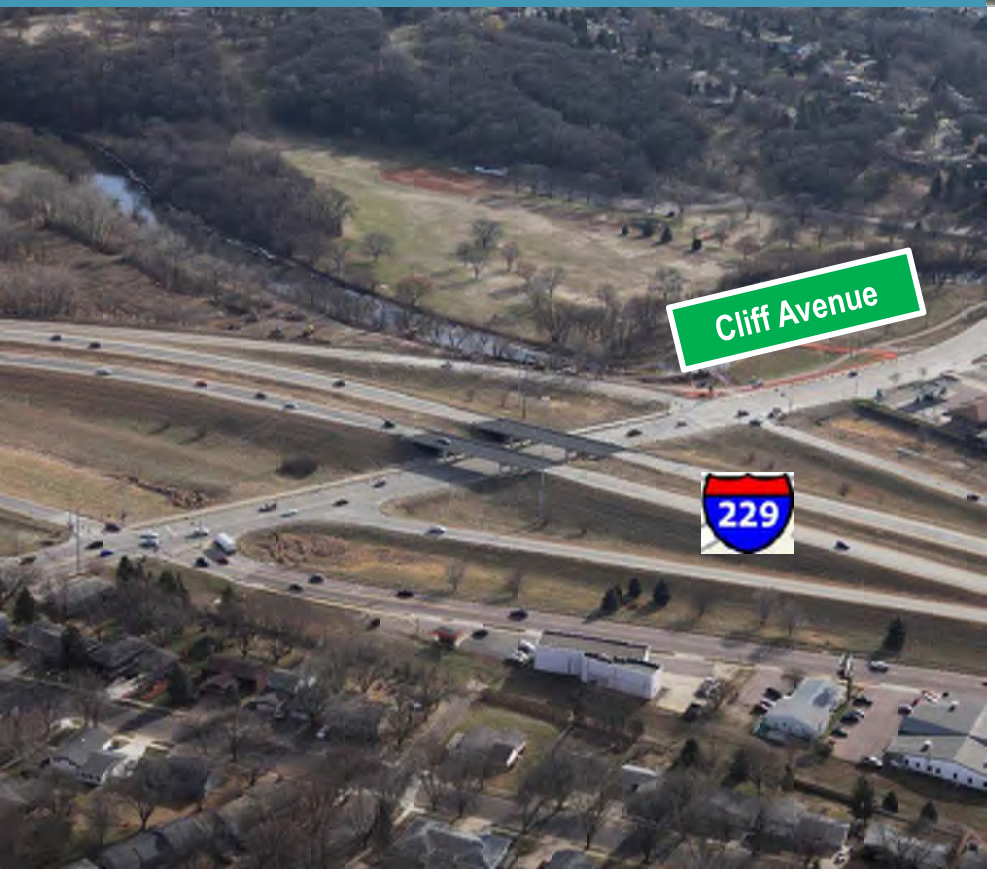
Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

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!

HDR 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) Russ Robers (First National Bank) Heath Hoftiezer, (City of Sioux Falls) 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

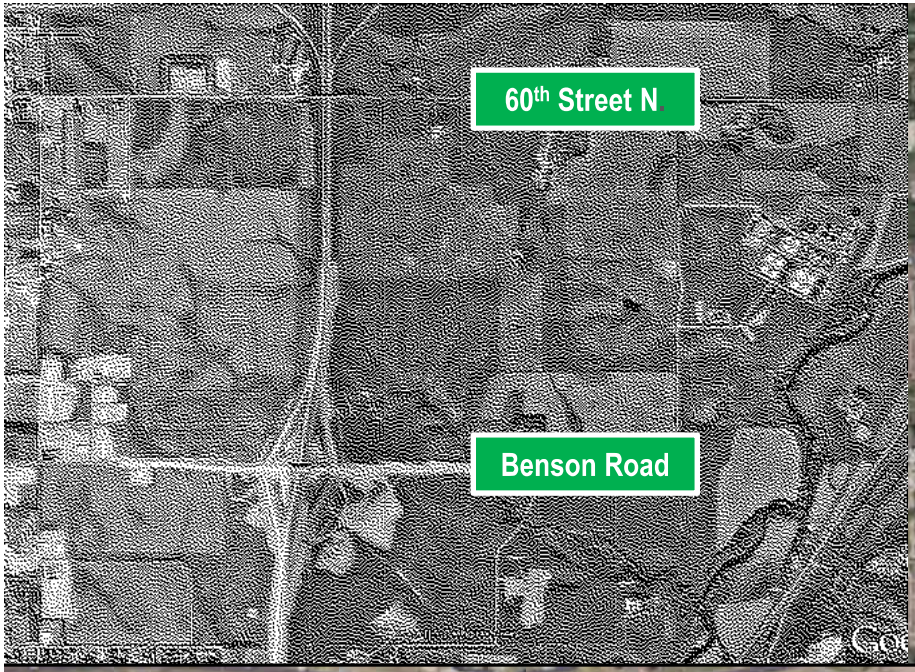
Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 3516P, 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 Dresser	SDDOT		
6	Russ Roberts First Nat'l Bank	1901 E. Benson Rd Sf= SD 57104	605-782-5801	rsroberts@fnbsf.com
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







Interstate 229 Major Investment Study

Exit 9 – Benson Rd

Stakeholder Meeting
December 15th, 2014
5:30 pm to 6:30 pm

HDR

HRGreen

© 2014 HDR, all rights reserved.

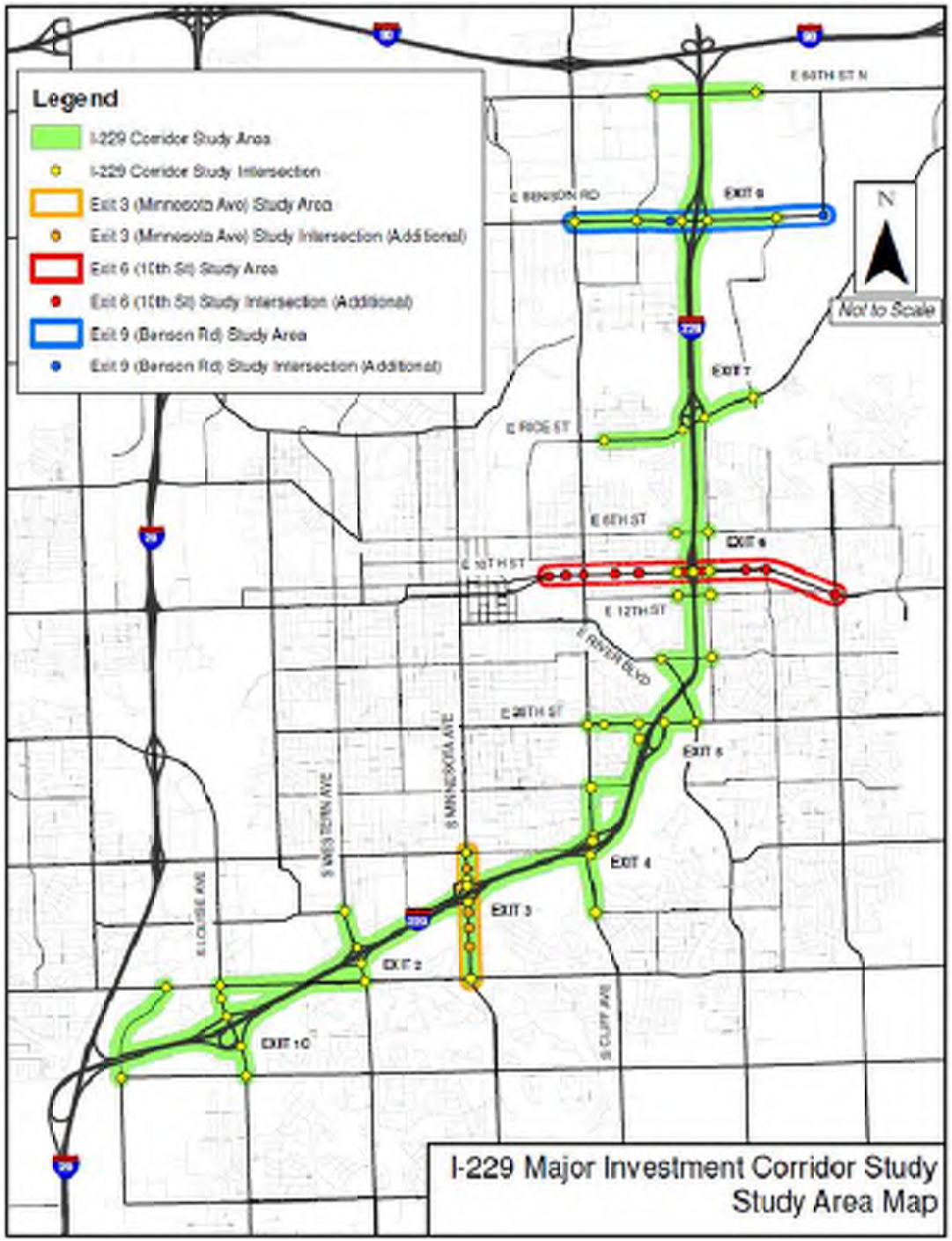
Study Area Map

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



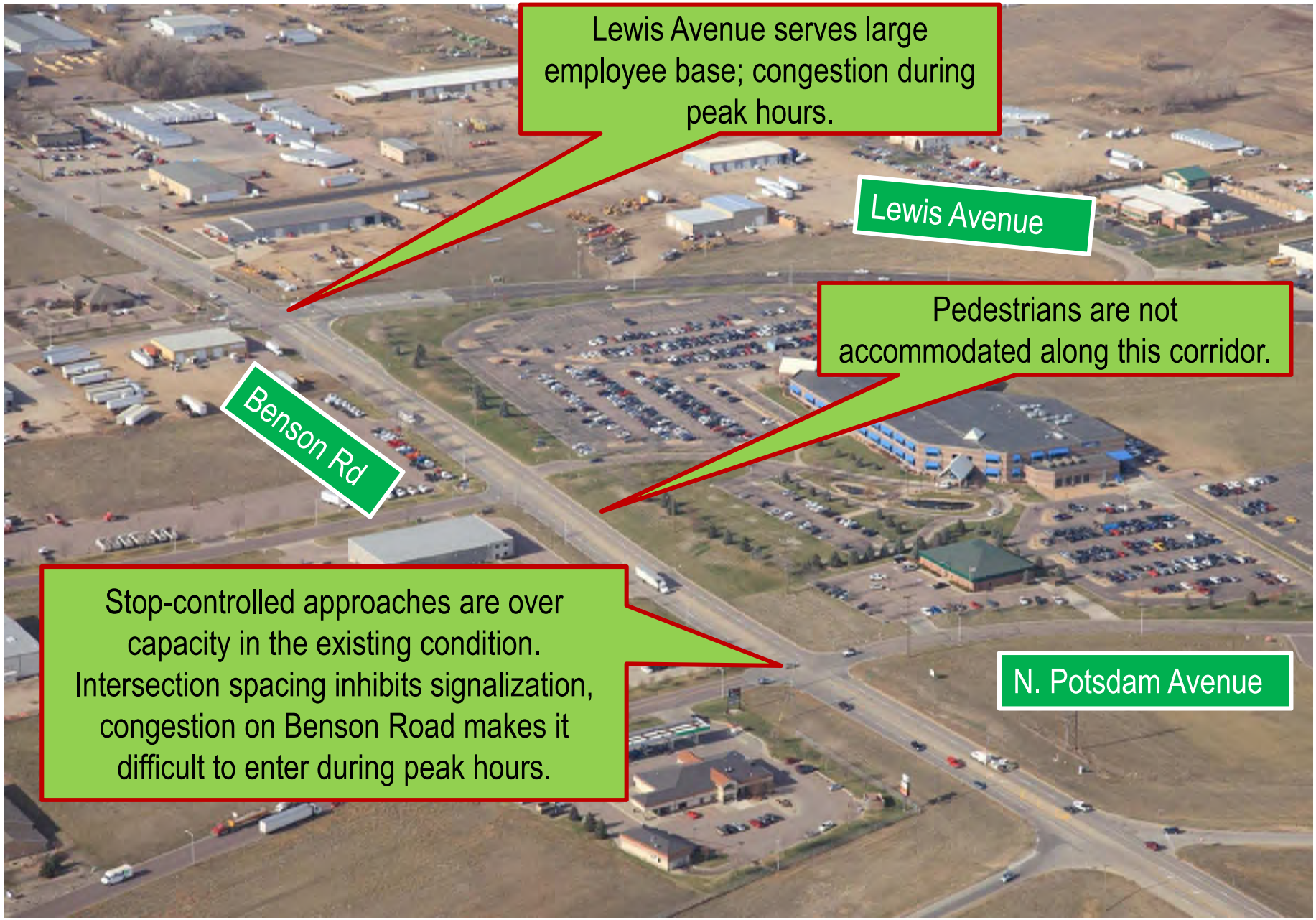




Benson Rd Corridor Overview



Benson Rd Corridor Overview



Benson Rd Corridor Overview

Stop-controlled approach projected to be over capacity by 2035.

I229 Southbound

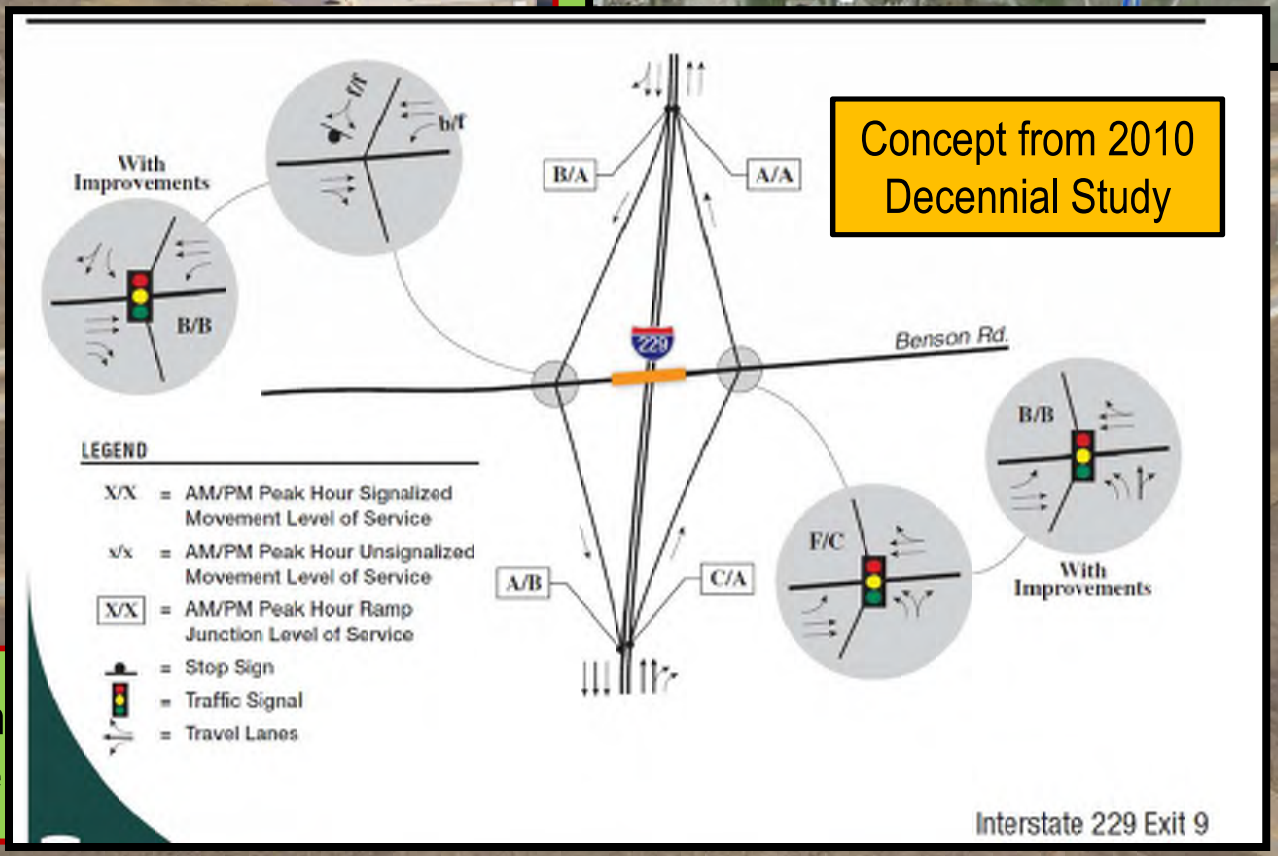
229

In
be

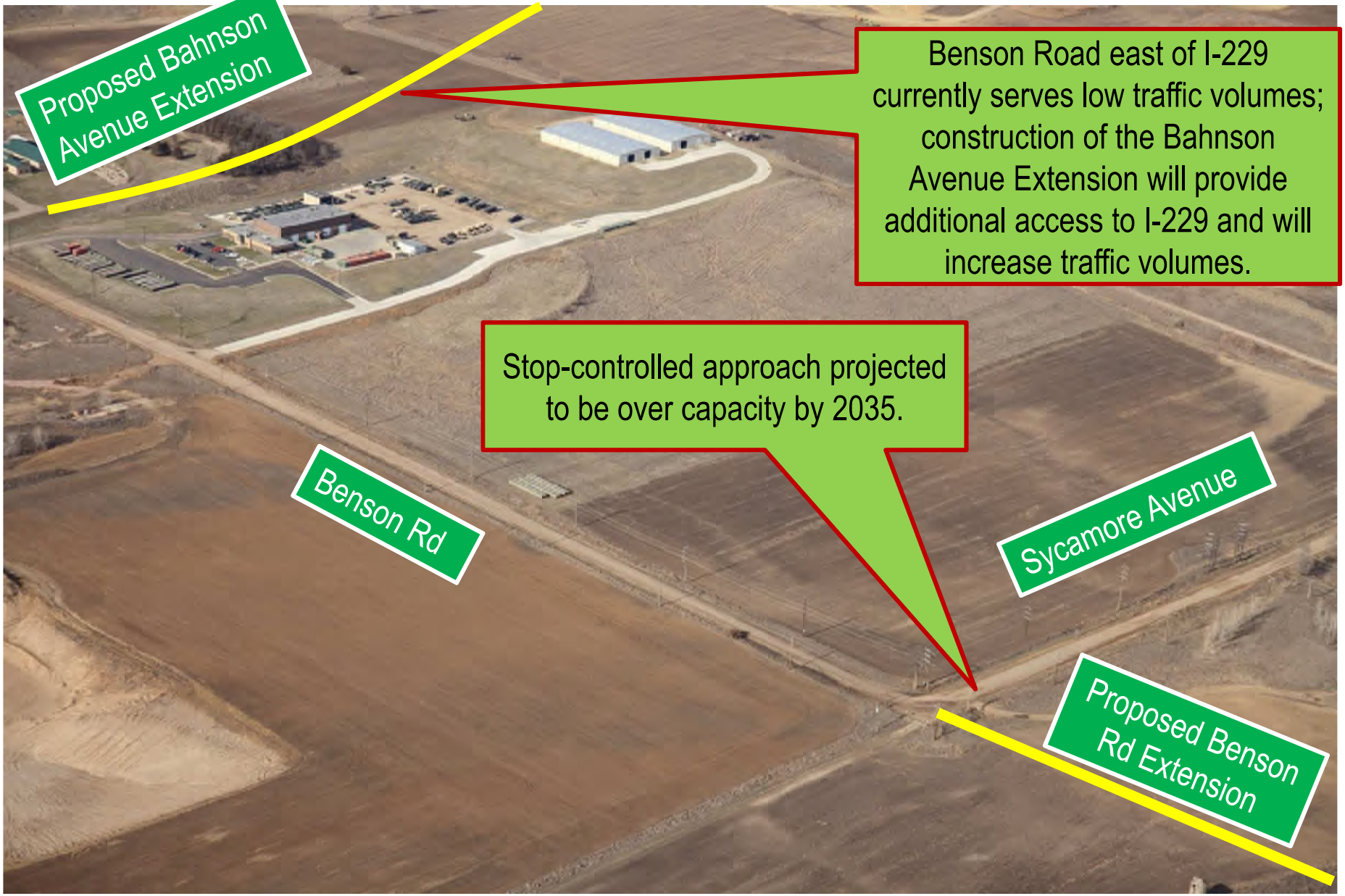
Concept from 2006 I-229 and I-90 Study



Concept from 2010 Decennial Study



Benson Rd Corridor Overview



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

Thanks for Attending!!!!!

HDR

HRGreen

© 2014 HDR, all rights reserved.

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.

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(87) 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	HARSH PATEL	2616 E 10TH STREET SIOUX FALLS SD 57103	605 338 8881	gm@supers1oux falls.com
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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(67) 36167; PCN 044K **Project No.:** 207000

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.	515 971-7184	jajr4p630gmail.com
2	Mark Elsion	101 S. Cleveland Ave	605-338-8151	melsion@sio.midco.net
3	Mike Bruns	2310 E 10th	605-728-1570	mike@buildersnw.com
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Sign In Sheet

Subject I-229 Major Investment Corridor Study – Stakeholder Meetings for 10th Street Sub-Study

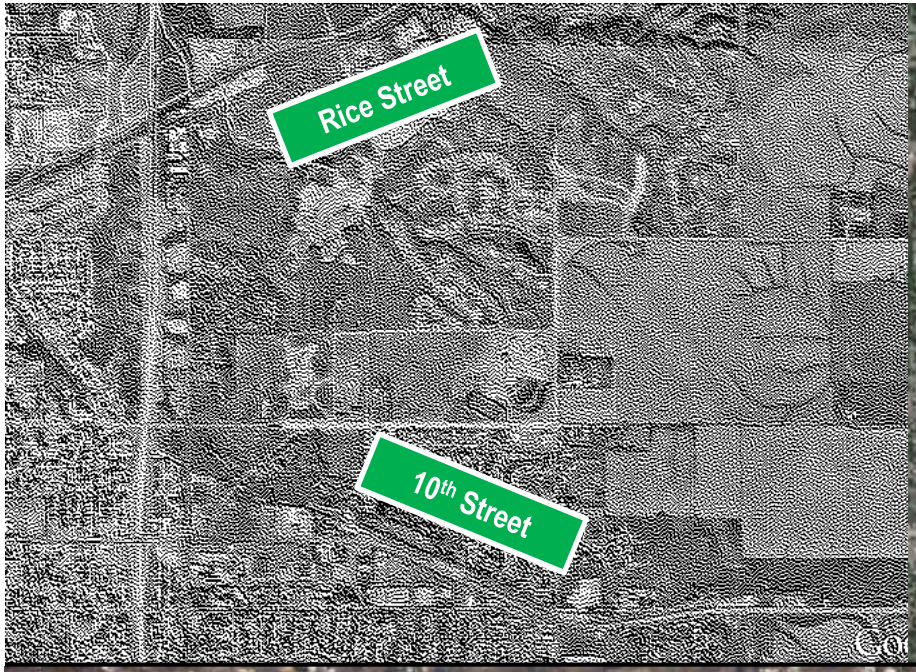
Client City of Sioux Falls/South Dakota Department of Transportation

Project PL 0100(87) 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	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	Layne Breath	2520 W. 8th St SF SD 57104	379-1053	layne.bob.prop@midcontinent.work.com
5	Shannon Ausen	224 [illegible] St	367-8607	sausen@siouxfalls.org
6	Gayle Nelson	2901 S Bahnson 57103	366-5782	DEKDAD@AOL.com
7	Layton C Noonk	301 S. Blaine	3382206	
8	Quality Efficiencies Linon Hart	3503 S Norton Ave Sioux Falls, SD 57105	339-2382	[illegible]@[illegible]construction.com
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







Interstate 229 Major Investment Study

Exit 6 – 10th Street

Stakeholder Meeting
December 16th, 2014
3:30 pm to 4:30 pm

HDR

HRGreen

© 2014 HDR, all rights reserved.

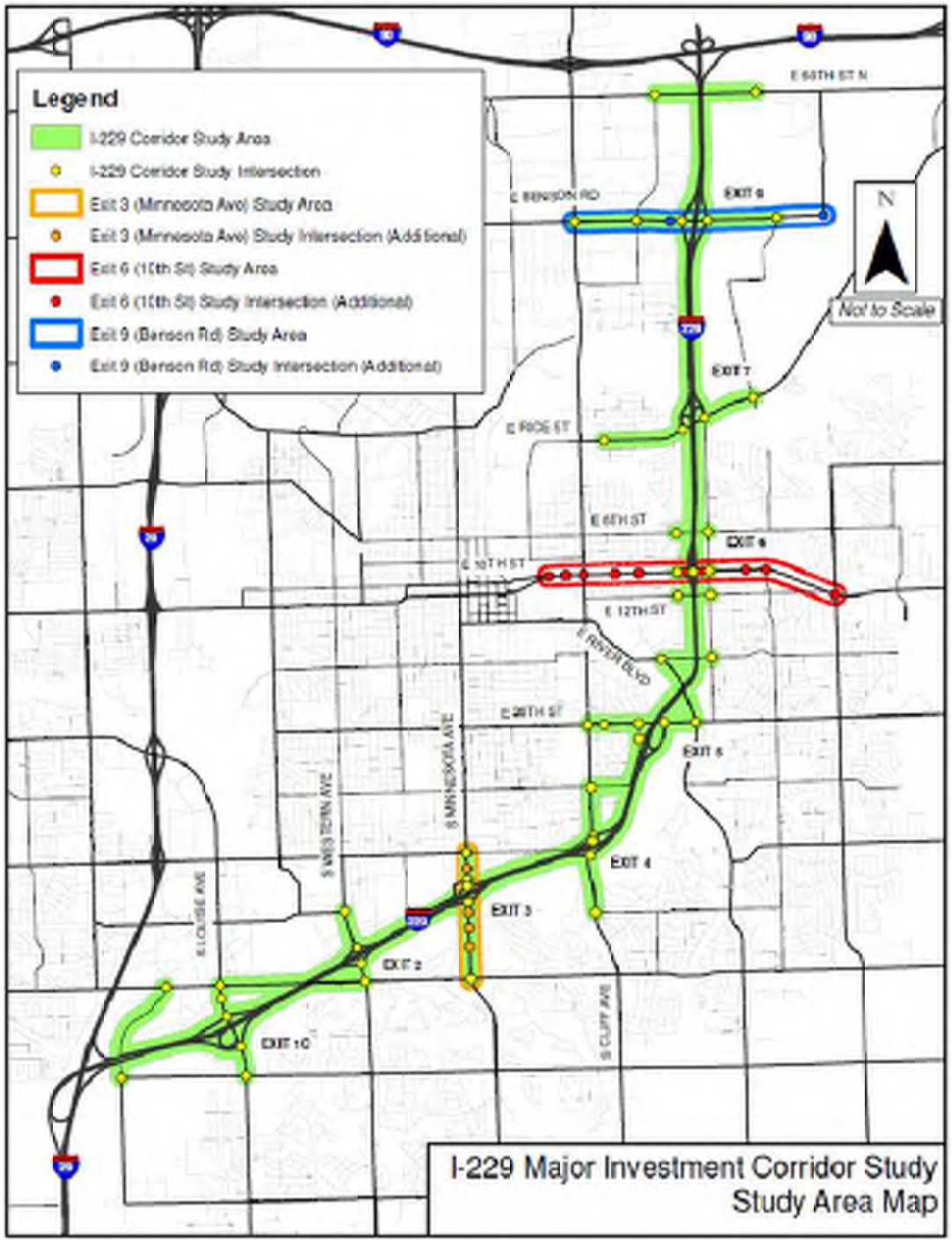
Study Area Map

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

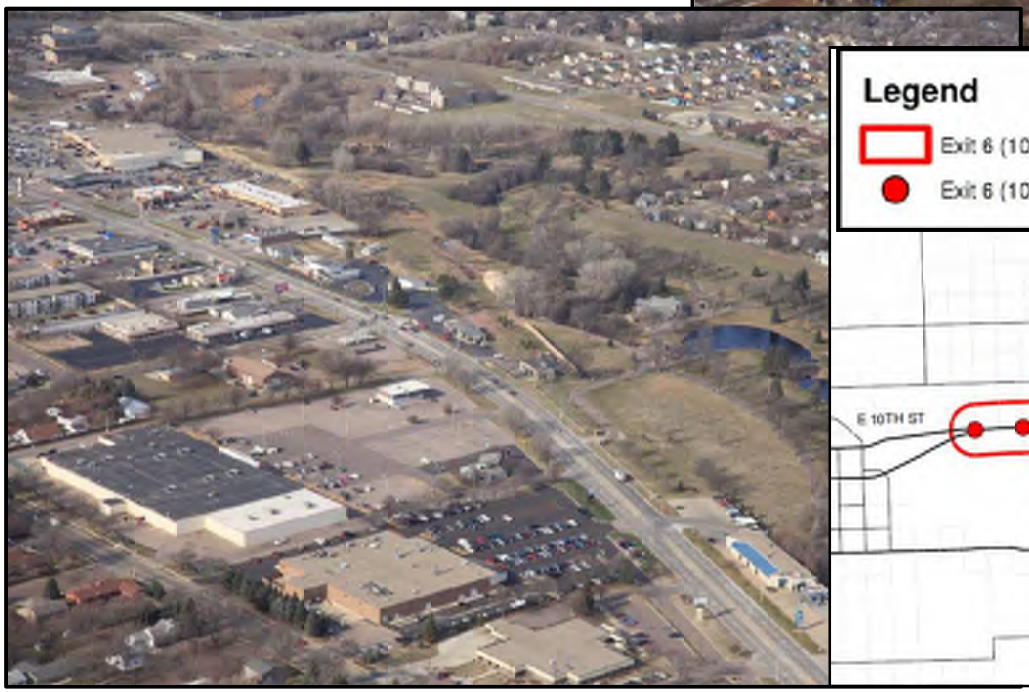
Sioux Falls Metropolitan Planning Organization (MPO)

Federal Highway Administration (FHWA)

Exit 6 (10th Street) Crossroad Study Goals

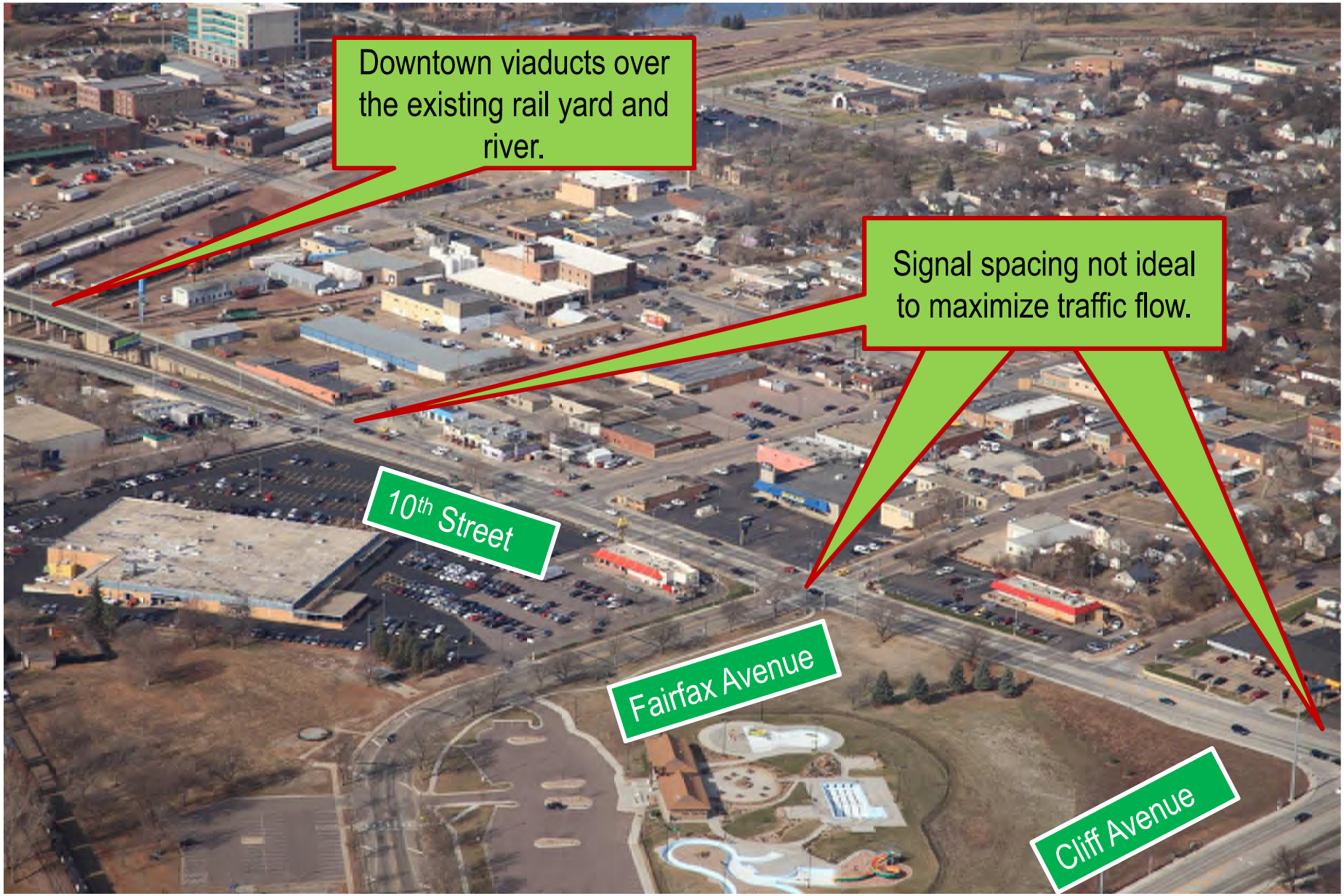
- Reduce traffic congestion
- Develop Corridor Growth Plan to meet traffic demands but minimizing impacts to developed properties
- Improve pedestrian mobility
- Improve safety for corridor users
- Identify improvements to the interchange as well as the 10th Street and Cleveland Ave intersection



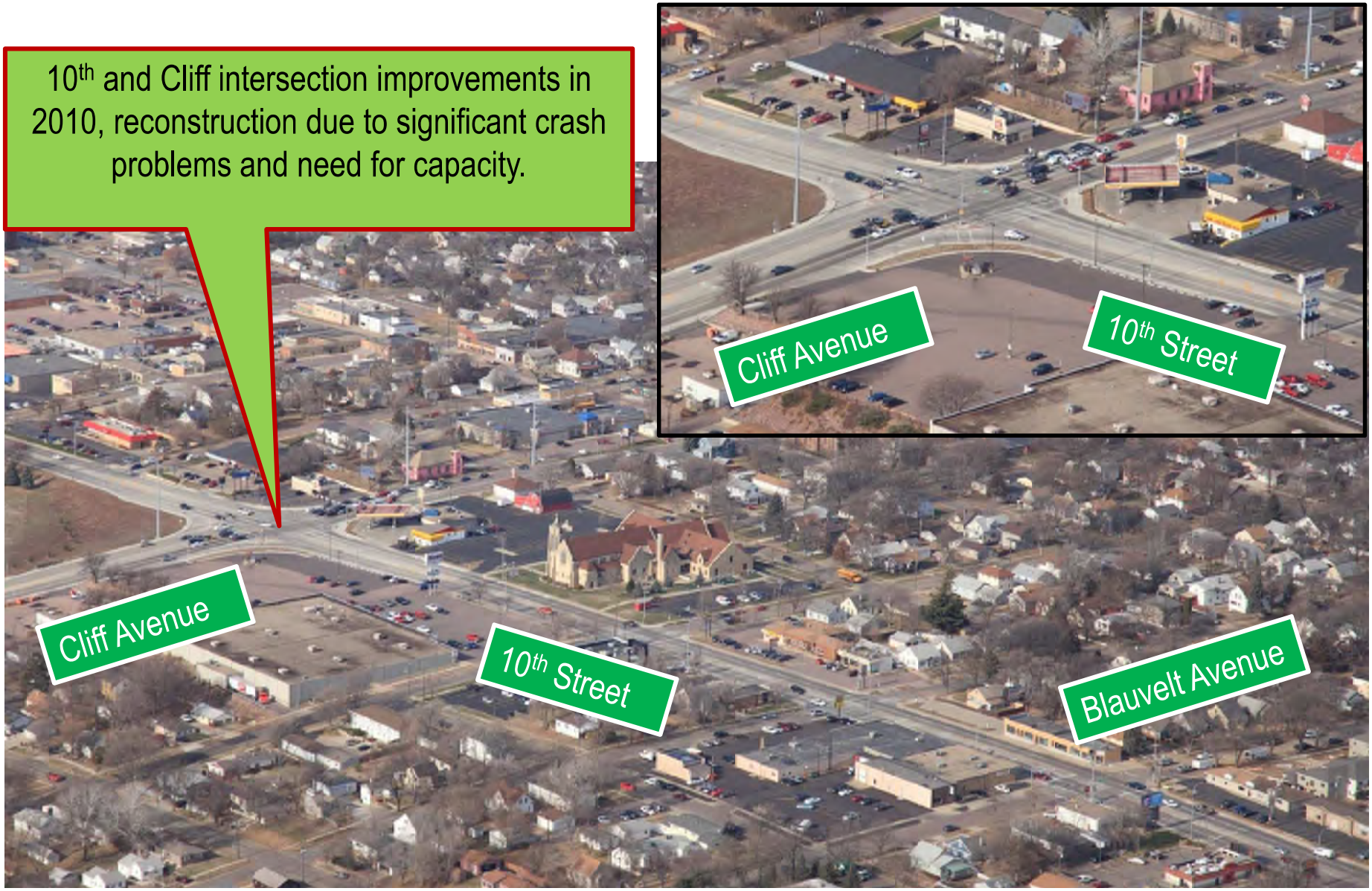




10th Street Corridor Overview



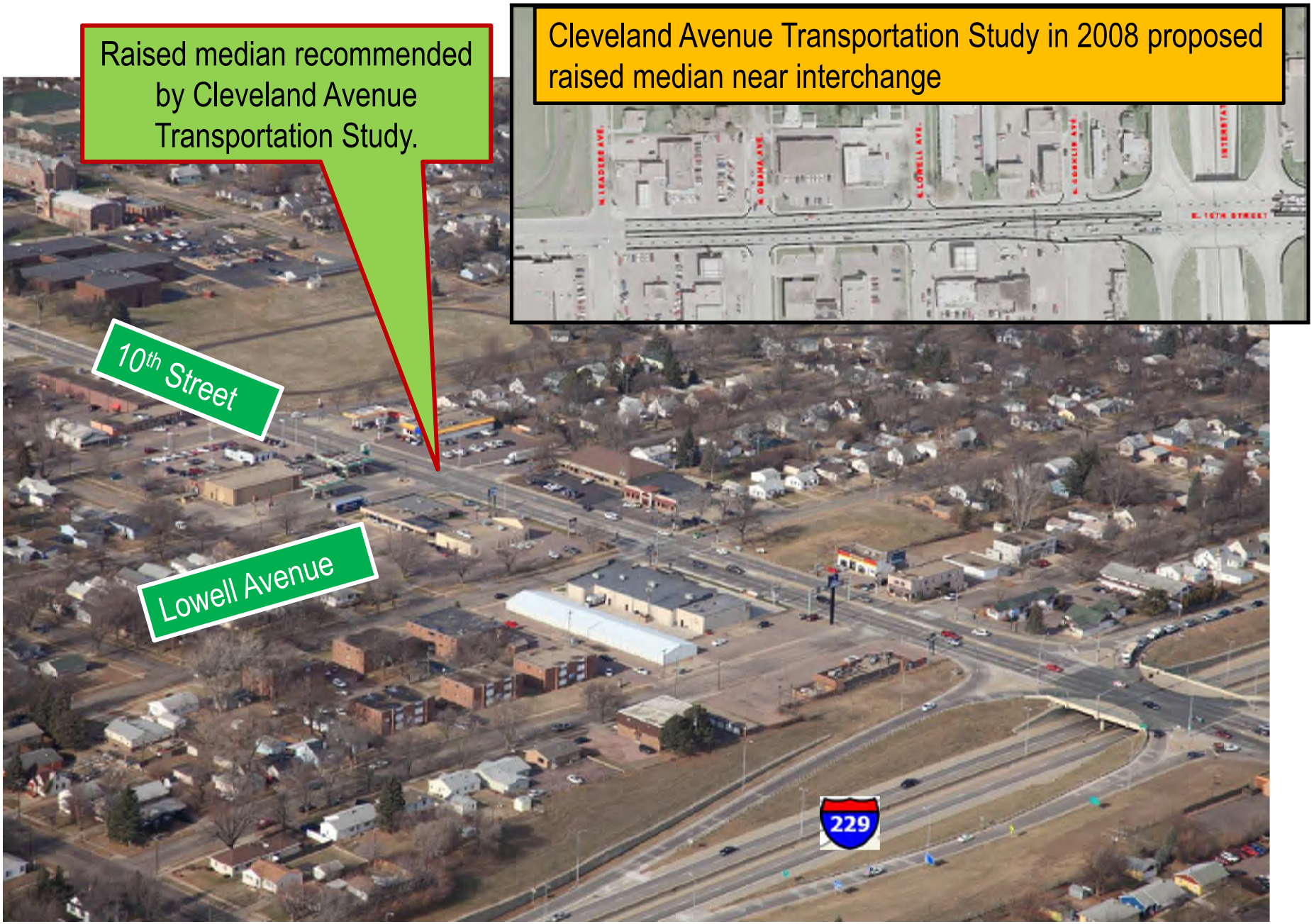
10th Street Corridor Overview



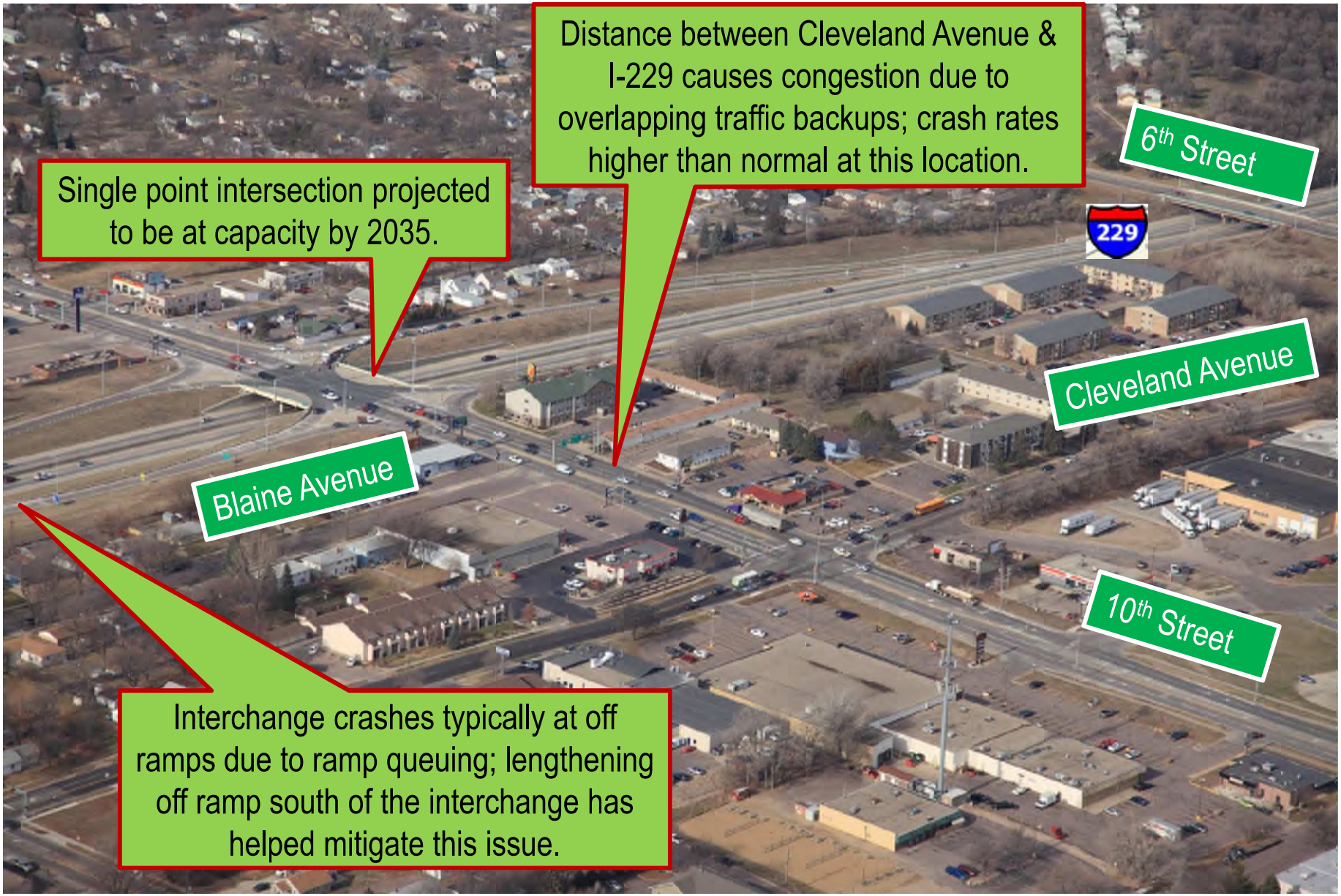
10th Street Corridor Overview



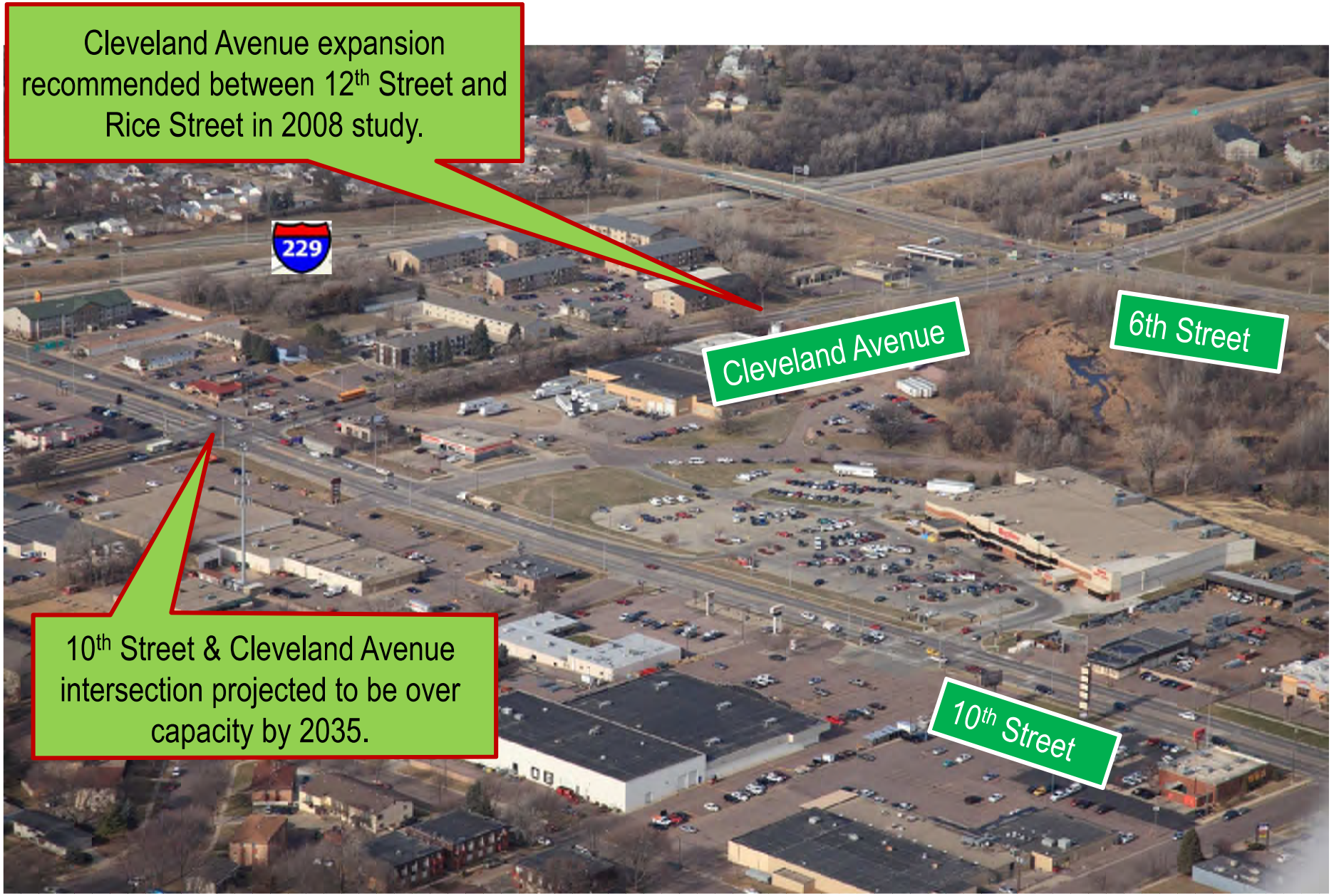
10th Street Corridor Overview



10th Street Corridor Overview



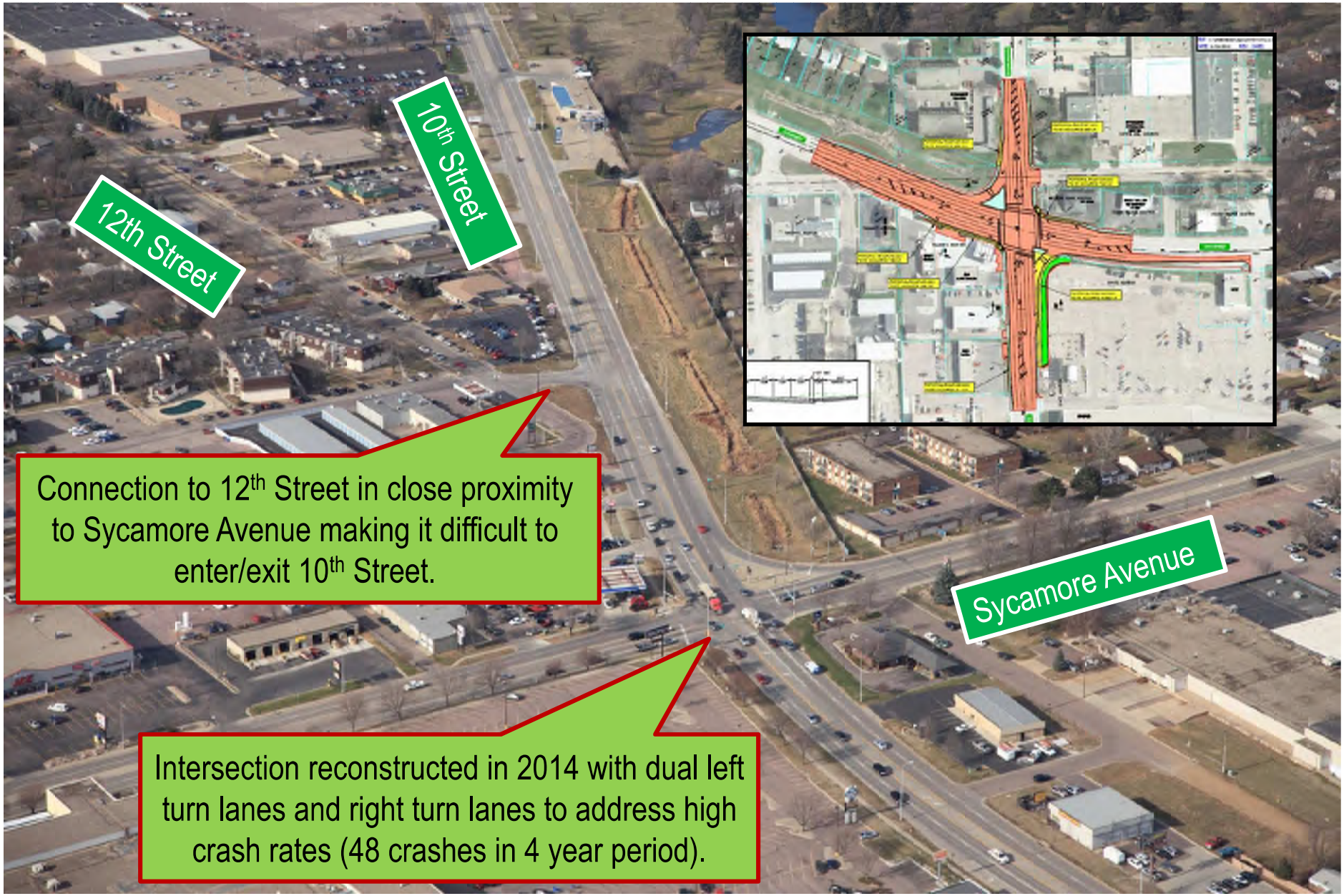
10th Street Corridor Overview



10th Street Corridor Overview

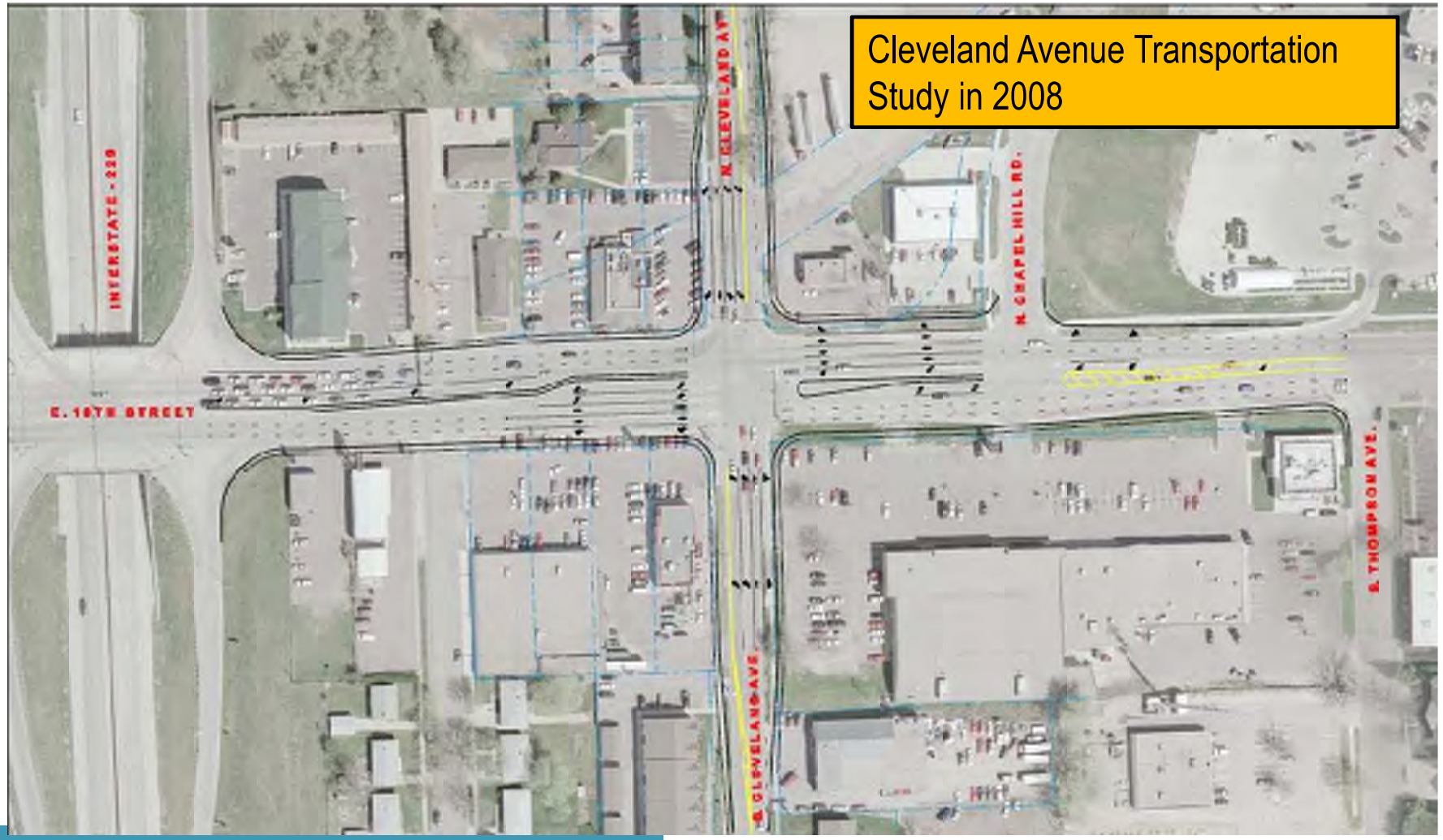


10th Street Corridor Overview



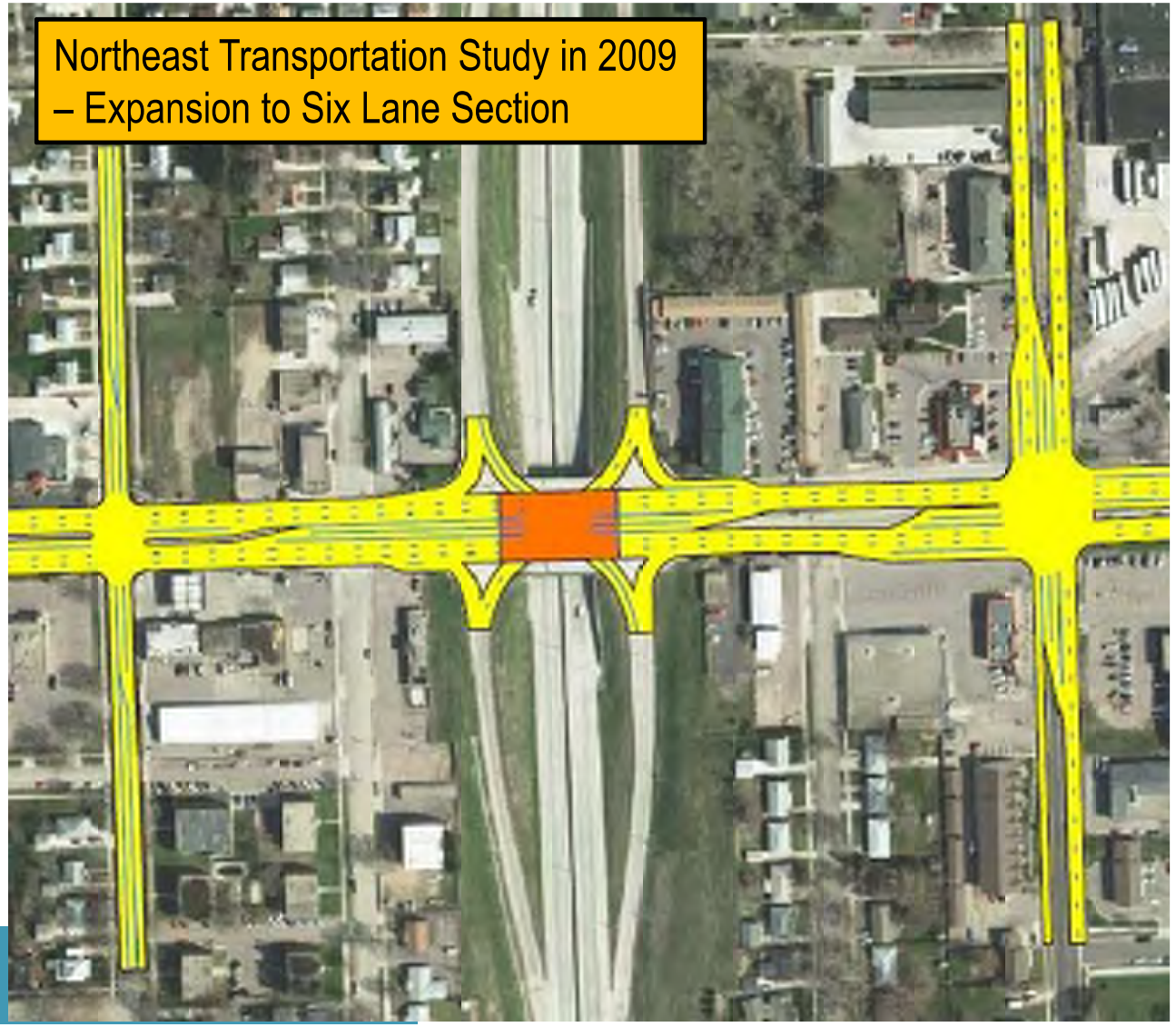
Previous Study Ideas for 10th Street Corridor

- Cleveland Ave. Transportation Study



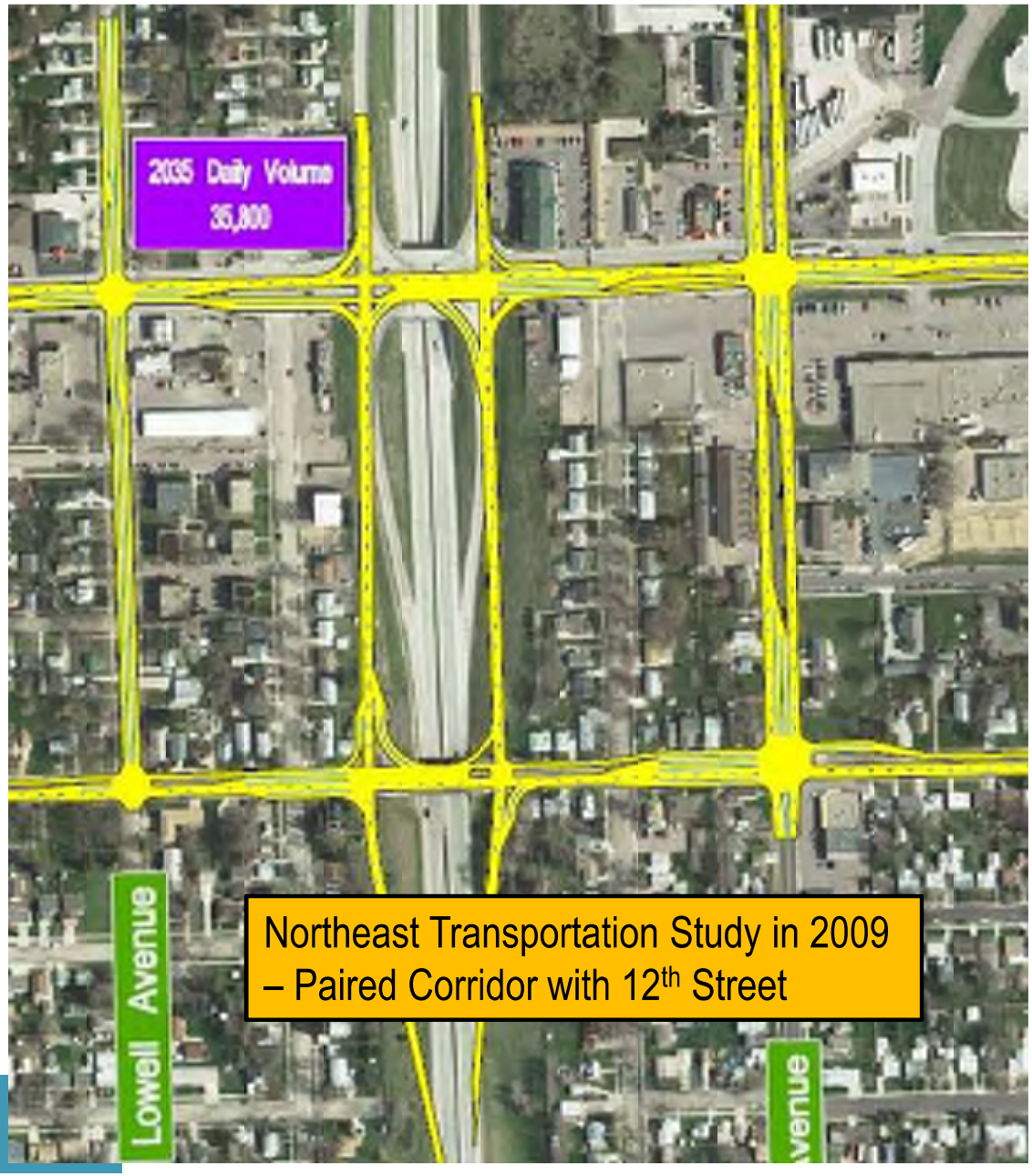
Previous Study Ideas for 10th Street Corridor

- **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!!!!!

HDR

HRGreen

© 2014 HDR, all rights reserved.

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.

- 57th Street and Minnesota: 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 PI. 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 Auser	224 W. 9th St SF SD	367-8607	Sauser@siouxfalls.org
2	Bob Bottine	3600 S. Dakota Ave	334-4220	robert.bottine@dakotabilities.org
3	Pam Taylor	5000 S. Sunny Mede Cir Sioux Falls	332-6509	Pam.Jansa@gmail.com
4	Steve Sherman	3800 S. Grange	359-7857	ssherman@jackhenry.com
5	Cindy Shrewsbury	4300 So. Pine Cone Place	367-6871	Cabeson@AOL.com
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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) 3615P, 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
2	Thomas Hein	6100 E. Hein Place SE 57110	361-8400	Theinmail@gmail.com
3	Paul Nikolas	5316 W. 60th St. N.	367-5680	Paul.Nikolas@state.sd.us
4	Ann Kelly	4601 S. Minn Ave.	334-2838	
5	Normande Haai	4600 W. 12th.	605-366-3233	norm.dehaai@billionauto.com
6	BRIAN SATHER	3308 S. Minn, #108 Bank 600 E AUTUMN LN	338-3243	gdentted@hotmail.com
7	John Hart	1309 W. 51st	444-6320	j.hart@vea-dakotas.org
8	MARK KOZEL	4040 S. GRANGE AVE	336.0860	mkozel@lampertyards.com
9	Richard Elmen	3501 S. Minnesota	366 0252	relmen@rentall-inc.com
10	Kelly Vis	404 S. Grange Ave	336-6860	kvis@lampertlumber.com
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







Interstate 229 Major Investment Study

Exit 3 – Minnesota Avenue

Stakeholder Meeting
December 16th, 2014
1:30 pm to 2:30 pm

HDR

HRG
HRGreen

© 2014 HDR, all rights reserved.

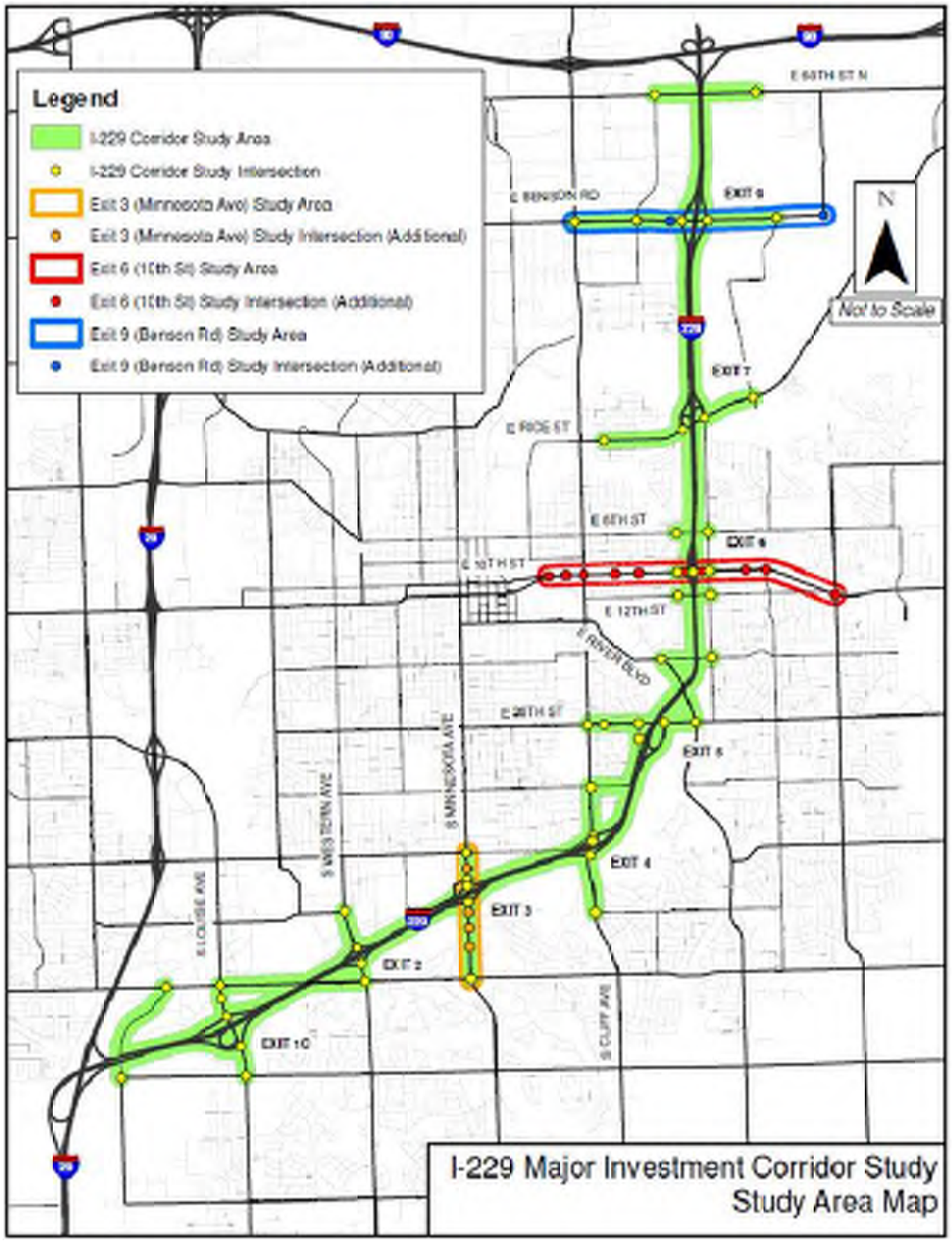
Study Area Map

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



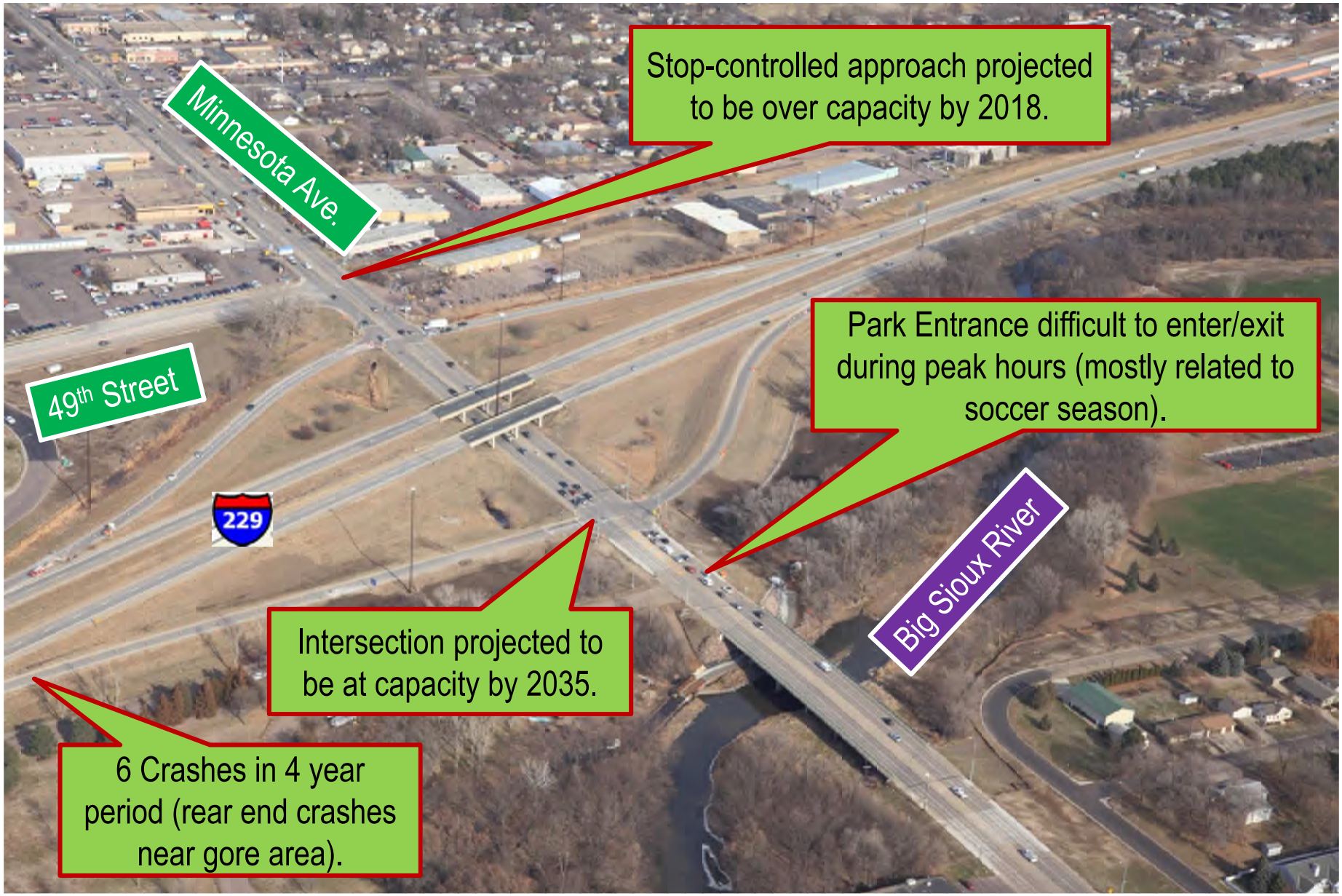




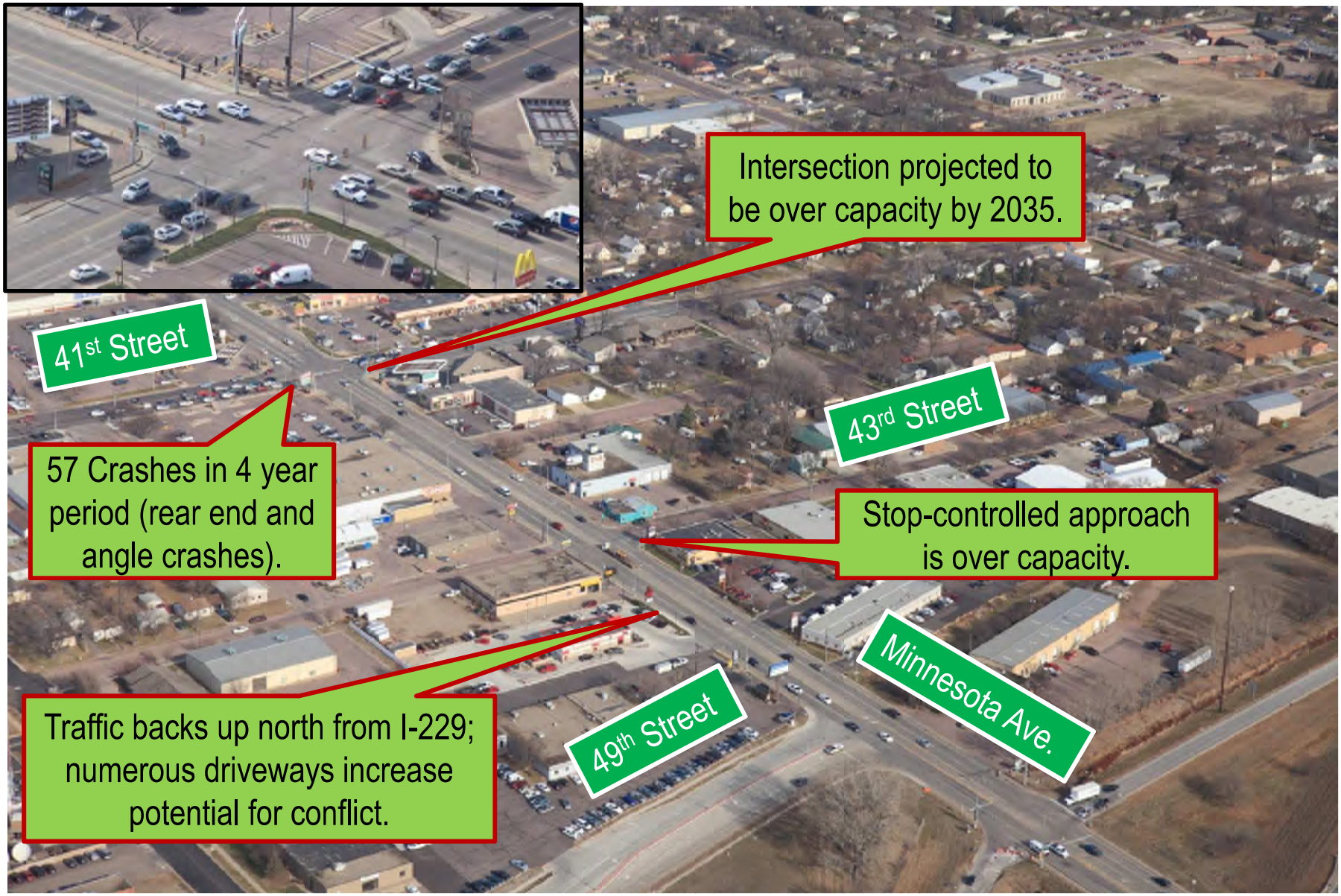
Minnesota Avenue Corridor Overview



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!!!!!

HDR

HRGreen

© 2014 HDR, all rights reserved.

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 Nahr Myr le Roy's Paving	1300 N. Bahnson Ave	334-3204	Patty.n@marpaving.com
2	DARREL HOYER	1300 N. BAHNSON AVE SFSD	334-3204	daunal.hoyer@myrlaad royspaving.com
3	Milt Nussbaum	2900 East Rice St SFSD	605-338.0053	[illegible]
4	PAN KEARNY	47046 259 ST SFSD	351-5705	PINBALLFIXER@AOL.COM
5	Harold Doerr	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
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







Interstate 229 Major Investment Study

Exit 7 – Rice Street

Stakeholder Meeting
June 22nd, 2016
1:00 pm to 2:00 pm

HDR

© 2014 HDR, all rights reserved.

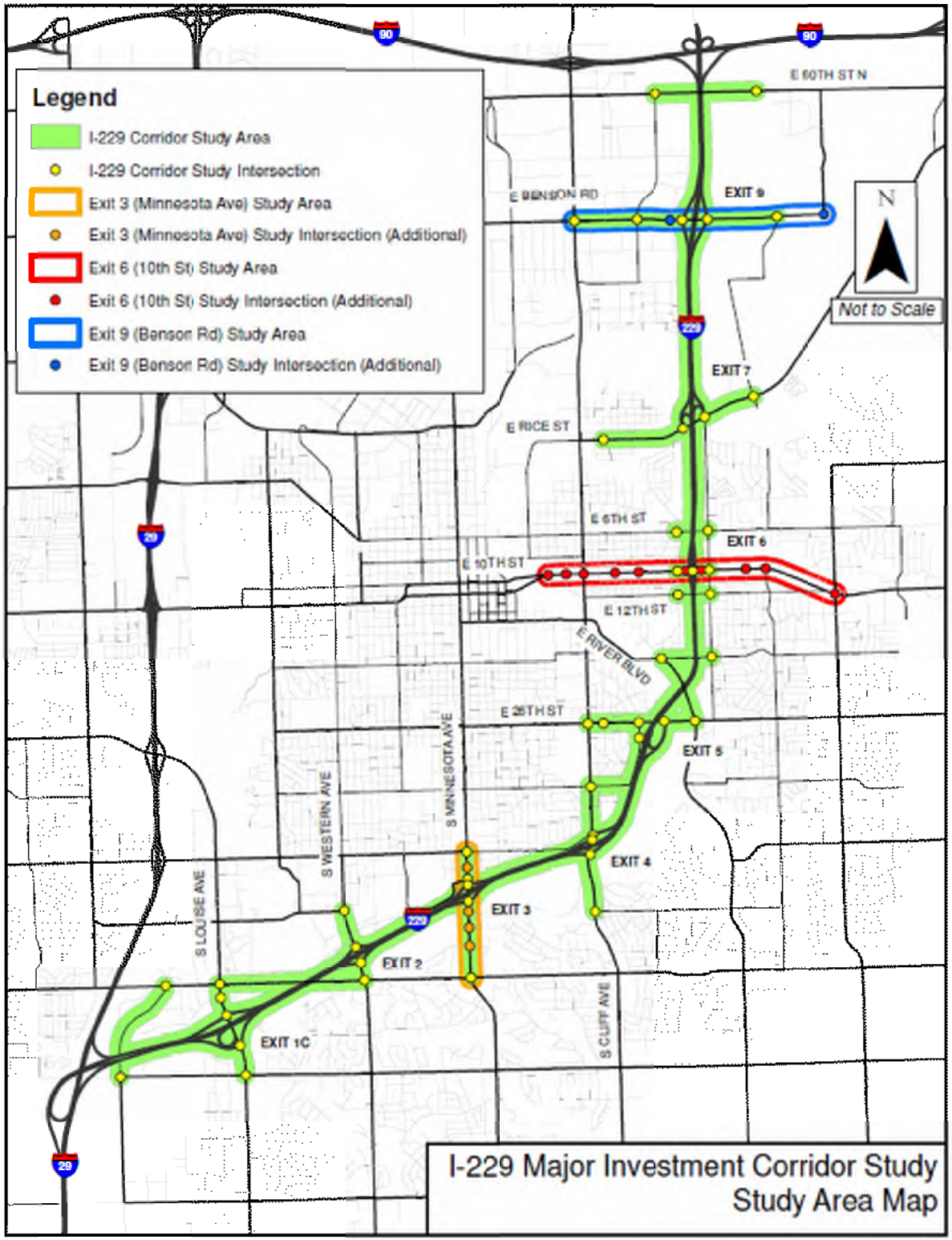
Study Area Map

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)

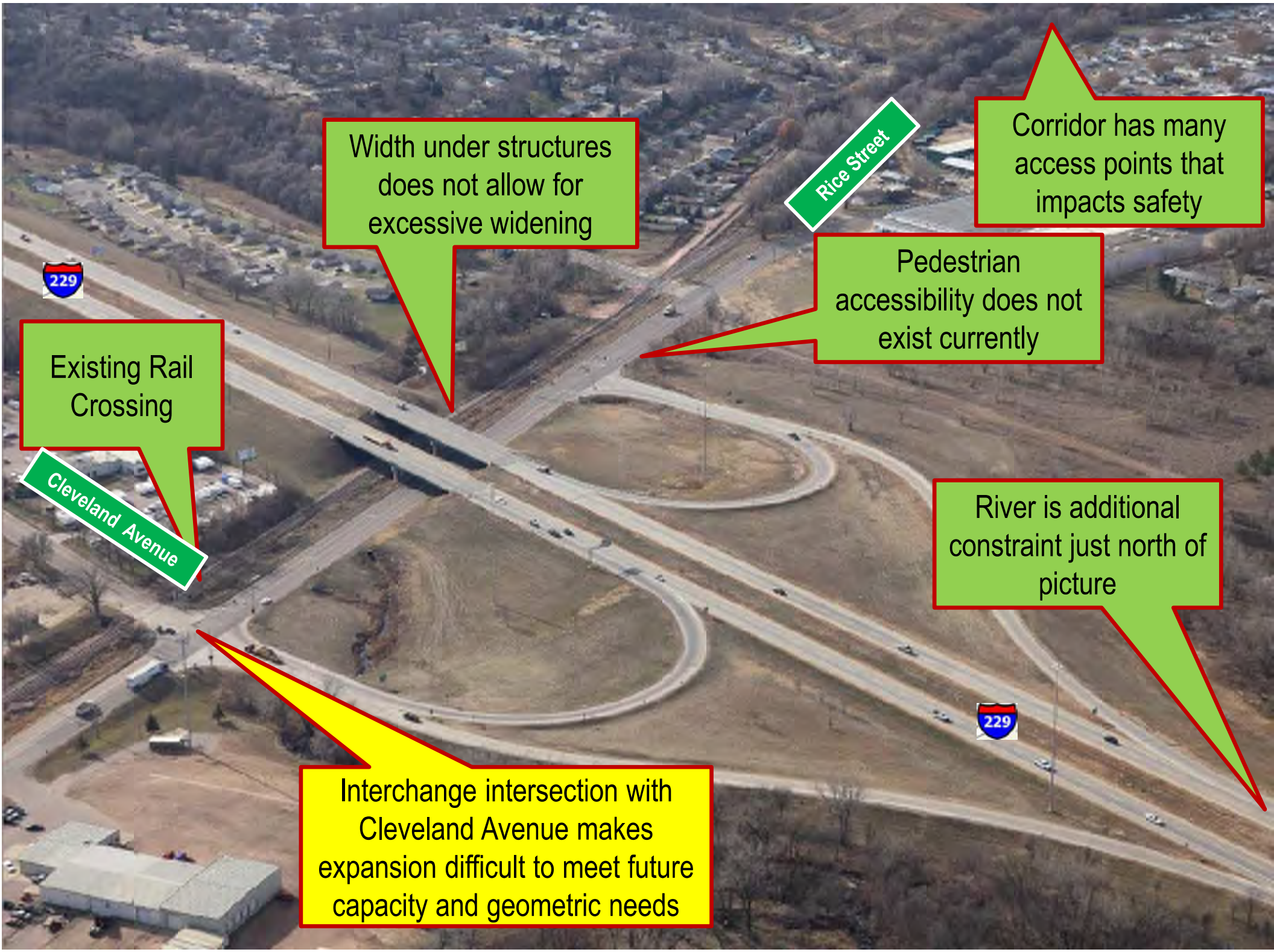
Exit 7 (Rice Street) Crossroad Study Goals

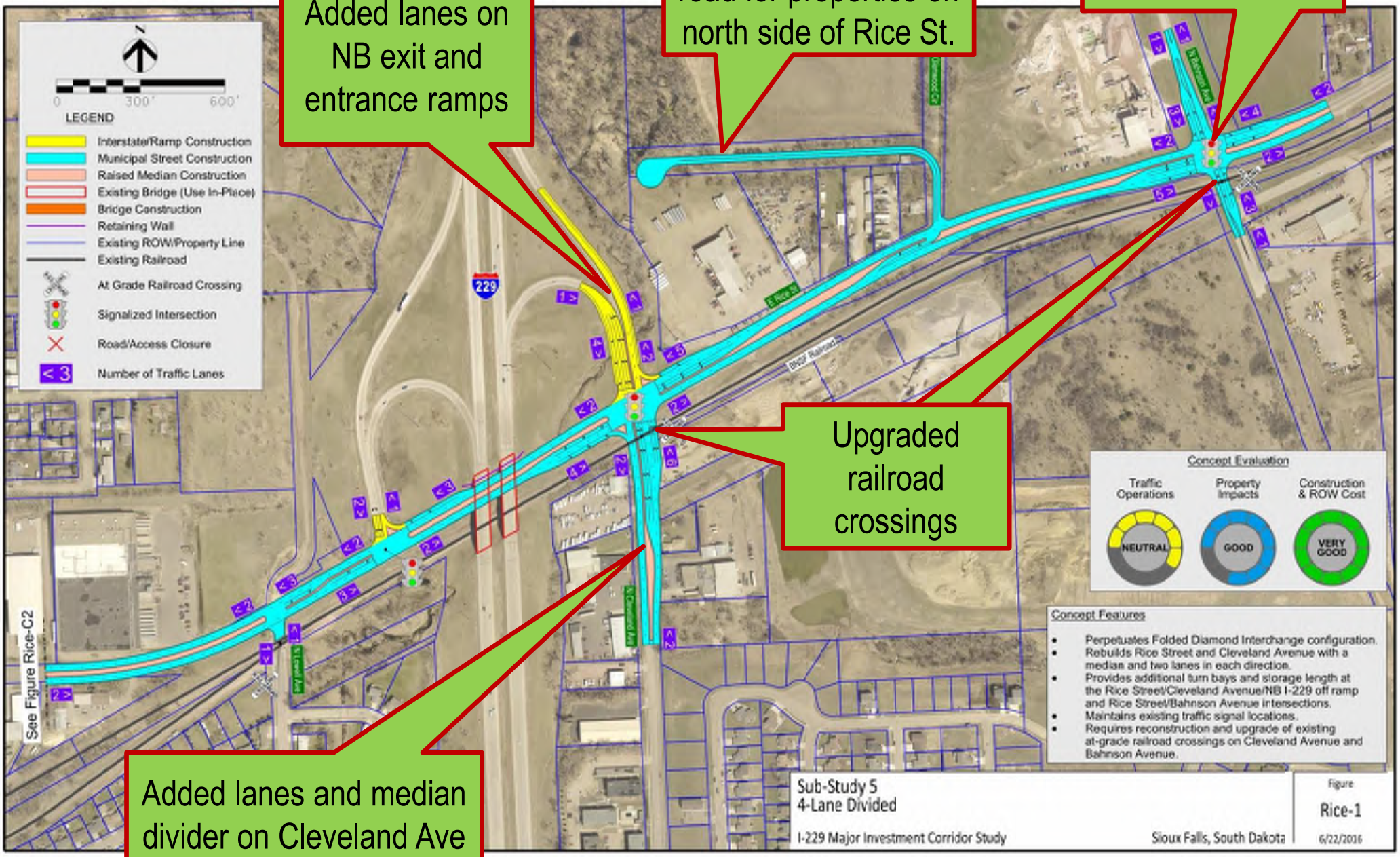
- Reduce traffic congestion
- Provide and Interchange that will meet the future capacity requirements
- Improve pedestrian mobility
- Improve safety for corridor users

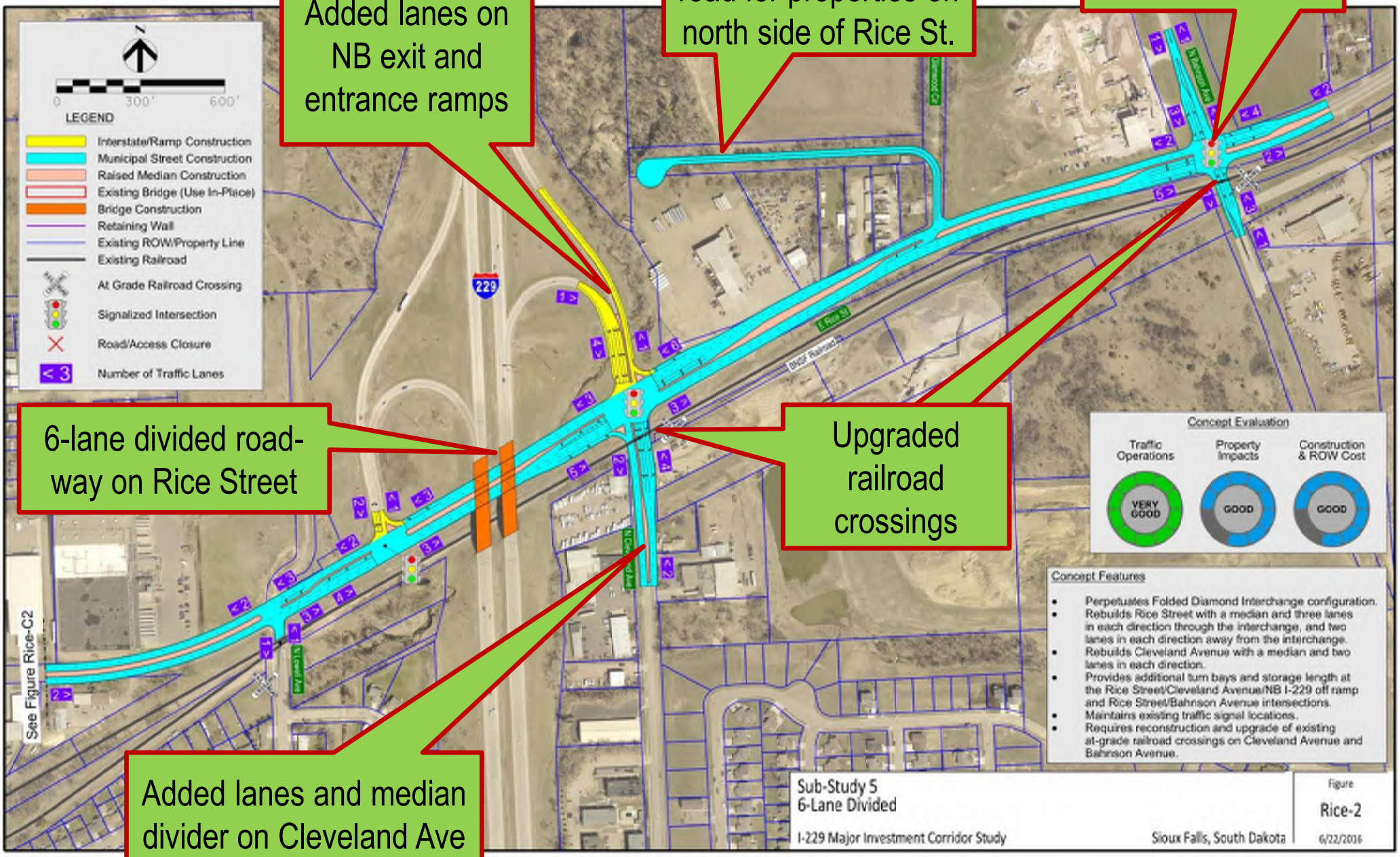


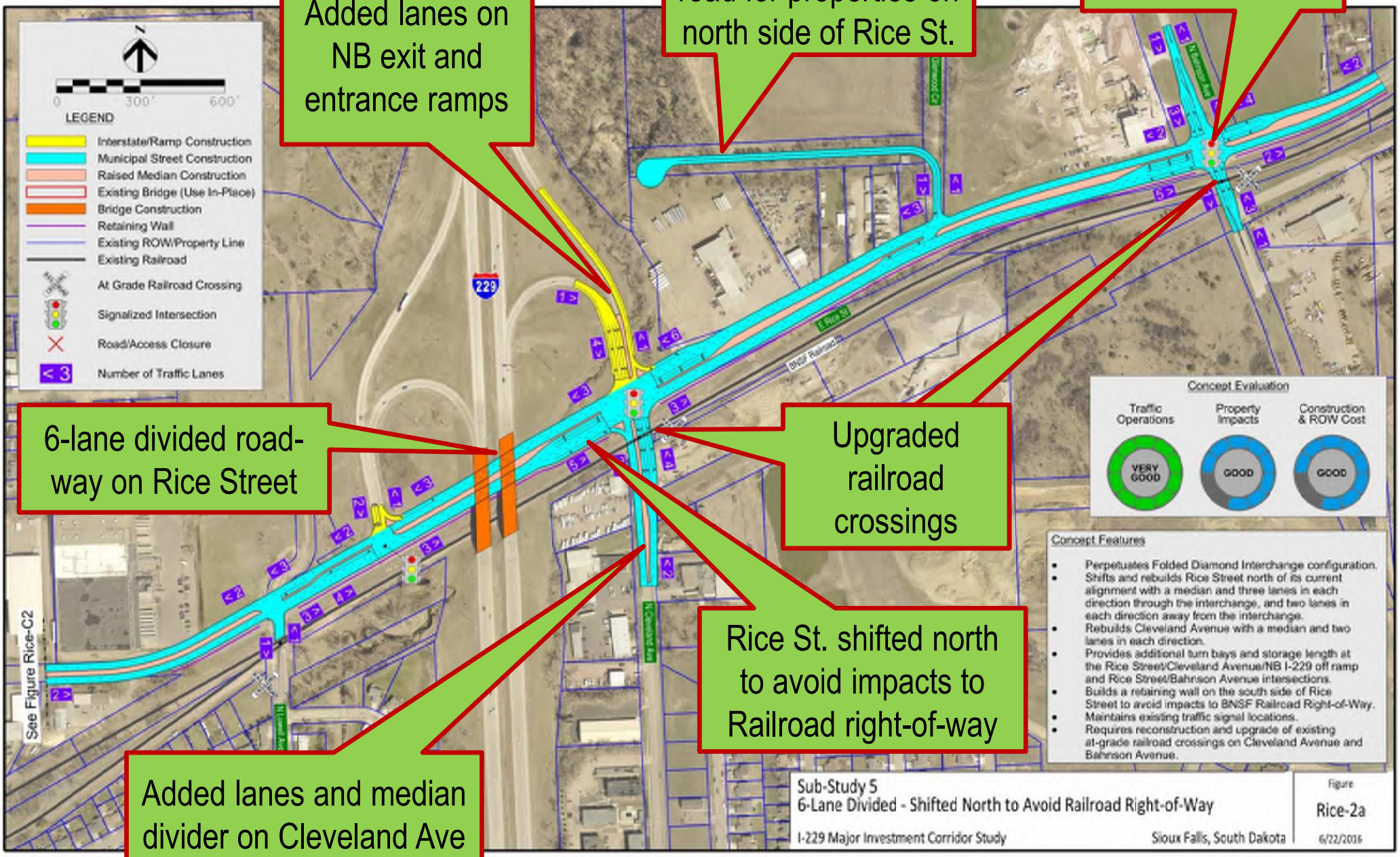


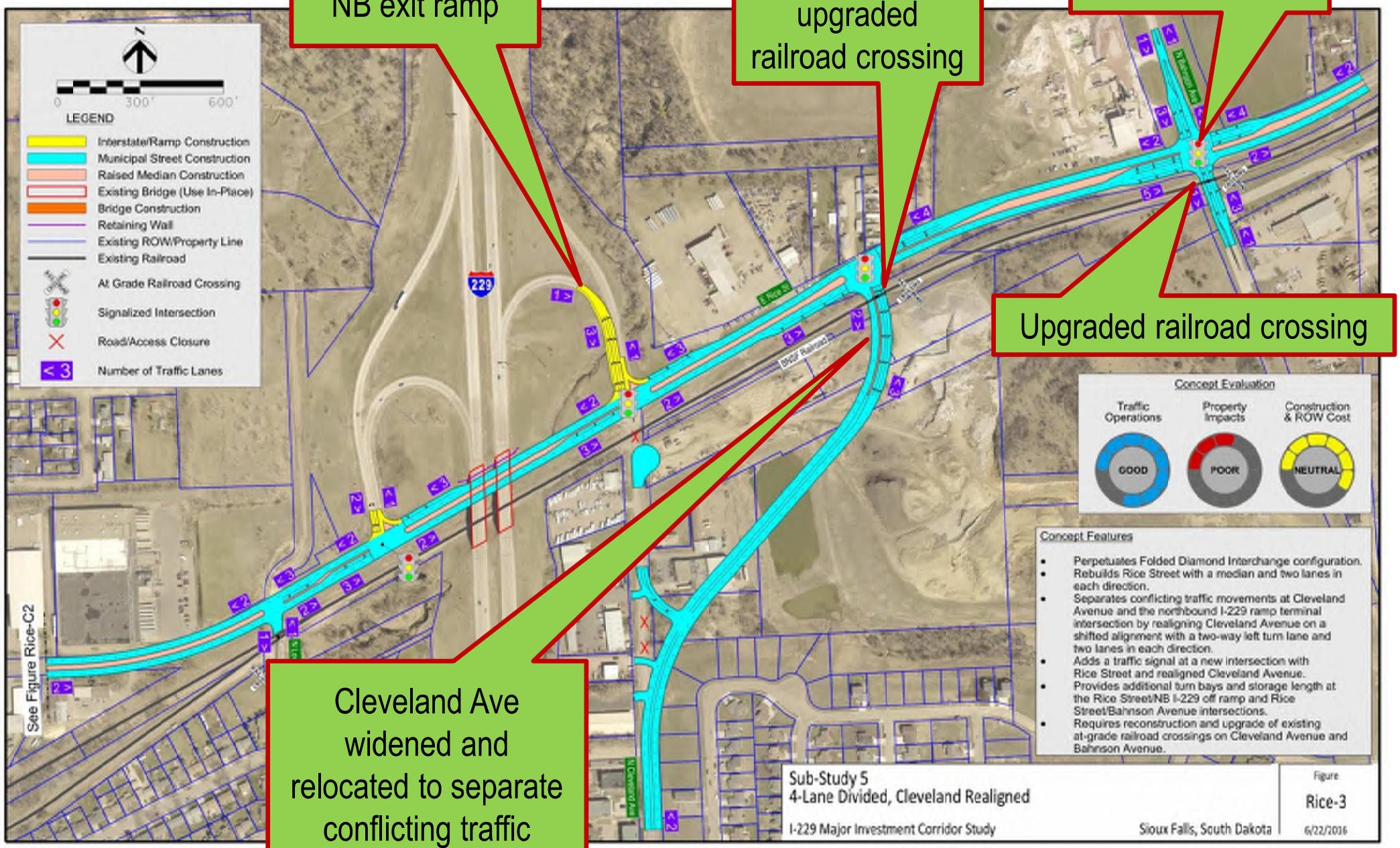


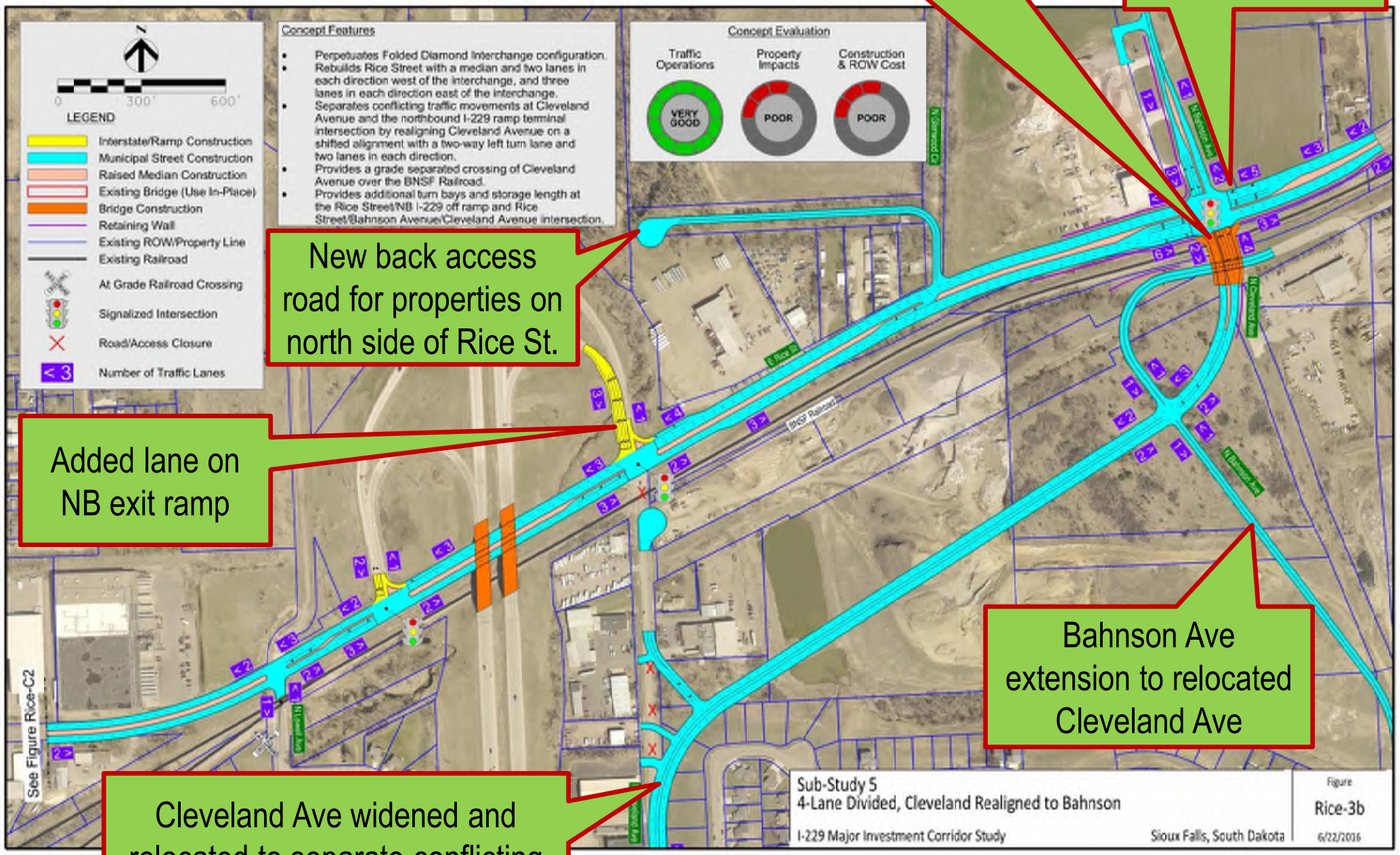

Width under structures does not allow for excessive widening
Rice Street
Corridor has many access points that impacts safety
229
Pedestrian accessibility does not exist currently
Existing Rail Crossing
Cleveland Avenue
River is additional constraint just north of picture
229
Interchange intersection with Cleveland Avenue makes expansion difficult to meet future capacity and geometric needs

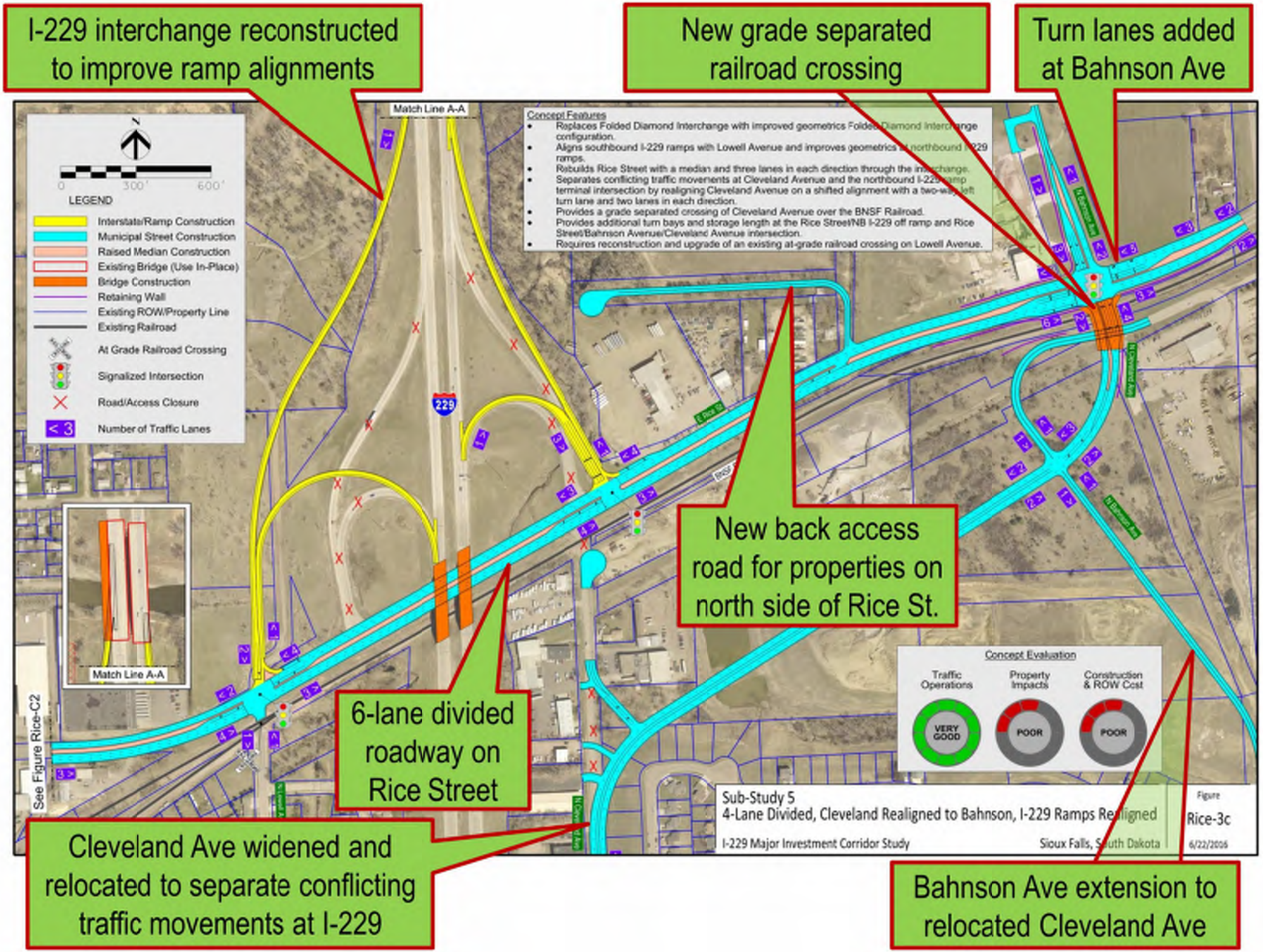

Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
Upgraded railroad crossings
Added lanes and median divider on Cleveland Ave
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
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
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.
See Figure Rice-C2
Sub-Study 5
4-Lane Divided
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-1
6/22/2016

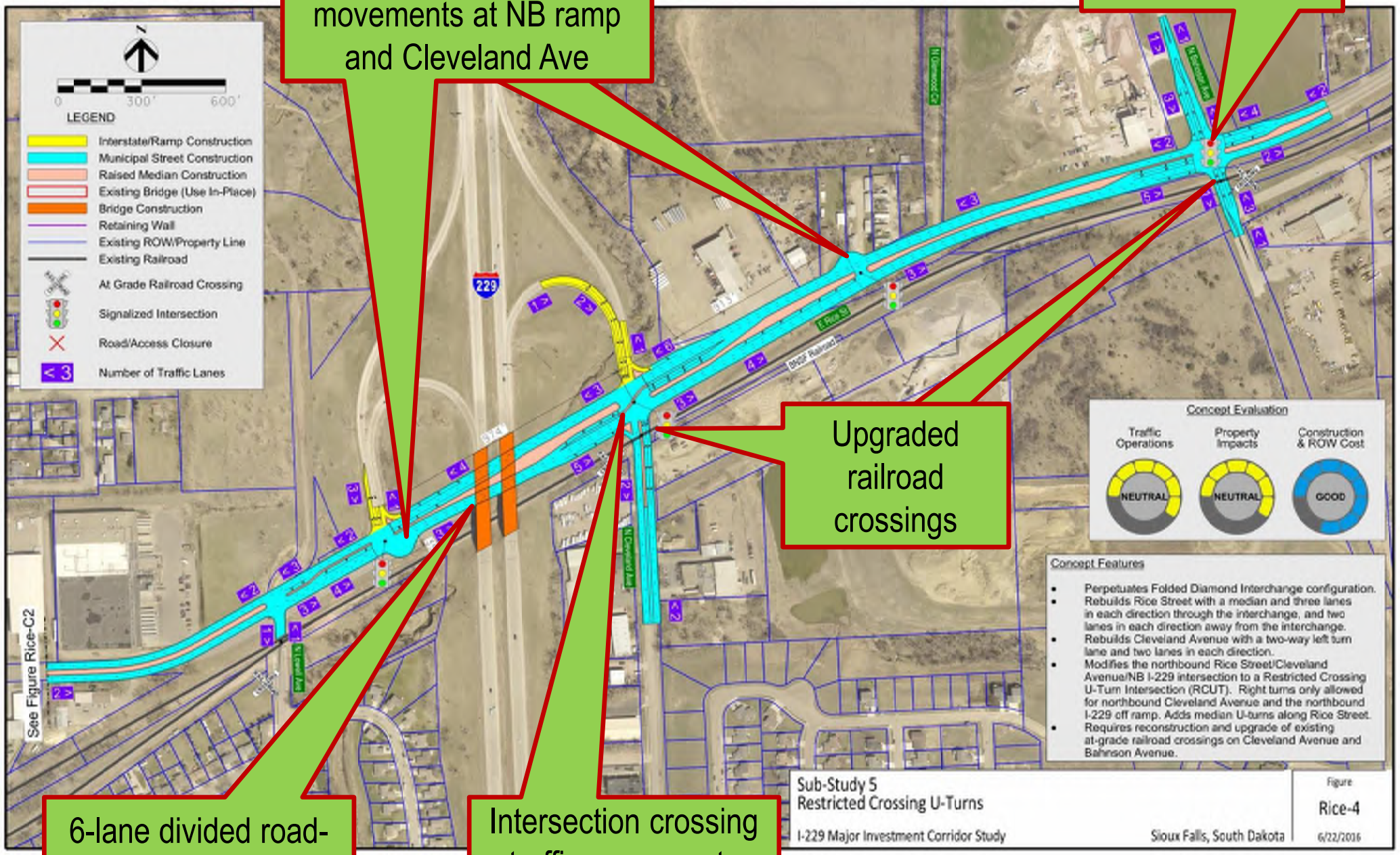

Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
6-lane divided road-way on Rice Street
Upgraded railroad crossings
Added lanes and median divider on Cleveland Ave
LEGEND
Interstate/Ramp Construction
Municipal Street 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
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.
See Figure Rice-C2
Sub-Study 5
6-Lane Divided
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-2
6/22/2016

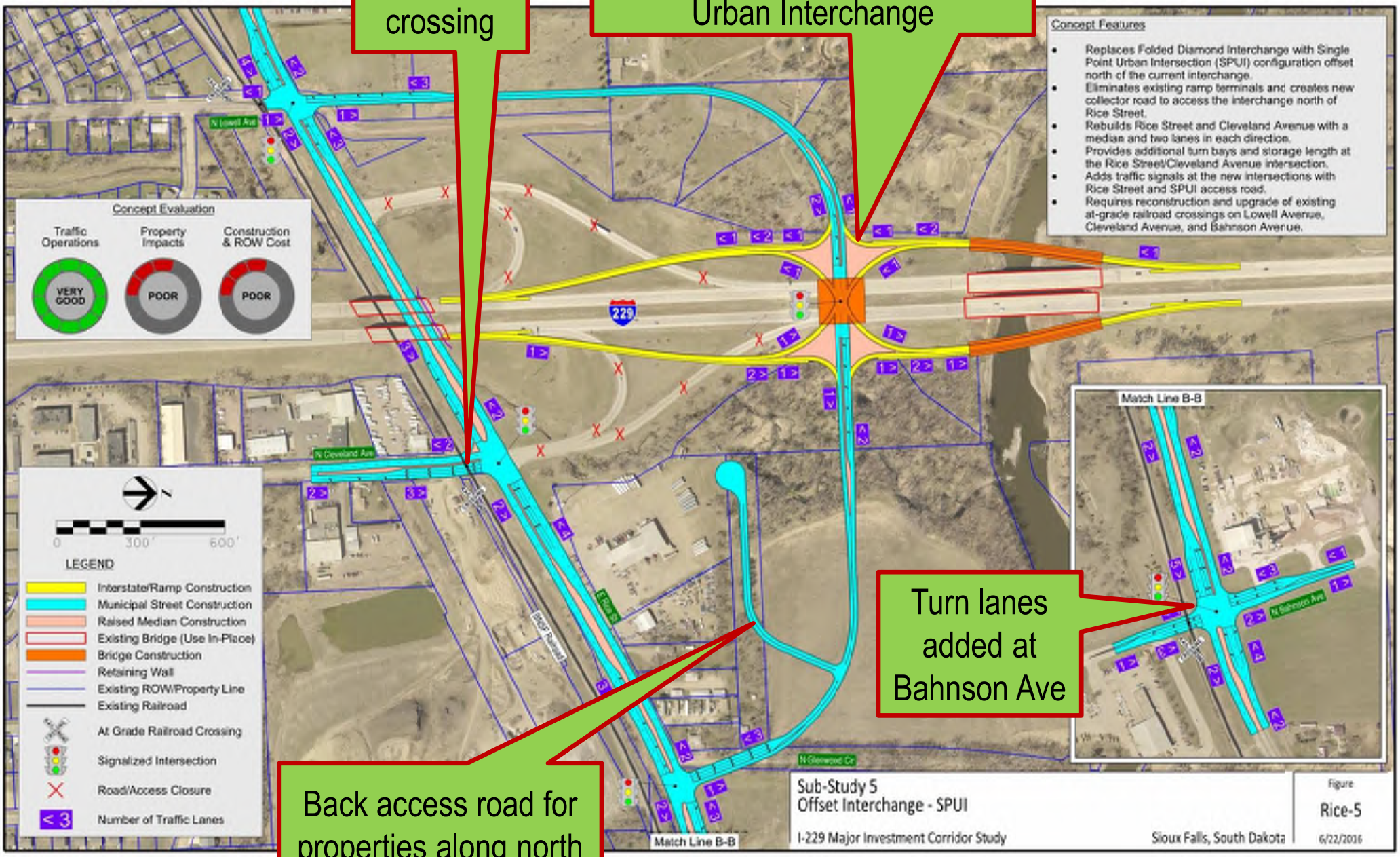

Added lanes on NB exit and entrance ramps
New back access road for properties on north side of Rice St.
Turn lanes added at Bahnson Ave
6-lane divided road-way on Rice Street
Upgraded railroad crossings
Rice St. shifted north to avoid impacts to Railroad right-of-way
Added lanes and median divider on Cleveland Ave
LEGEND
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
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.
See Figure Rice-C2
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

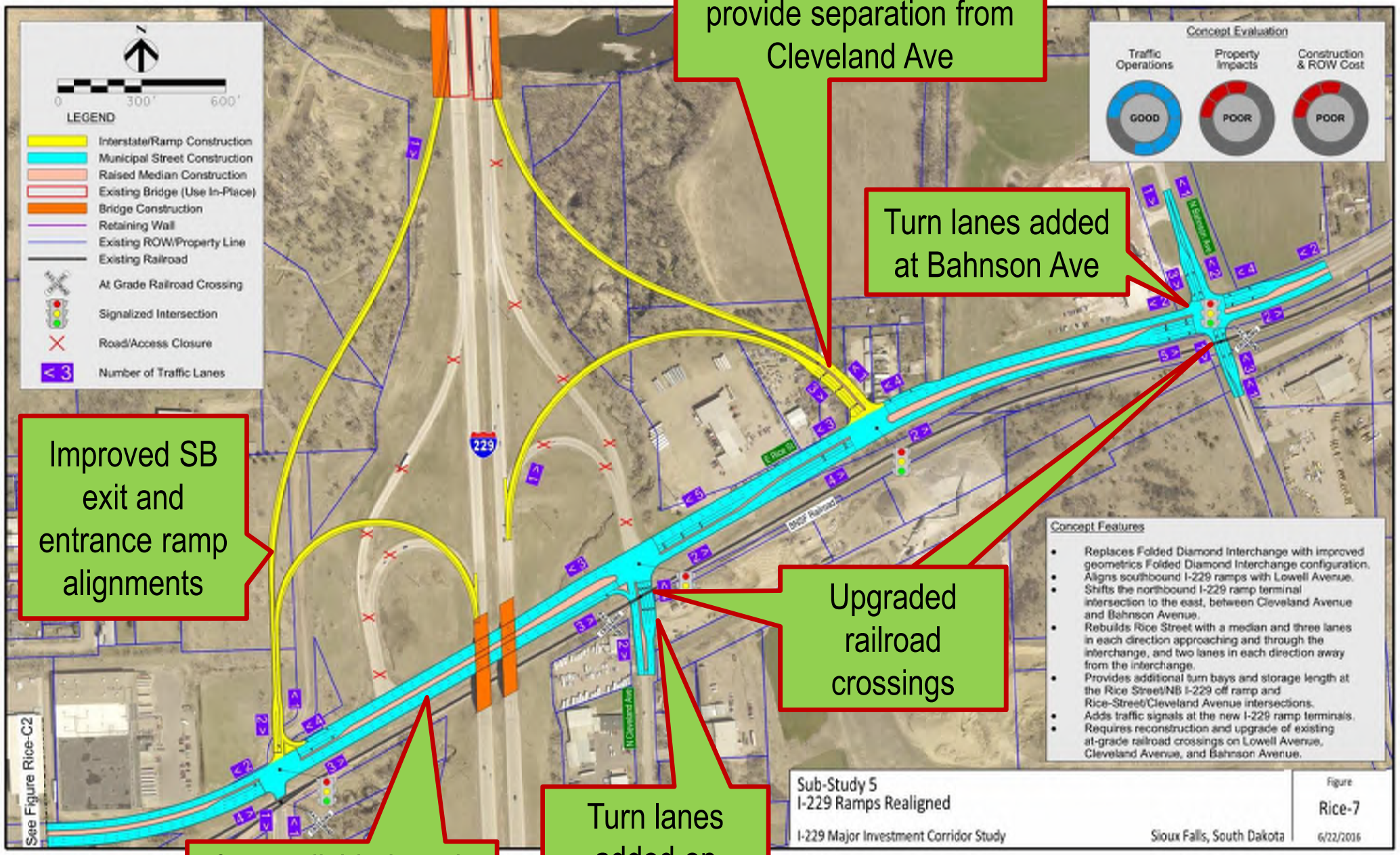

Added lane on NB exit ramp
Relocated and upgraded railroad crossing
Turn lanes added at Bahnson Ave
Upgraded railroad crossing
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
LEGEND
Interstate/Ramp Construction
Municipal Street Construction
Raised Median Construction
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
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.
See Figure Rice-C2
Sub-Study 5
4-Lane Divided, Cleveland Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3
6/22/2016

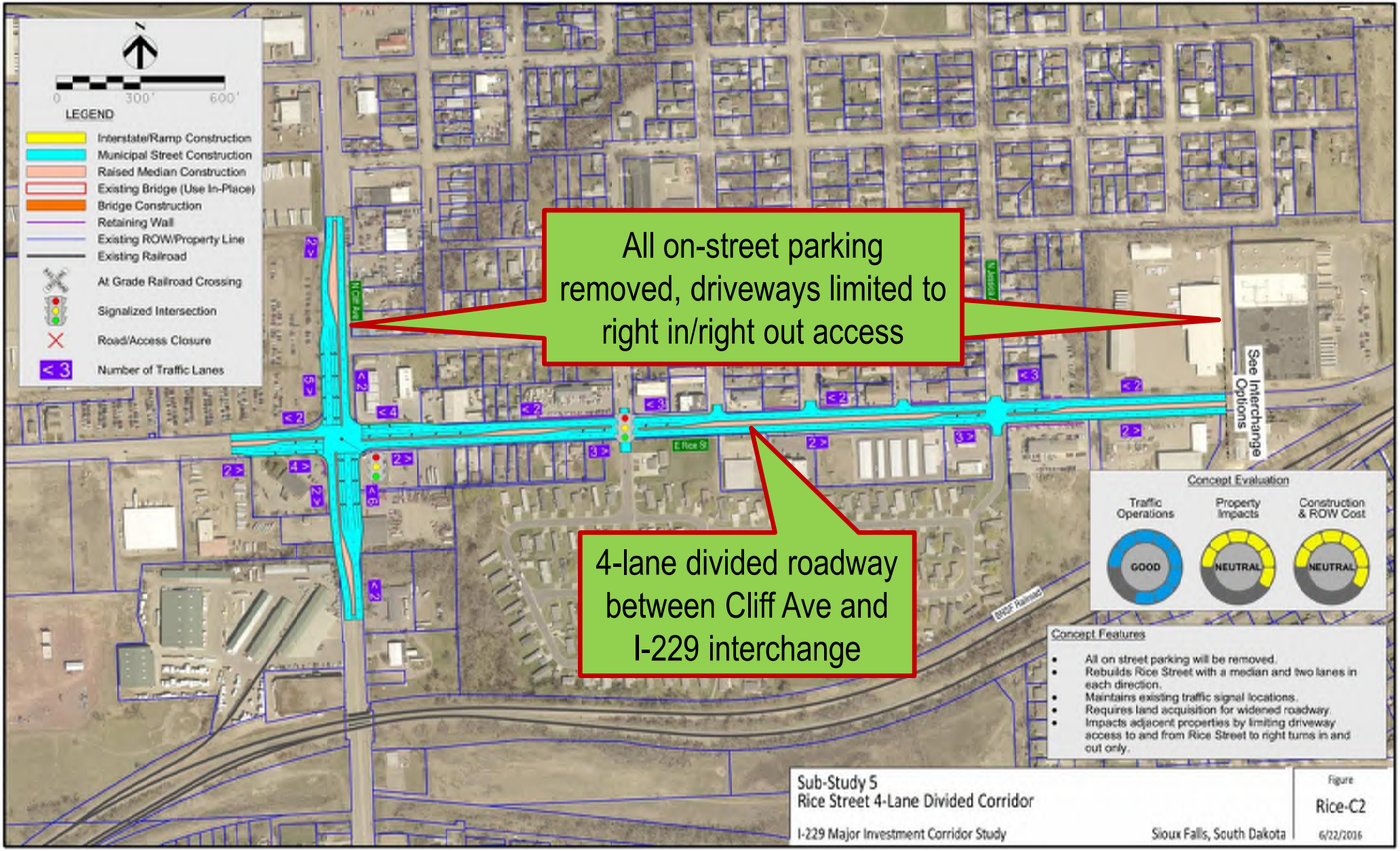

New grade separated railroad crossing
Turn lanes added at Bahnson Ave
New back access road for properties on north side of Rice St.
Added lane on NB exit ramp
Bahnson Ave extension to relocated Cleveland Ave
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
LEGEND
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
New back access road for properties on north side of Rice St.
6-lane divided roadway on Rice Street
Cleveland Ave widened and relocated to separate conflicting traffic movements at I-229
Bahnson Ave extension to relocated Cleveland 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.
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
< 3 Number of Traffic Lanes
229
E Rice St
BNSF
N Cleveland Ave
N Bahnson Ave
N Lowell Ave
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 Ramps Realigned
I-229 Major Investment Corridor Study
Sioux Falls, South Dakota
Figure
Rice-3c
6/22/2016


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
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
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.
See Figure Rice-C2
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
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
Turn lanes added at Bahnson Ave
Back access road for properties along north side of Rice St.
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
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
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
See Figure Rice-C2


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
See Interchange Options
E Rice St
BNSF Railway
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!!!!!

© 2014 HDR, all rights reserved.

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)

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 Mickelson Dodson	4001 S Cliff Ave	605 940-4186	lindamcad.com
2	Jason Igerstad	6240 S. Old Village Pl	977-7740	jason.igerstad@hdrinc.com
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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	PuHRAH1340@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	MAB3000@sio.midco.net
6	Minnehaha Properties Phil Johnson	100 S Phillips Ave	782-4011	pfjohnson@fnbsf.com
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







Interstate 229 Major Investment Study

Exit 4 – Cliff Avenue

Stakeholder Meeting
June 22nd, 2016
2:30 pm to 3:30 pm

HDR

© 2014 HDR, all rights reserved.

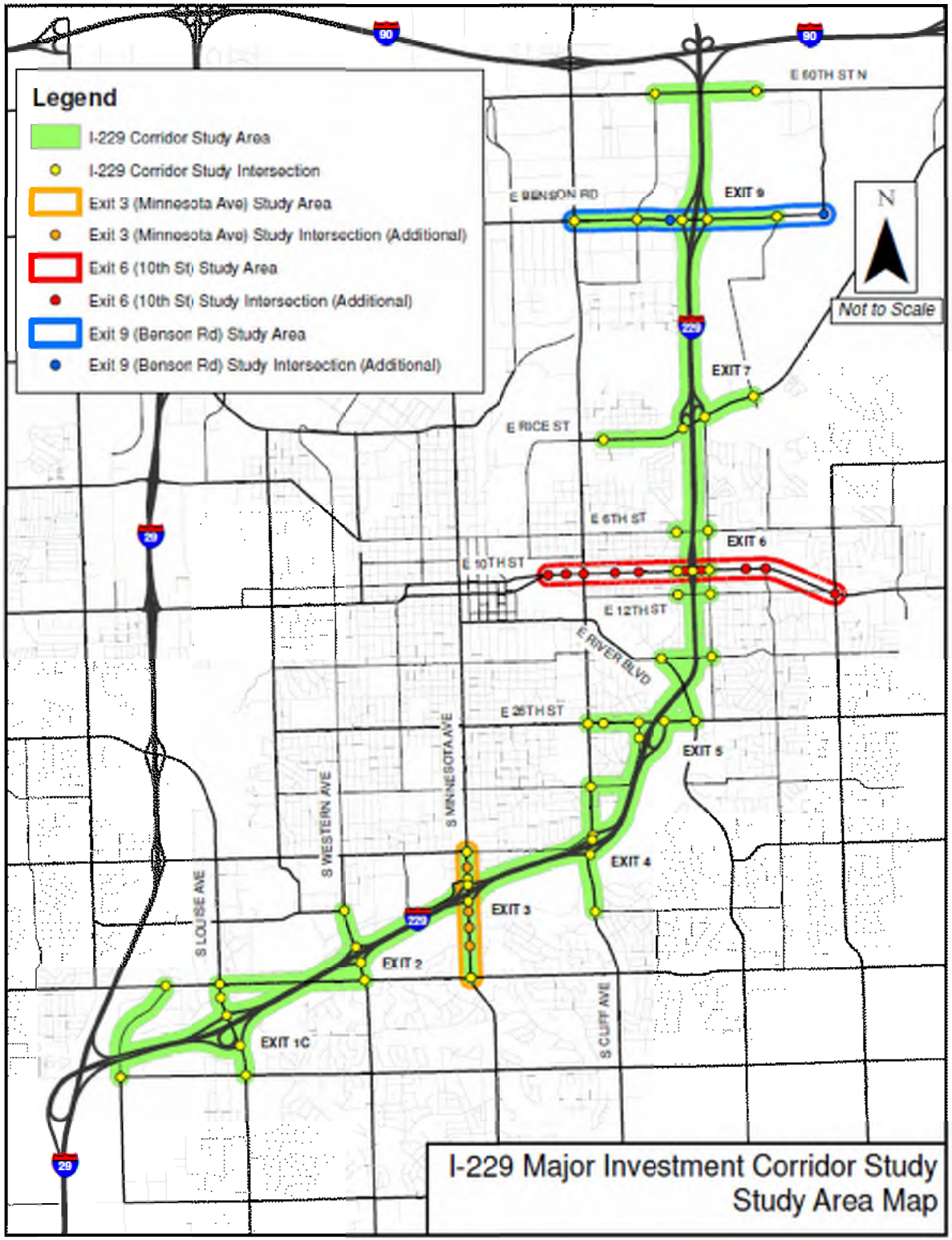
Study Area Map

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

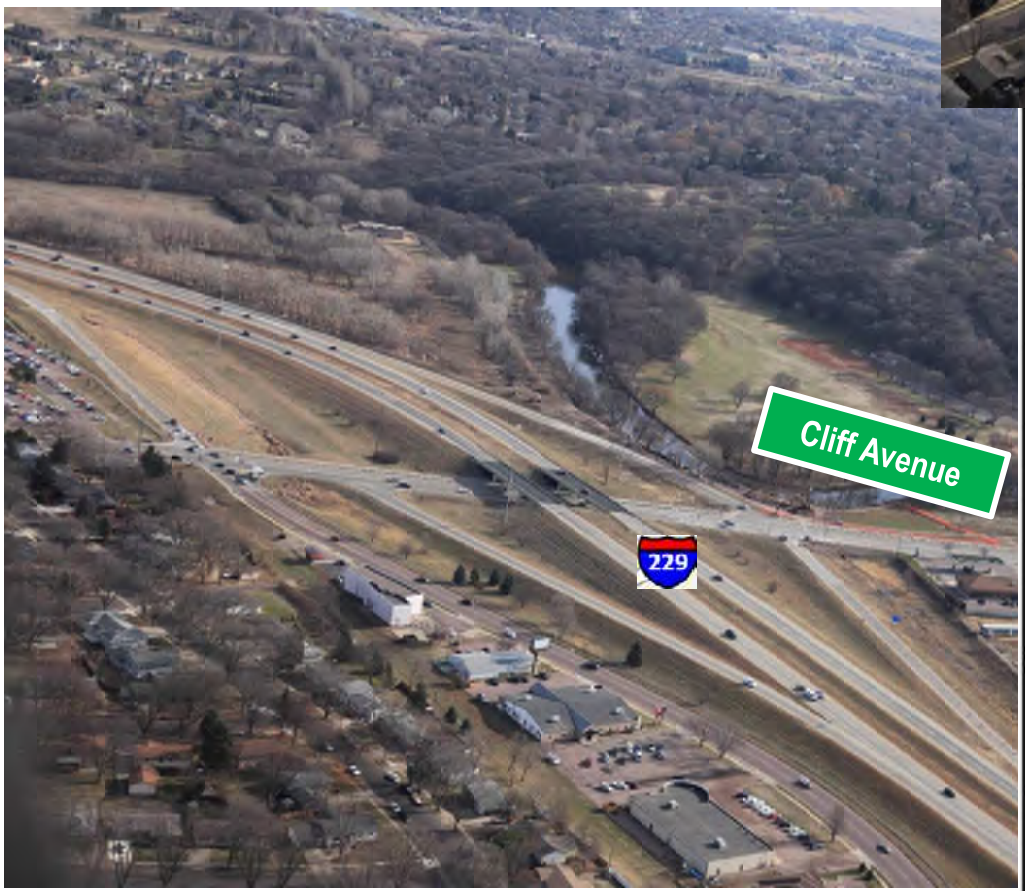
Sioux Falls Metropolitan Planning Organization (MPO)

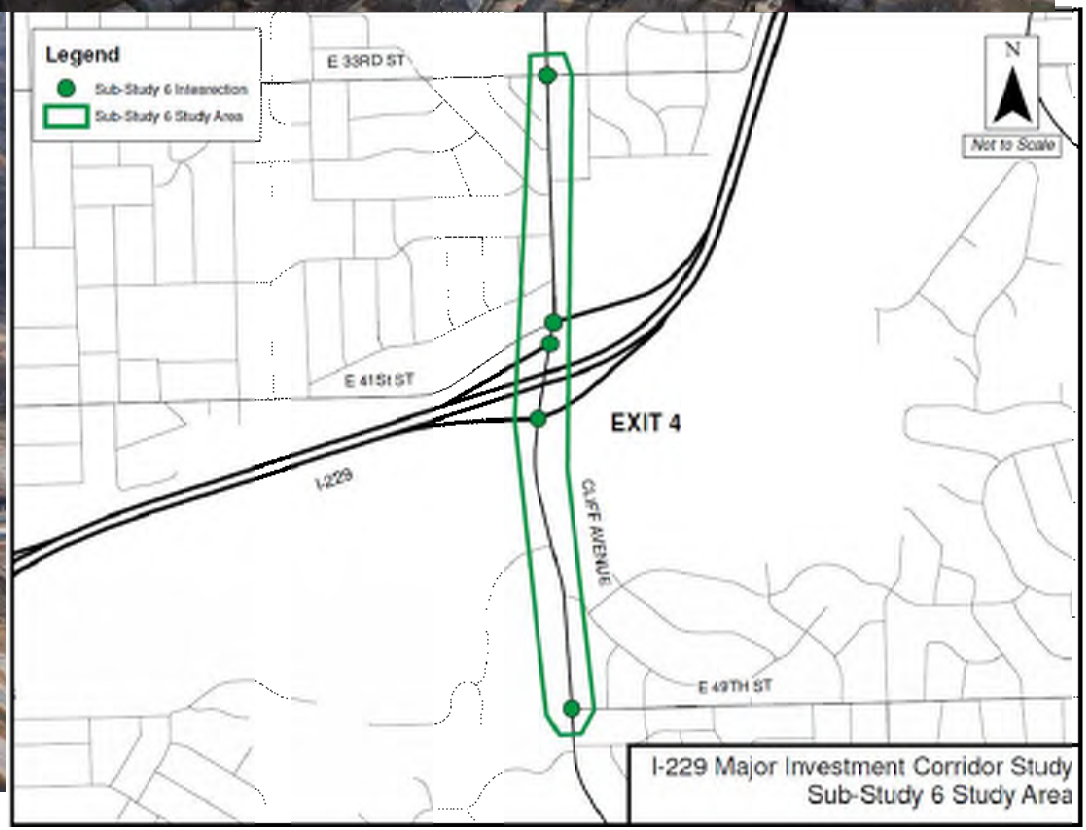
Federal Highway Administration (FHWA)

Exit 4 (Cliff Avenue) Sub - Study Goals

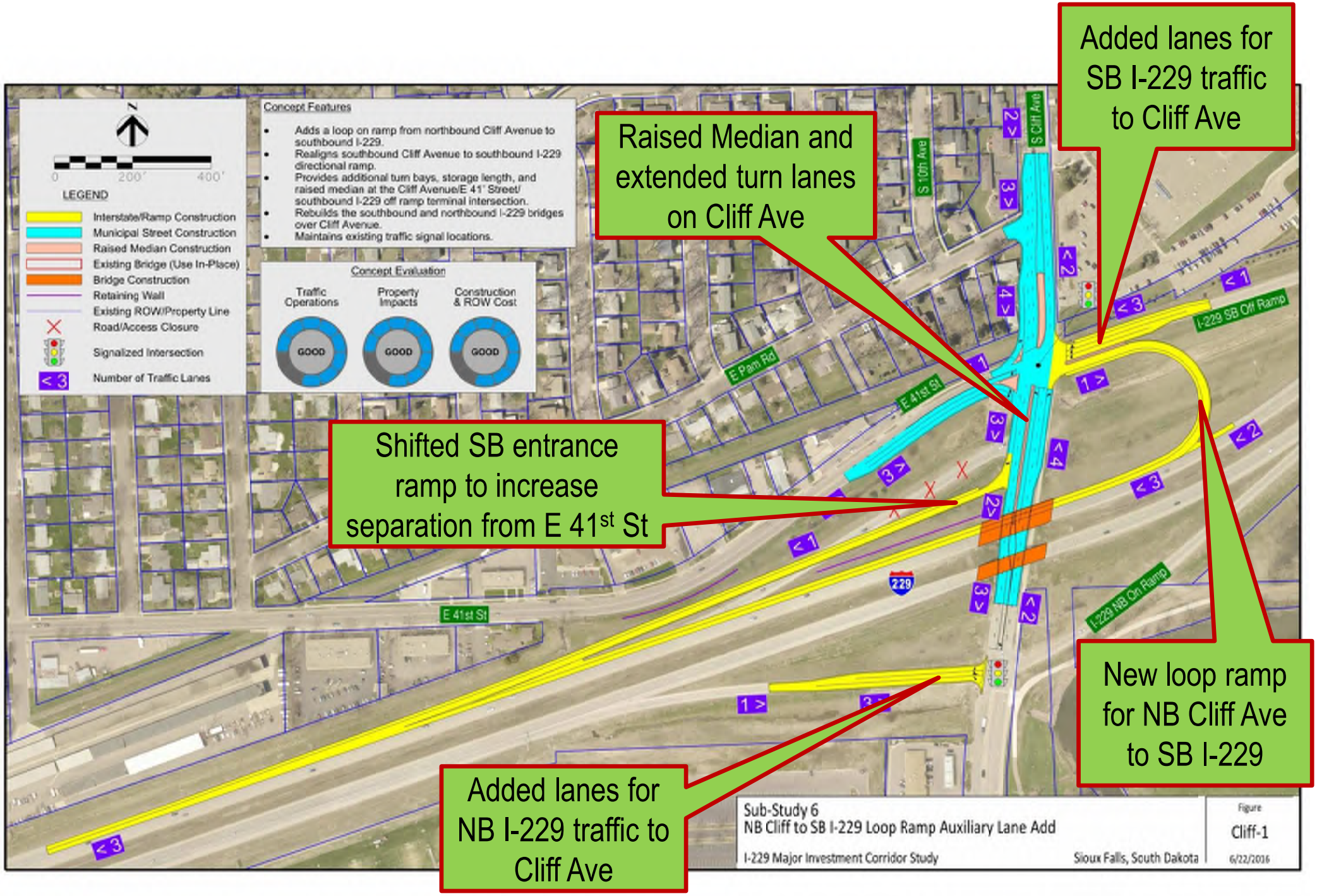
- Reduce traffic congestion
- Develop new geometrics to improve capacity at 41st Street and Interchange
- Improve pedestrian mobility
- Improve safety for corridor users

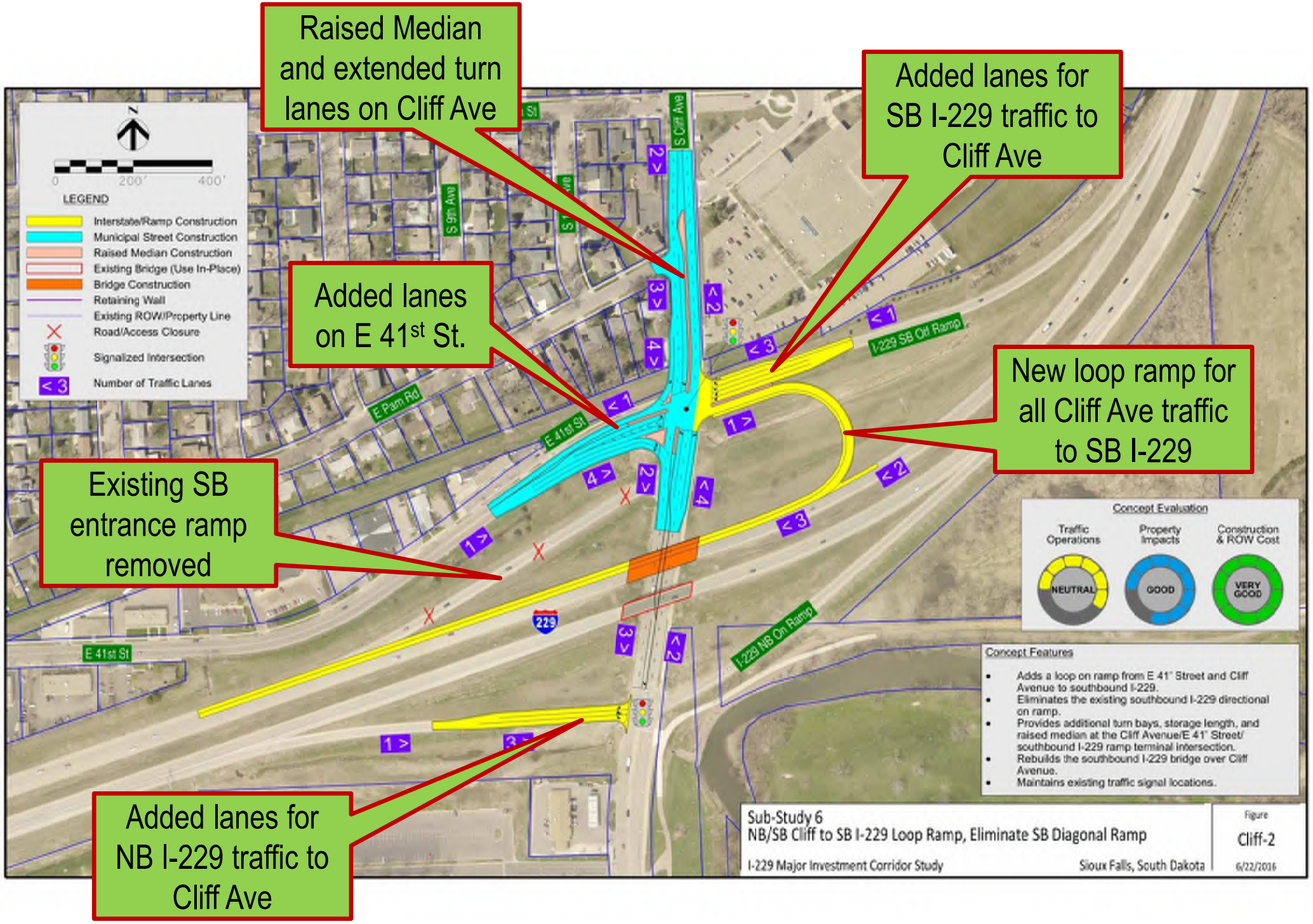


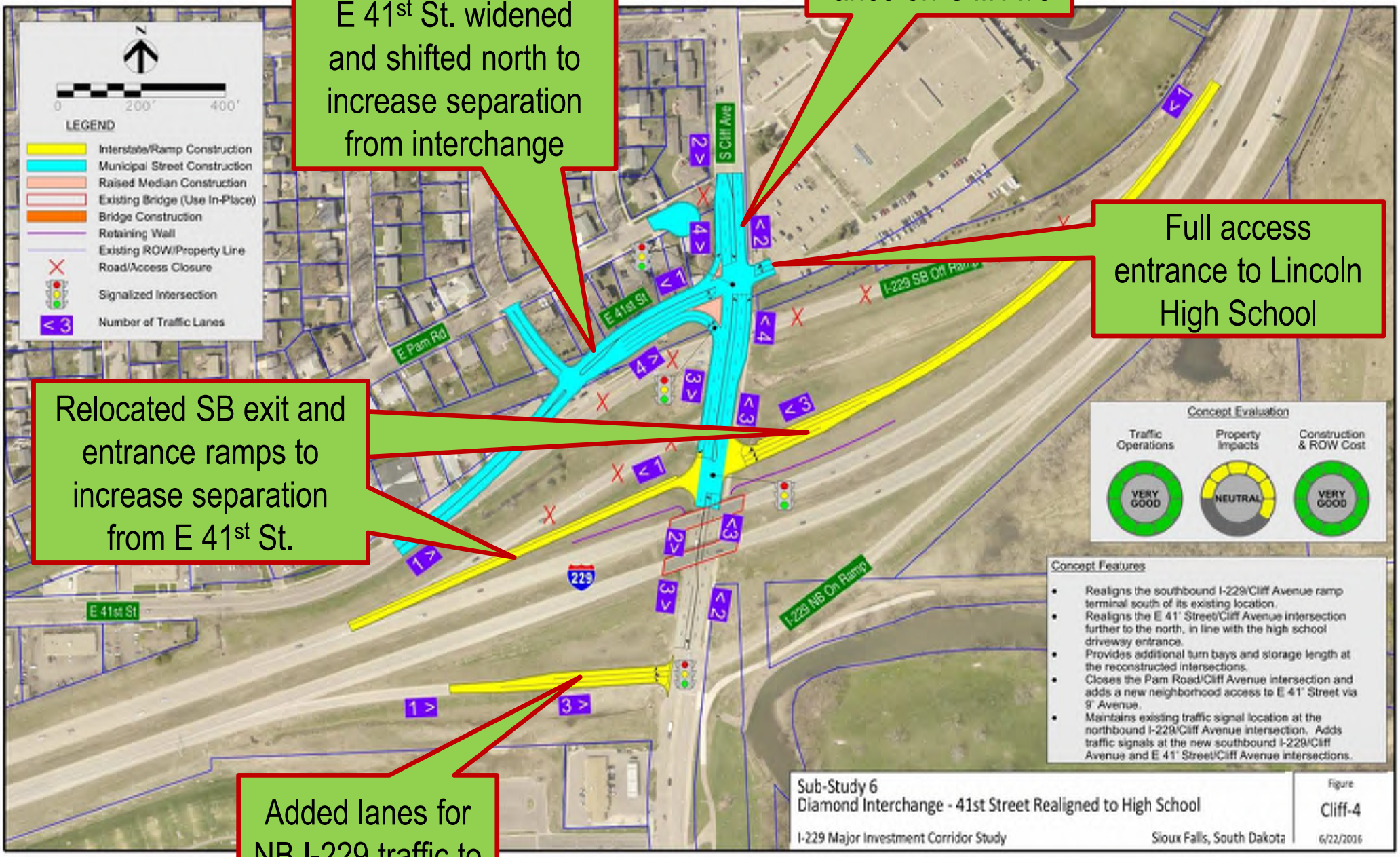


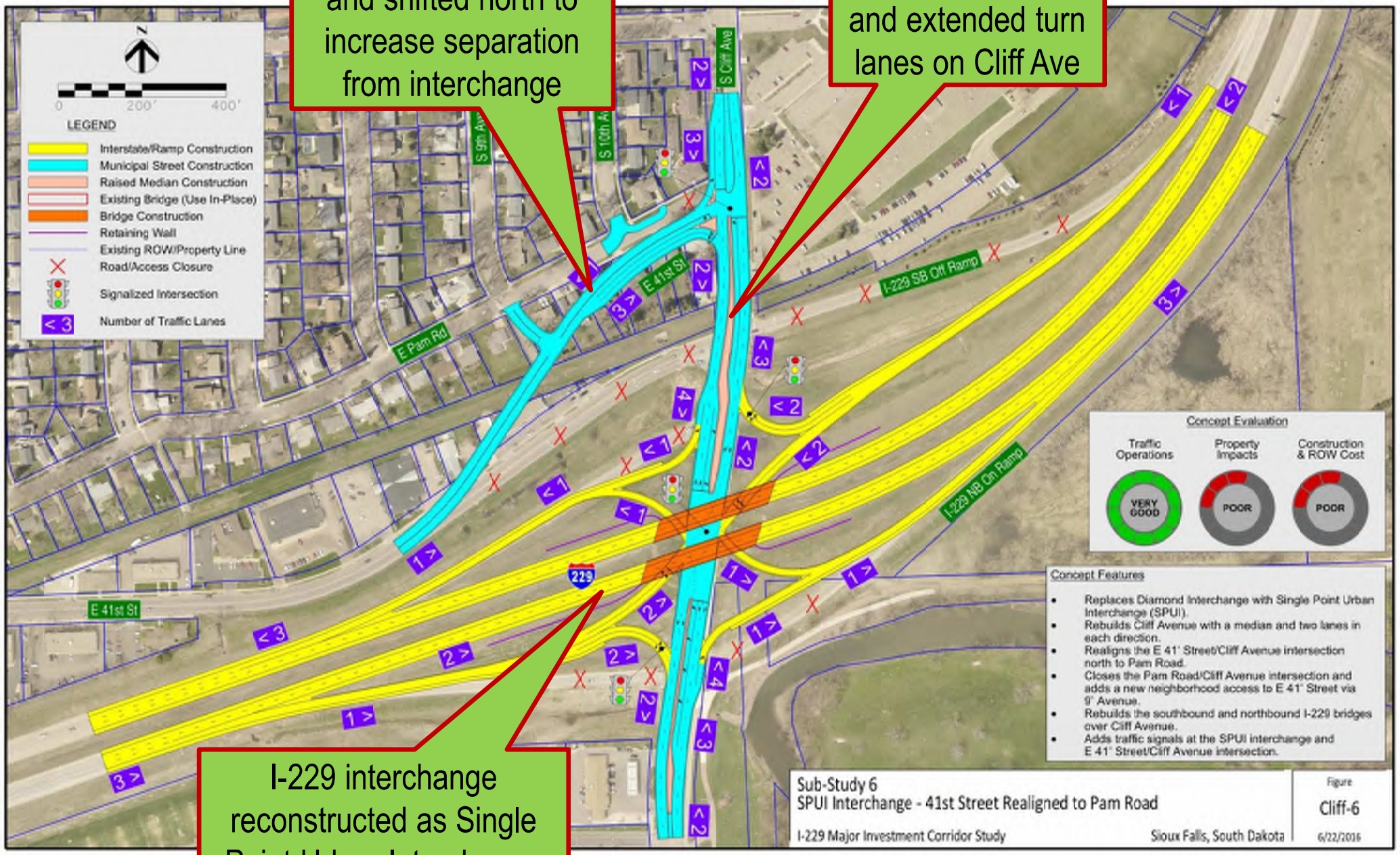


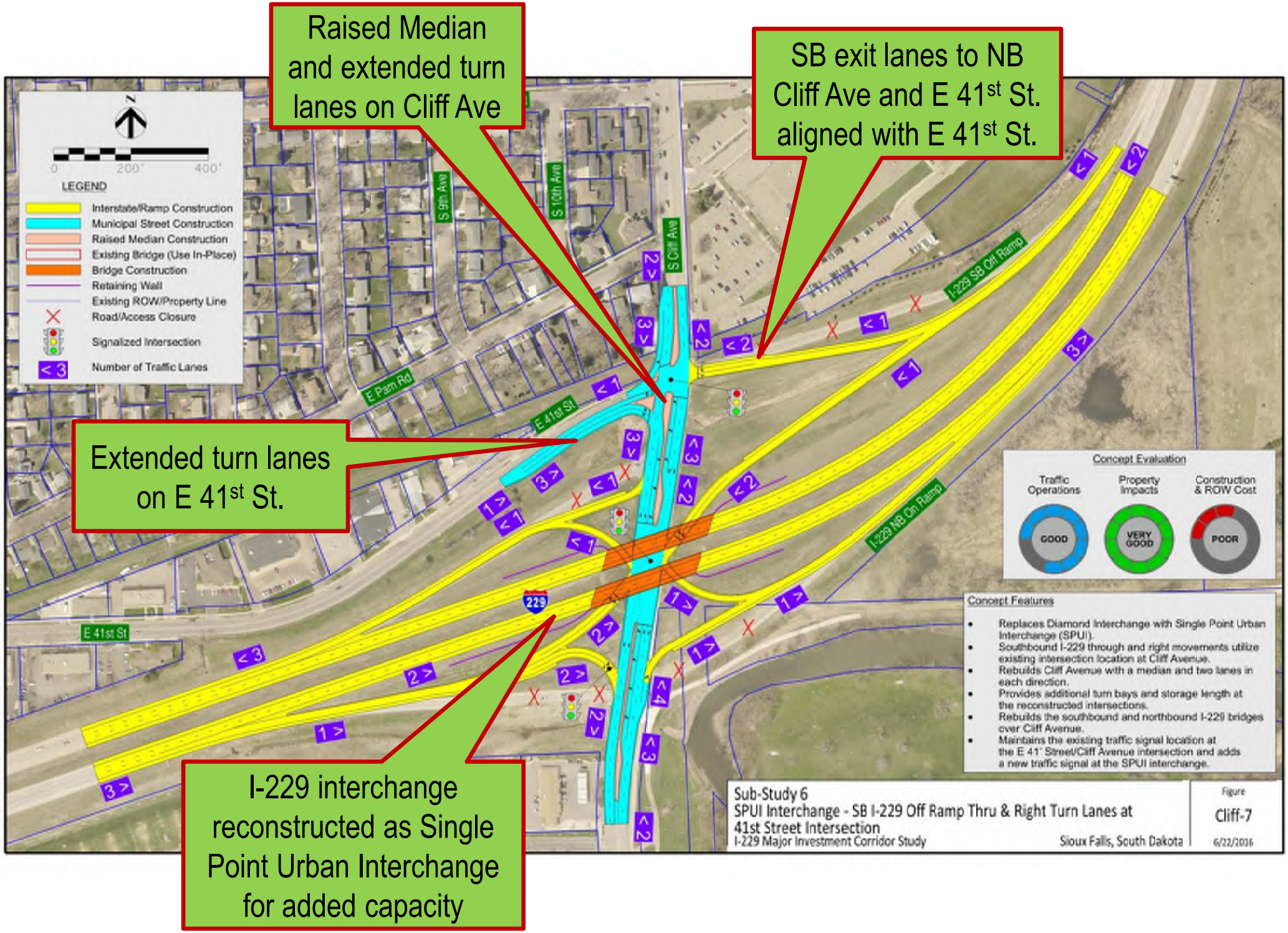

Access to Park close to interchange makes it difficult to exit during peak hour periods
Turn Lane short and few gaps exist to complete left turn movement
Cliff Avenue
229
Cliff Avenue
High Right Turn Volume in the PM Peak Hour
Congestion due to close proximity of 41st Street to I229 SB ON Ramp

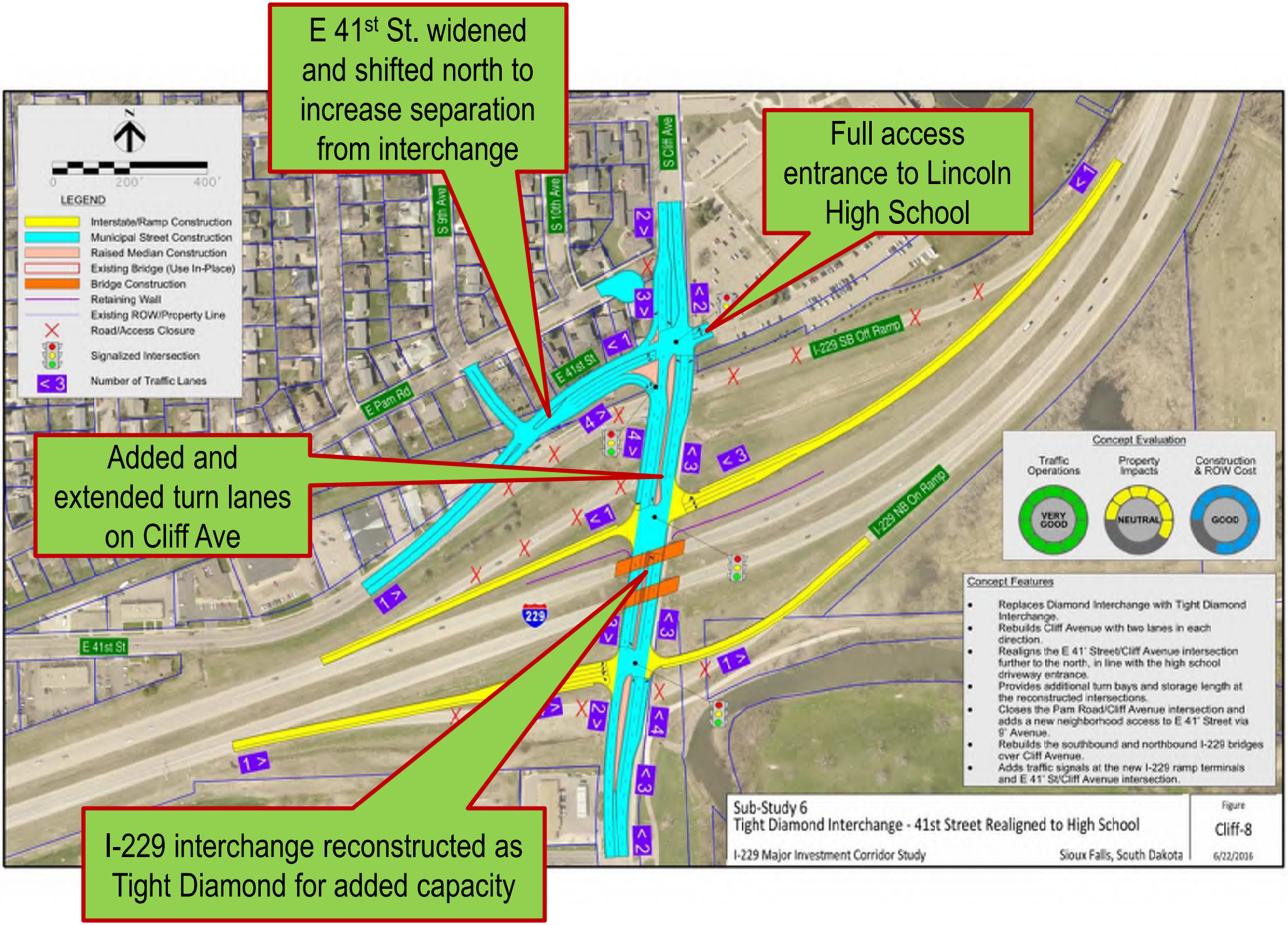

Added lanes for SB I-229 traffic to Cliff Ave
Raised Median and extended turn lanes on Cliff Ave
Shifted SB entrance ramp to increase separation from E 41st St
New loop ramp for NB Cliff Ave to SB I-229
Added lanes for NB I-229 traffic to Cliff Ave
LEGEND
Interstate/Ramp Construction
Municipal Street 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
E Pam Rd
E 41st St
S 10th Ave
S Cliff Ave
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
S Cliff Ave
S 9th Ave
E Pam Rd
E 41st St
I-229 SB On 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
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
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
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
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 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 41' 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
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
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

© 2014 HDR, all rights reserved.

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

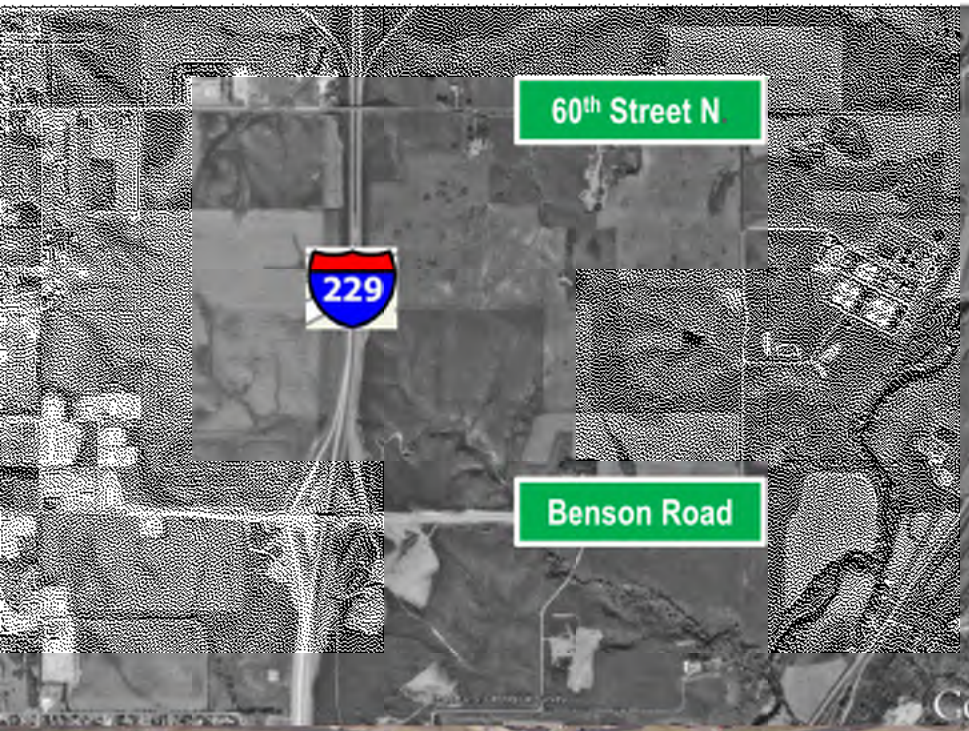
Client City of Sioux Falls/South Dakota Department of Transportation

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	605-773-6691	steve.gramm@state.sd.us
5	Bruce Mutschler	2101 E. Benson Rd	605-336-6100	bmutschler@bayertrucks.com
6	Lon Clemensen	SFDF 200 N. Phillips Ave	605-339-0703	lonc@siouxfalls.com
7	CHRIS RANS	3412 N POTSDAM AVE.	(605) 338-9110	CHRIS@SUNKOTACONSTRUCTION.COM
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 9 – Benson Rd Sub-Study

Stakeholder Meeting

December 5th, 2016
3:00 pm to 4:00 pm

HDR

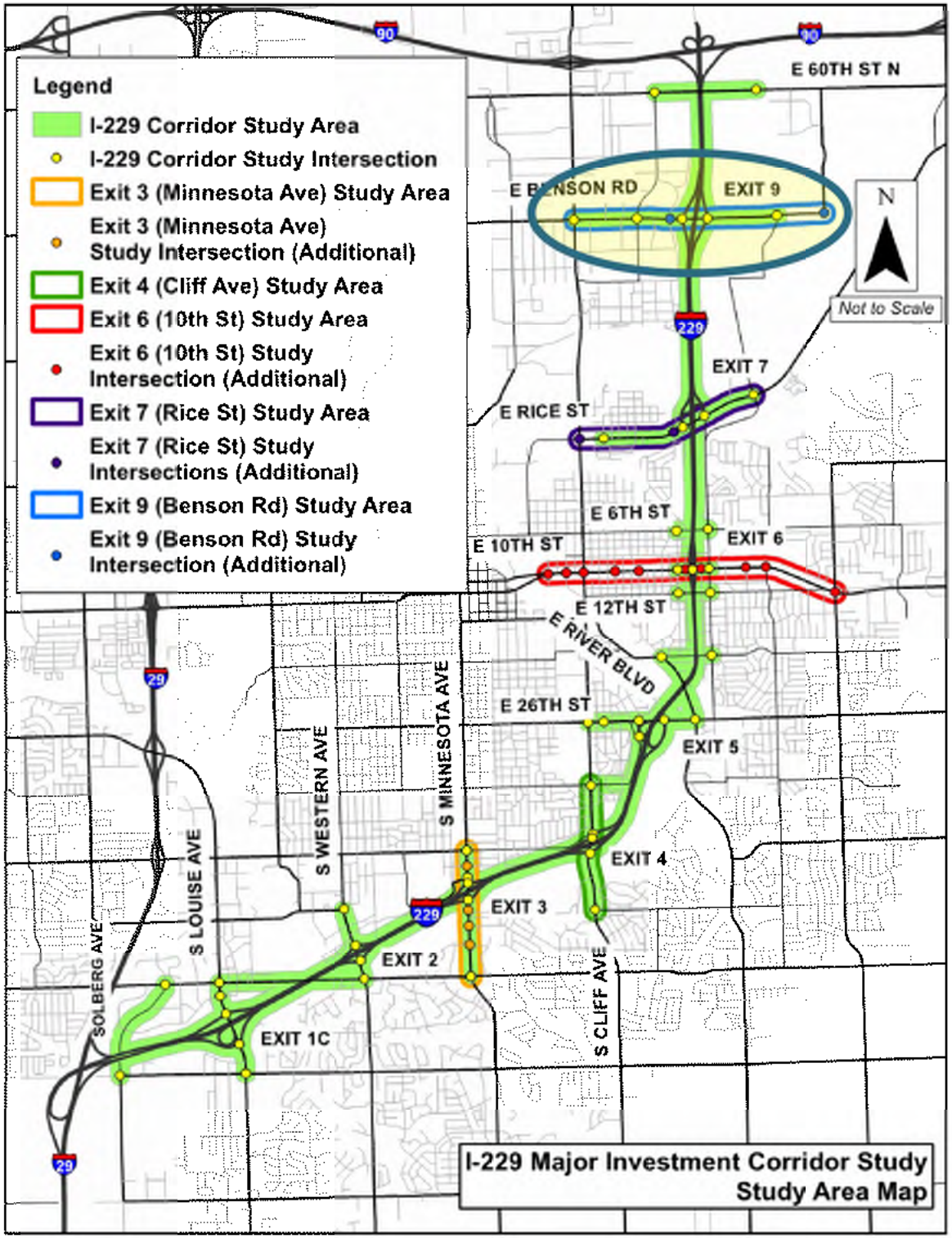
STUDY AREA MAP

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

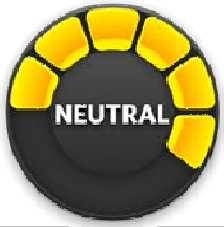
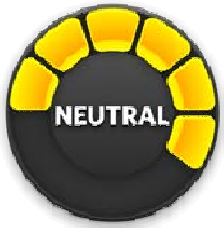
CONCEPT EVALUATION PROCESS

- 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**

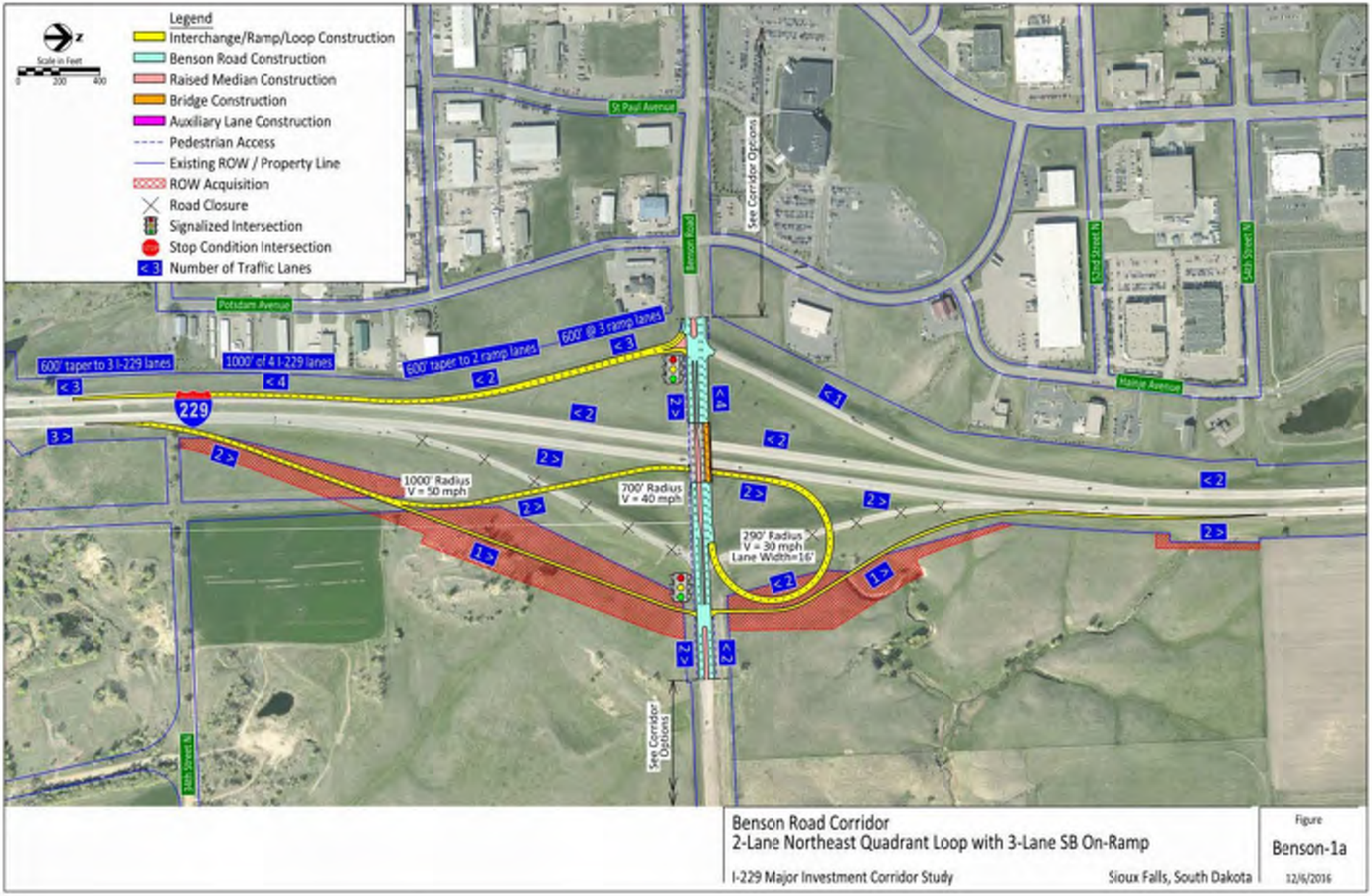
- Evaluation Matrix to Compare Concepts
- Recommended Action

CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						Advance
Benson-1A	2-Lane Northeast Quadrant Loop with 3-Lane SB On-Ramp						Advance
Benson-1B	2-Lane Northeast Quadrant Loop with 2-Lane SB On-Ramp						Advance
Benson-4	Diverging Diamond Interchange						Advance

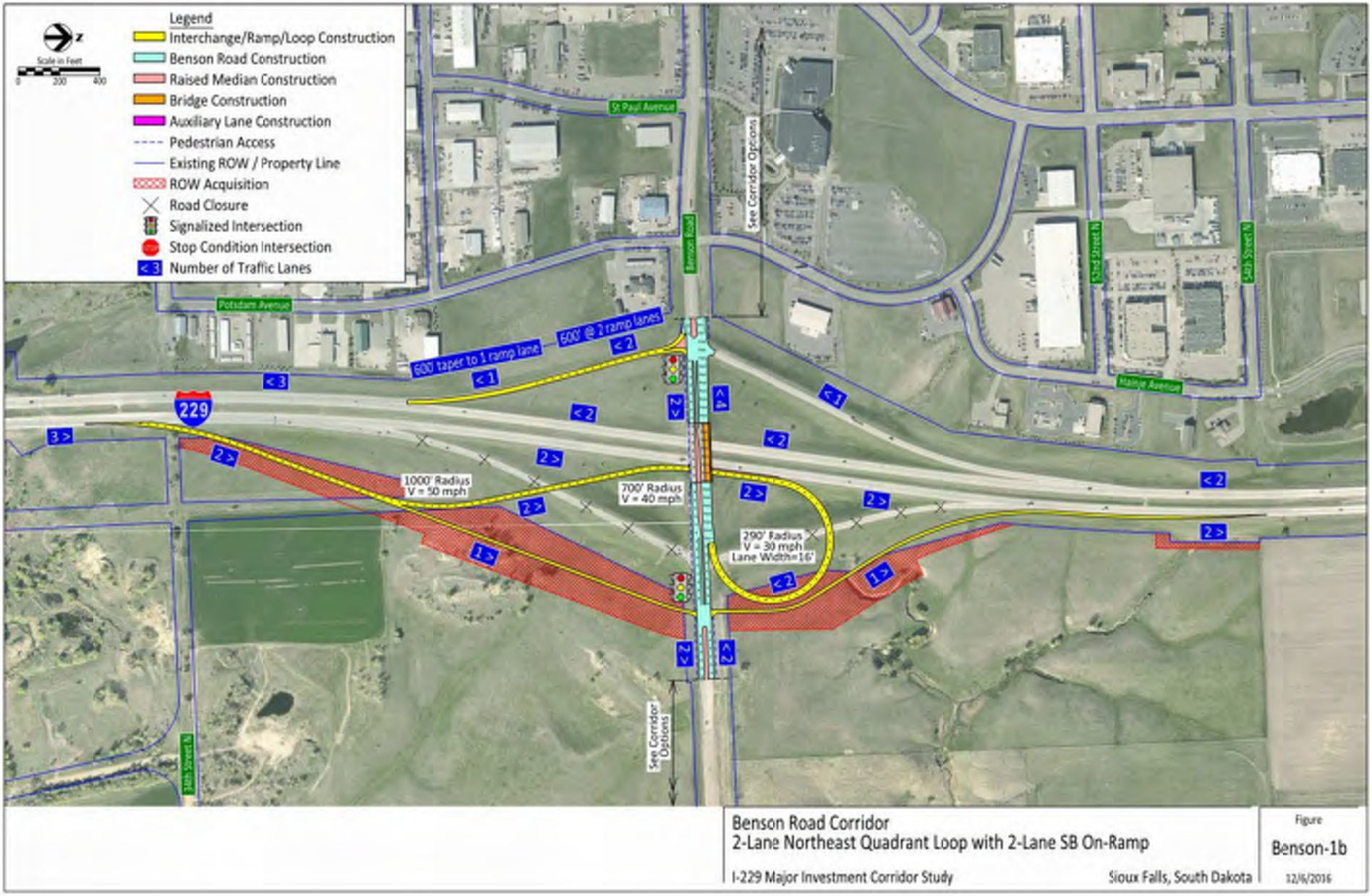
CONCEPTS FOR FURTHER CONSIDERATION

BENSON-1A



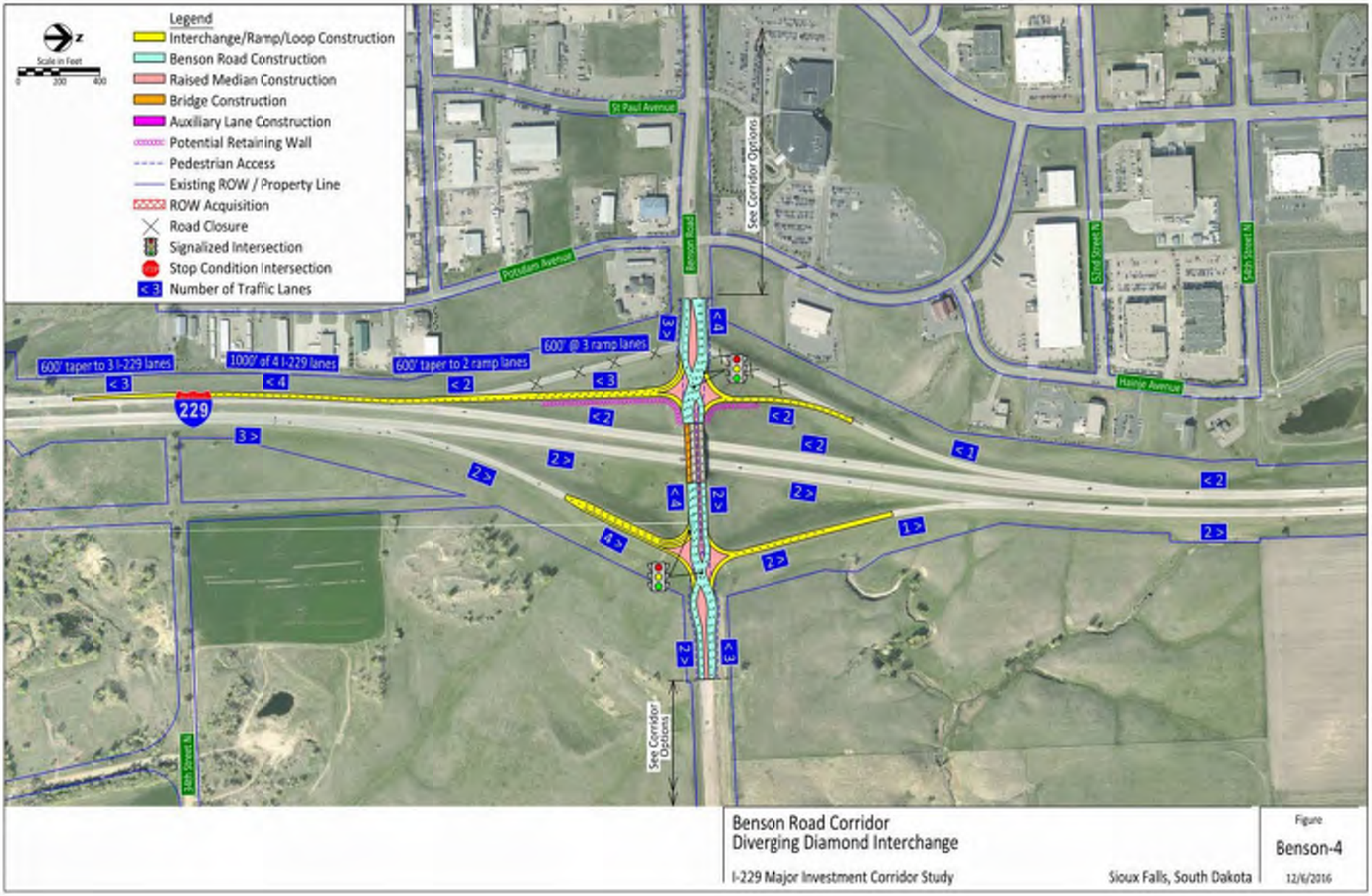
CONCEPTS FOR FURTHER CONSIDERATION

BENSON-1B



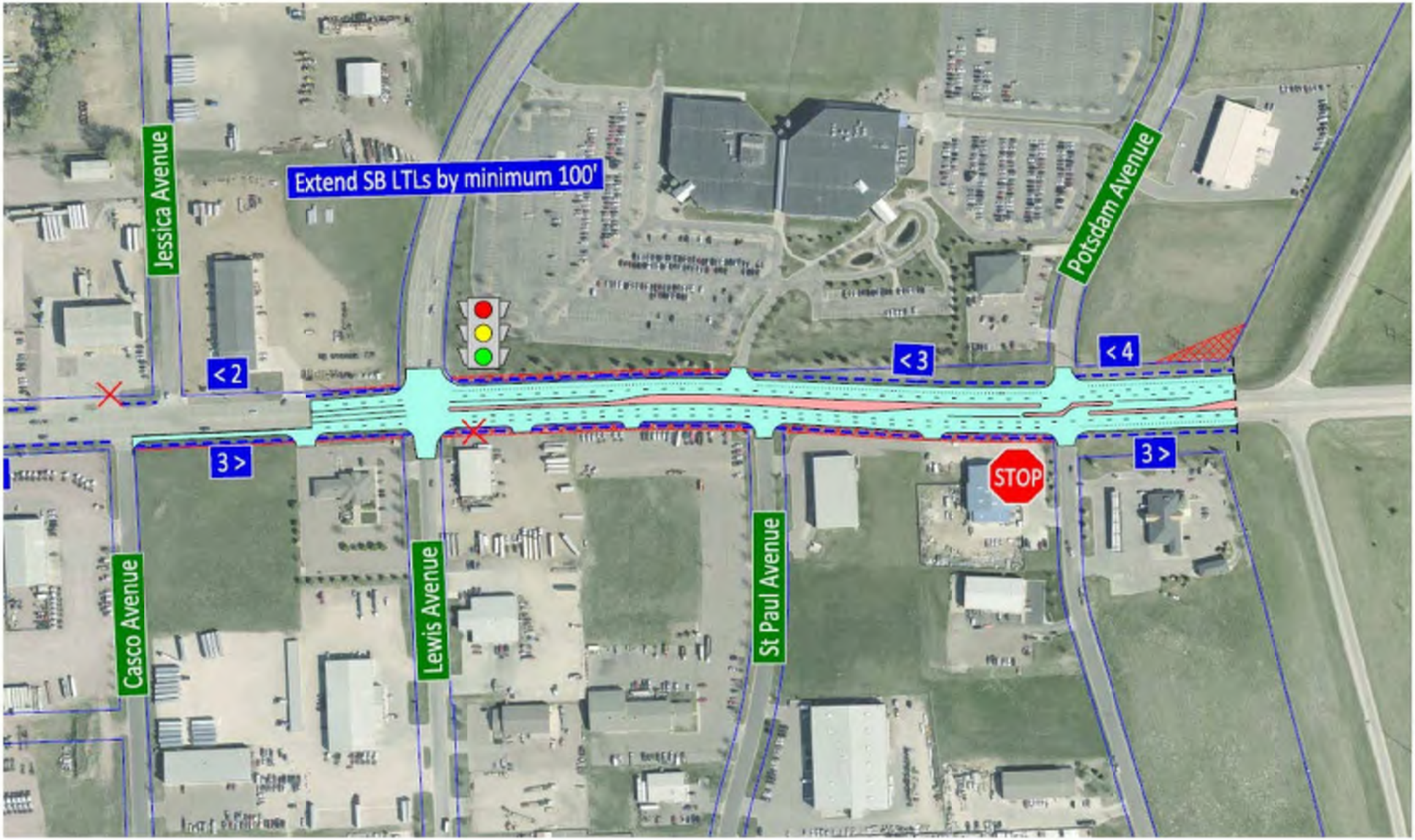
CONCEPTS FOR FURTHER CONSIDERATION

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.

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 605 338 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 TYSDAL	LLOYD COMPANIES	376-0127	RYAN@LLOYDCOMPANIES.com
7	Jason Kjenstad	HDR 6300 S. Old Village Pl	977-7740	jason.kjenstad@hdrinc.com
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 6 – 10th Street Sub-Study

Stakeholder Meeting

December 5th, 2016
4:30 pm to 5:30 pm

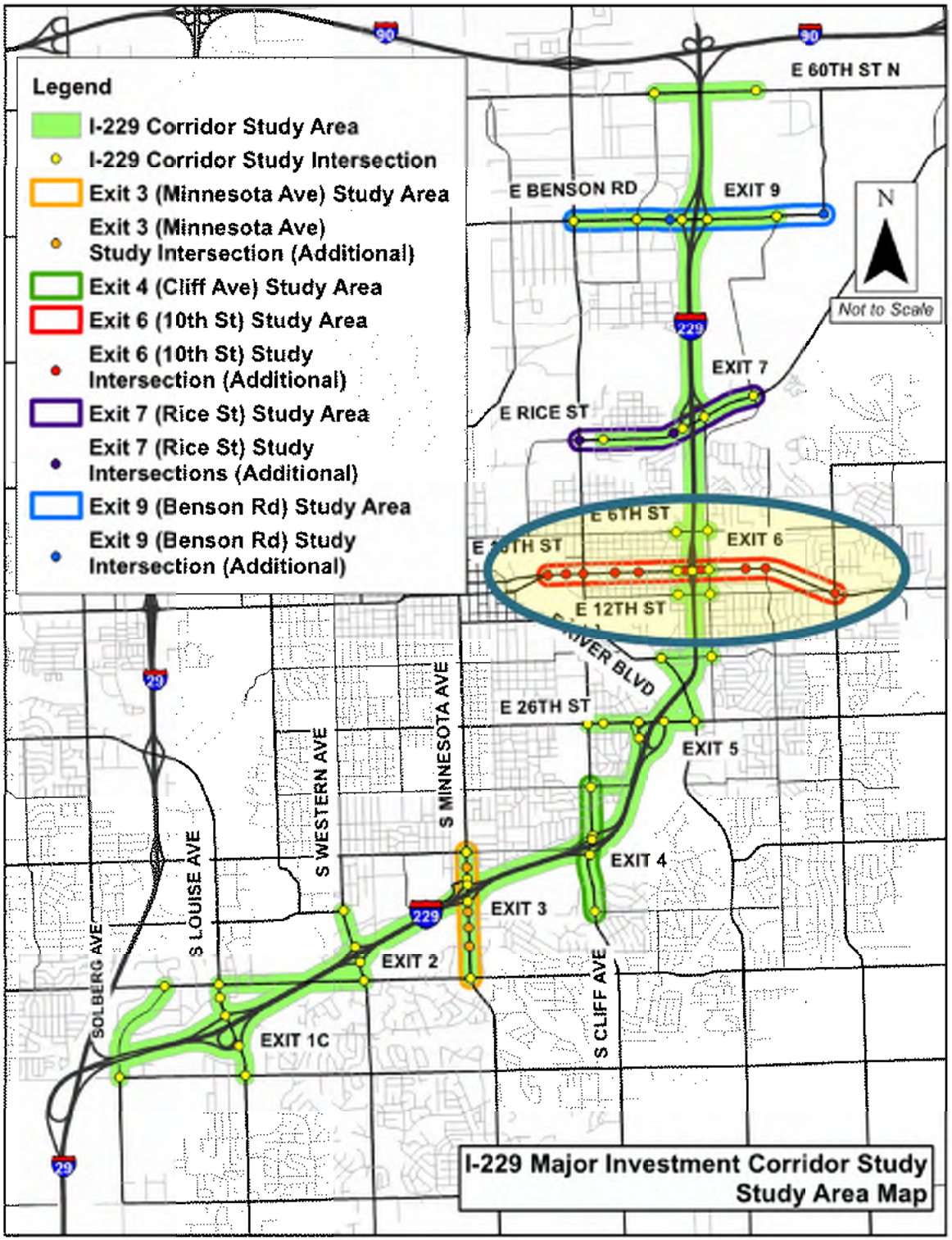
STUDY AREA MAP

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

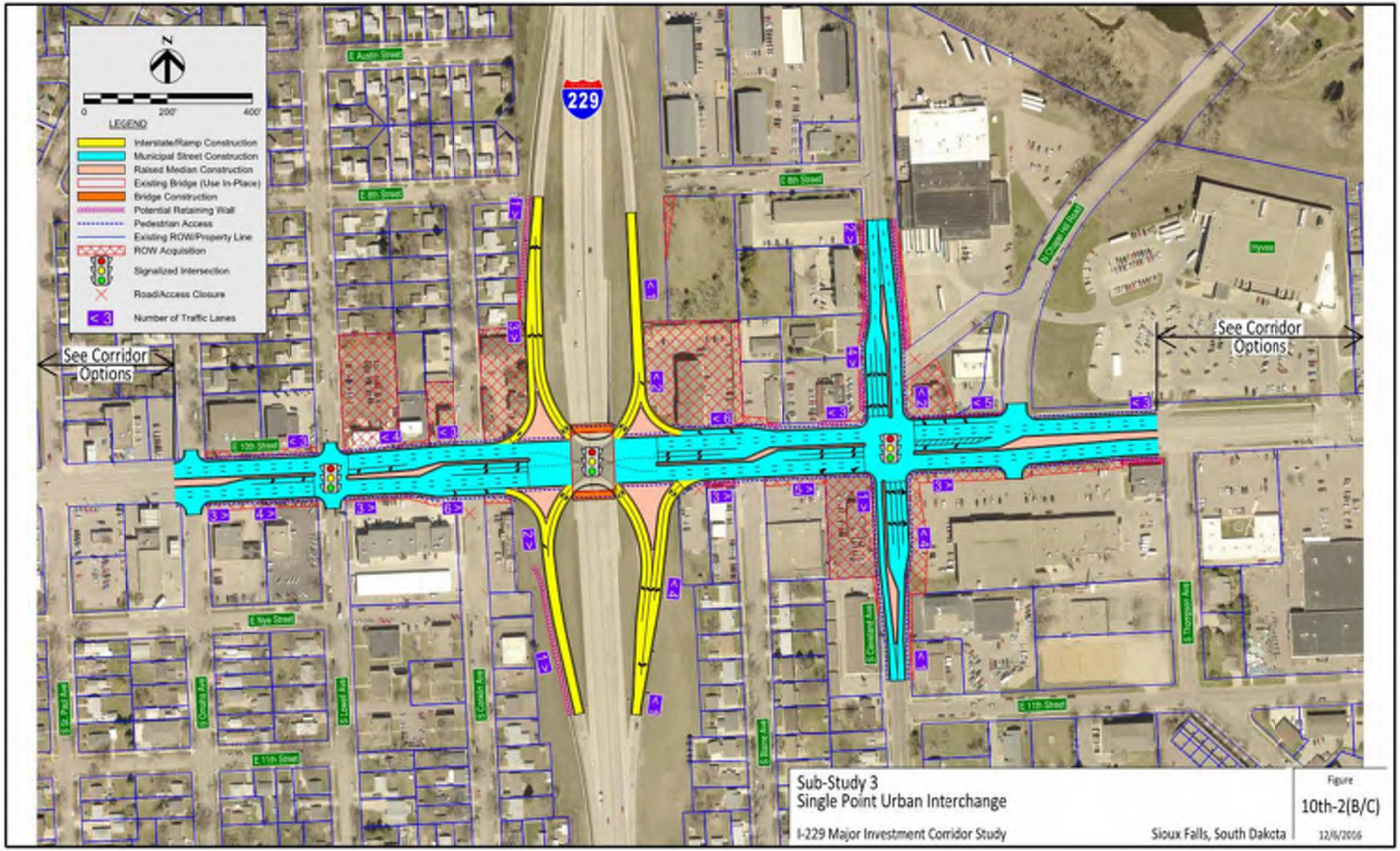
- Evaluation Factors:

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**

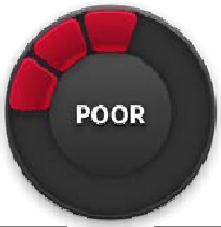
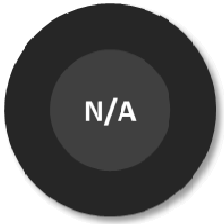
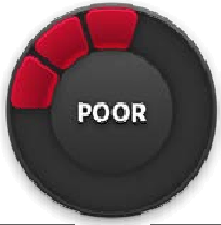
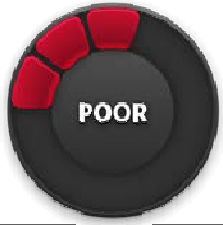
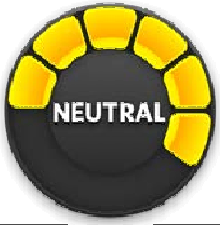
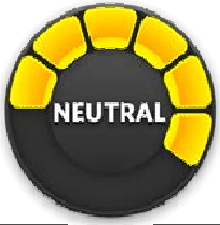
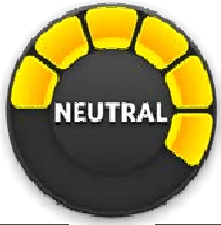
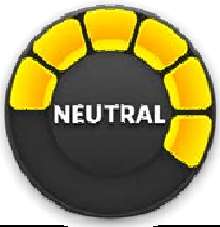
- Evaluation Matrix to Compare Concepts
- Recommended Action

CONCEPTS FOR FURTHER CONSIDERATION

10TH-2 (B/C)

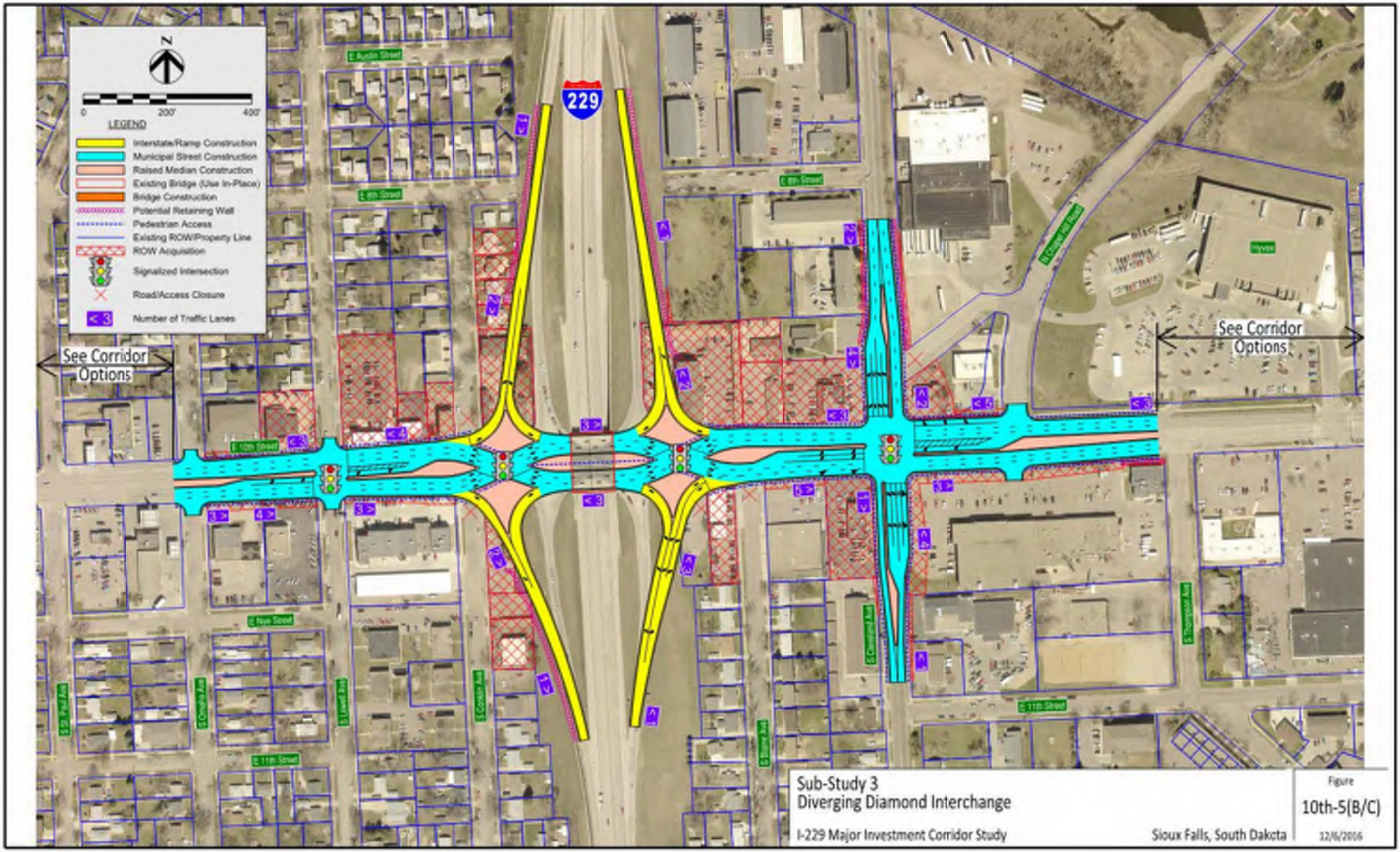


CONCEPT EVALUATION RESULTS

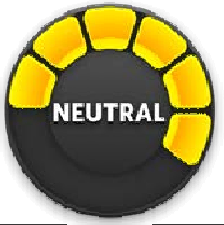
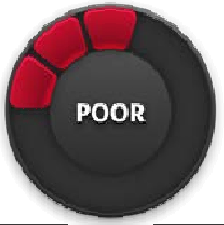
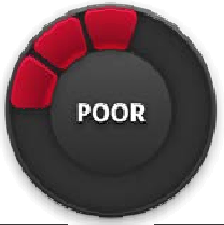
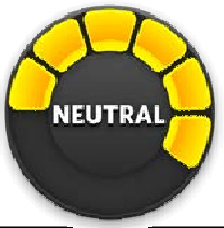
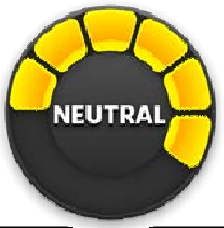
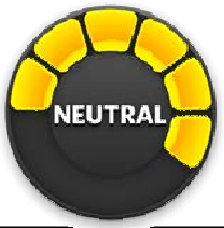
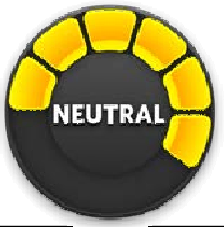
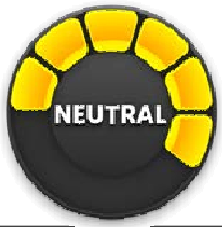
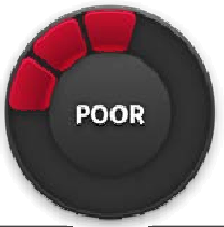
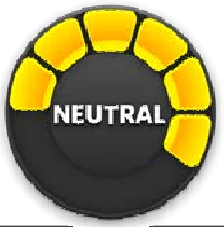
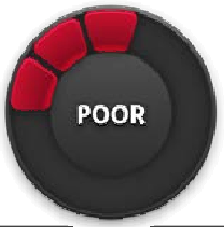
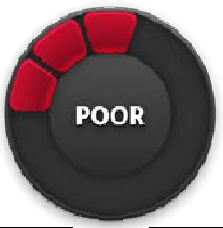
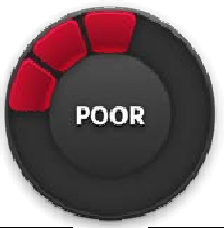
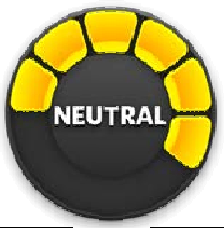
Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						**Advance**
10th-2A	Single Point Urban Interchange, 6-Lane Divided Corridor						**Eliminate** Property impacts, environmental impacts, and cost
10th-2B	Single Point Urban Interchange, 4-Lane Divided Corridor						**Advance**
10th-2C	Single Point Urban Interchange, 5-Lane Undivided Corridor						**Advance**

CONCEPTS FOR FURTHER CONSIDERATION

10TH-5 (B/C)

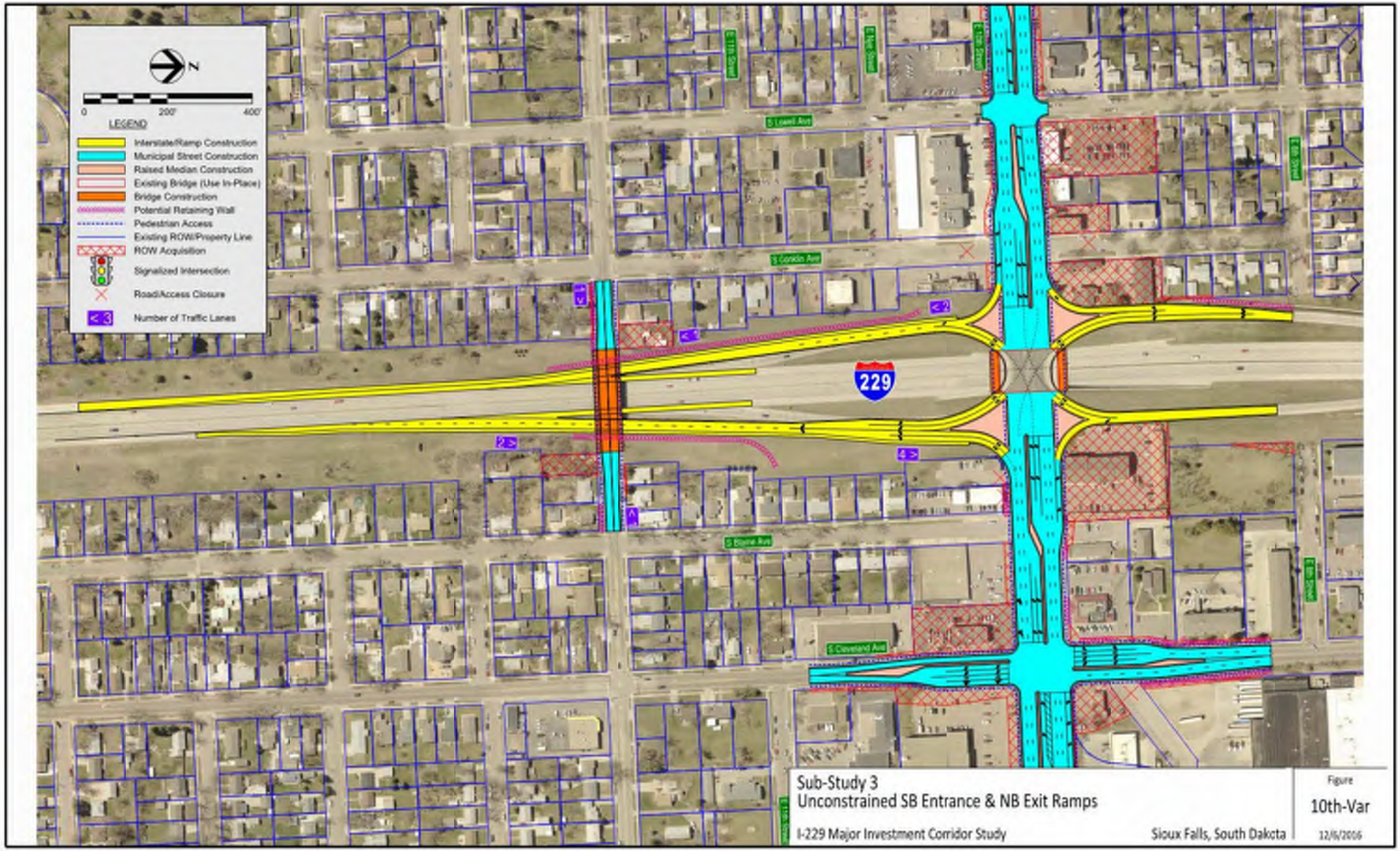


CONCEPT EVALUATION RESULTS (cont.)

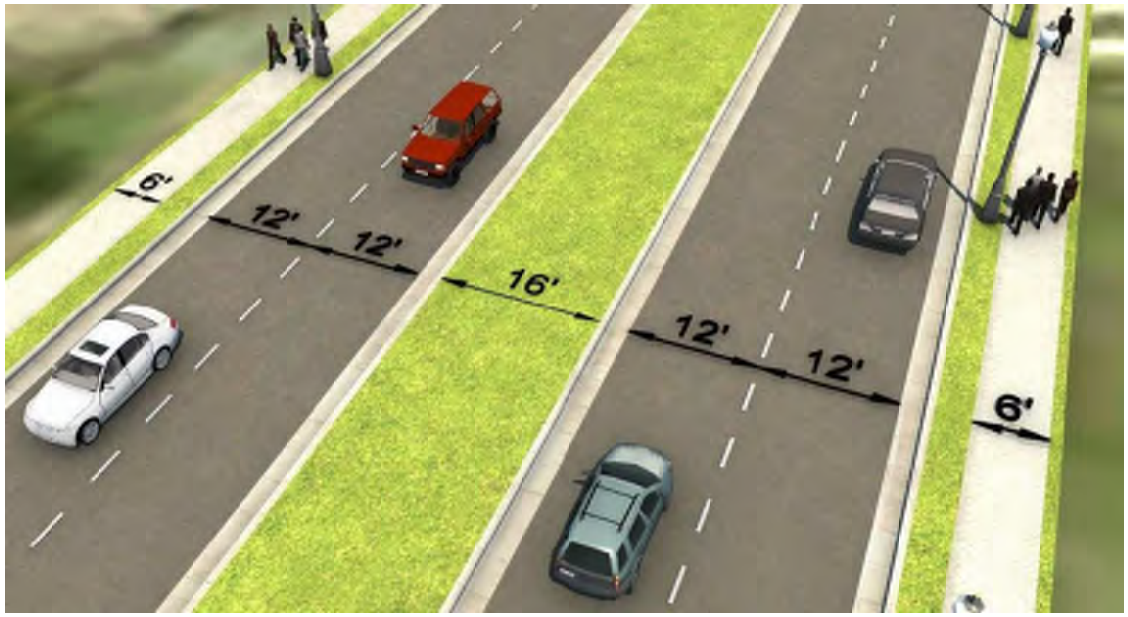
Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
10th-5A	Diverging Diamond Interchange, 6-Lane Divided Corridor						**Eliminate** Property impacts, environmental impacts, and cost
10th-5B	Diverging Diamond Interchange, 4-Lane Divided Corridor						**Advance**
10th-5C	Diverging Diamond Interchange, 5-Lane Undivided Corridor						**Advance**
10th-9A	Tight Split Diamond, 6th St/10th St with 4-Lane Divided Corridor						**Eliminate** Environmental impacts, cost, and lower traffic & safety benefits
10th-9B	Tight Split Diamond, 6th St/10th St with 5-Lane Undivided Corridor						**Eliminate** Environmental impacts and lower traffic & safety benefits
10th-Var							**Advance**

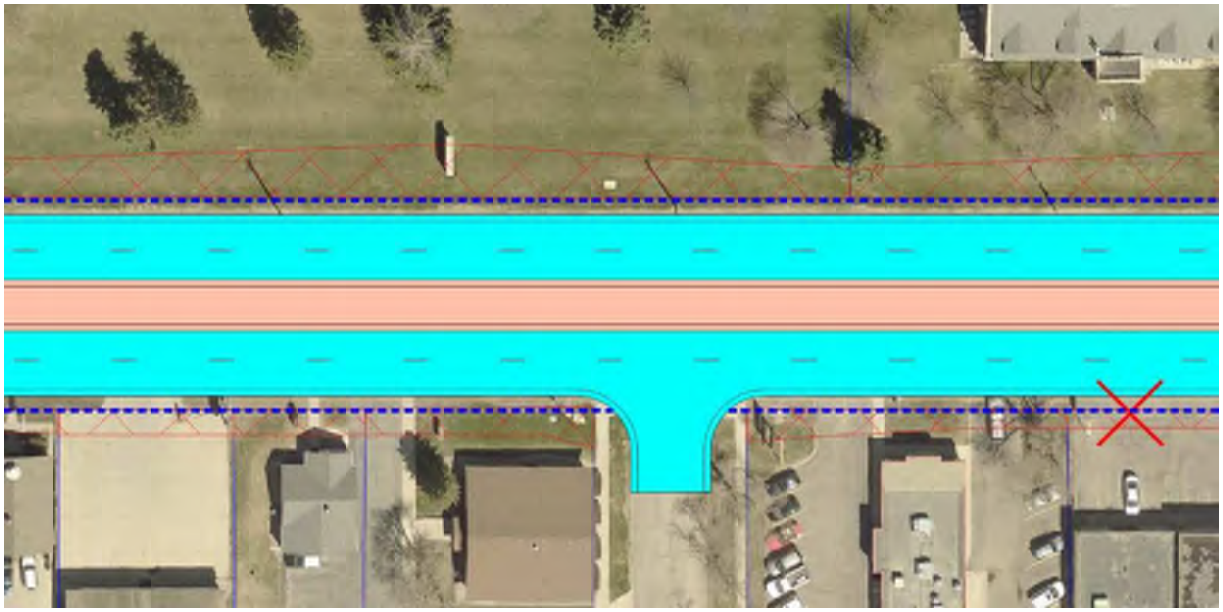
CONCEPTS FOR FURTHER CONSIDERATION

10TH-Var

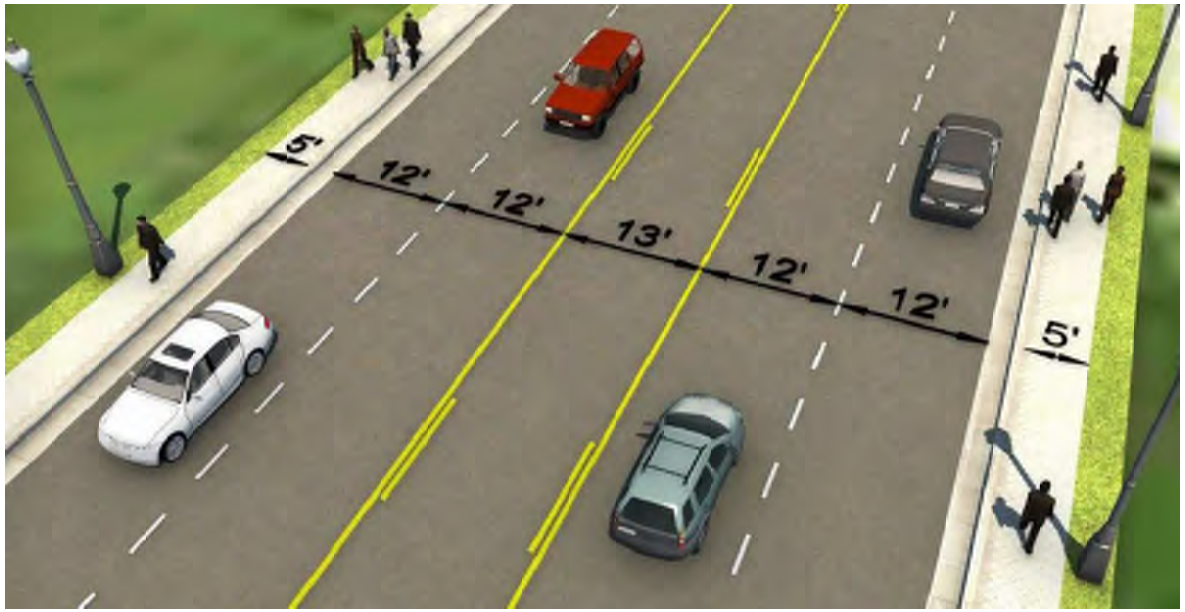


4-Lane Divided Corridor





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.

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~~ siouxfalls.org
3	Marlys Roskens	3105 S. 9th Ave	605-336-6226	marlys@sio.midco.net
4	PAUL HARTMAN	1201 OTONKA	605-929-9768	HART2HART @SIO.MIDCO.NET
5	JEFF KRESHEL			
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.	605-338 2387	brichards@sio.midco.net
9	Lois Merritt	3004 S. 10th Ave.	(605)334-9498	
10	Wendy Butler Boyer	1104 E. Pam Rd.	605-906-1223	wbutlerboyer@gmail.com
11	Jason Kjerstad	6300 S. Old Village Pl Suite 100 SF SD 57108	605-977-7741	jason.kjerstad@hdrinc.com
12				
13				
14				
15				
16				
17				
18				
19				
20				







INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 4 – Cliff Avenue Sub-Study

Stakeholder Meeting

December 5th, 2016
6:00 pm to 7:00 pm

HDR

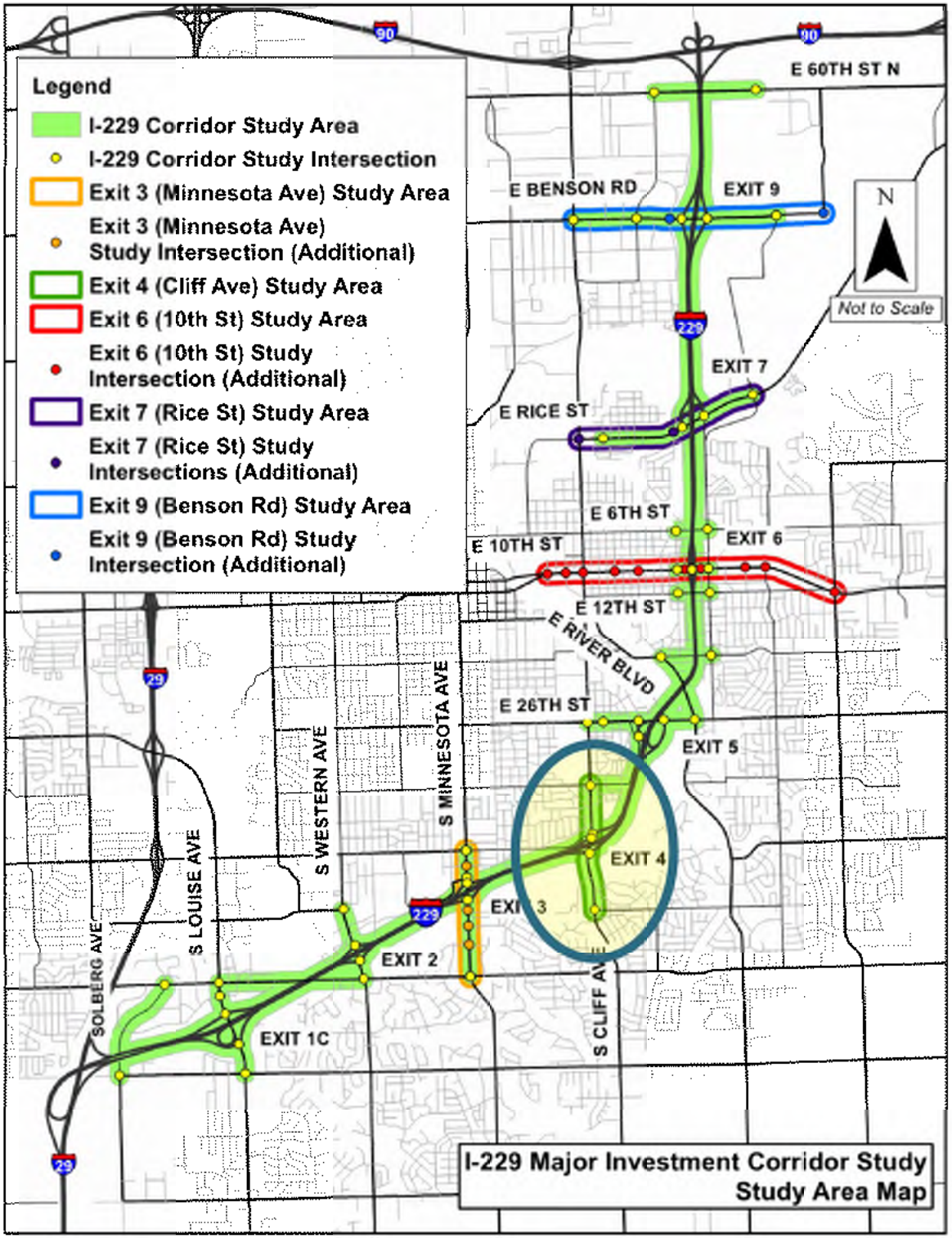
STUDY AREA MAP

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

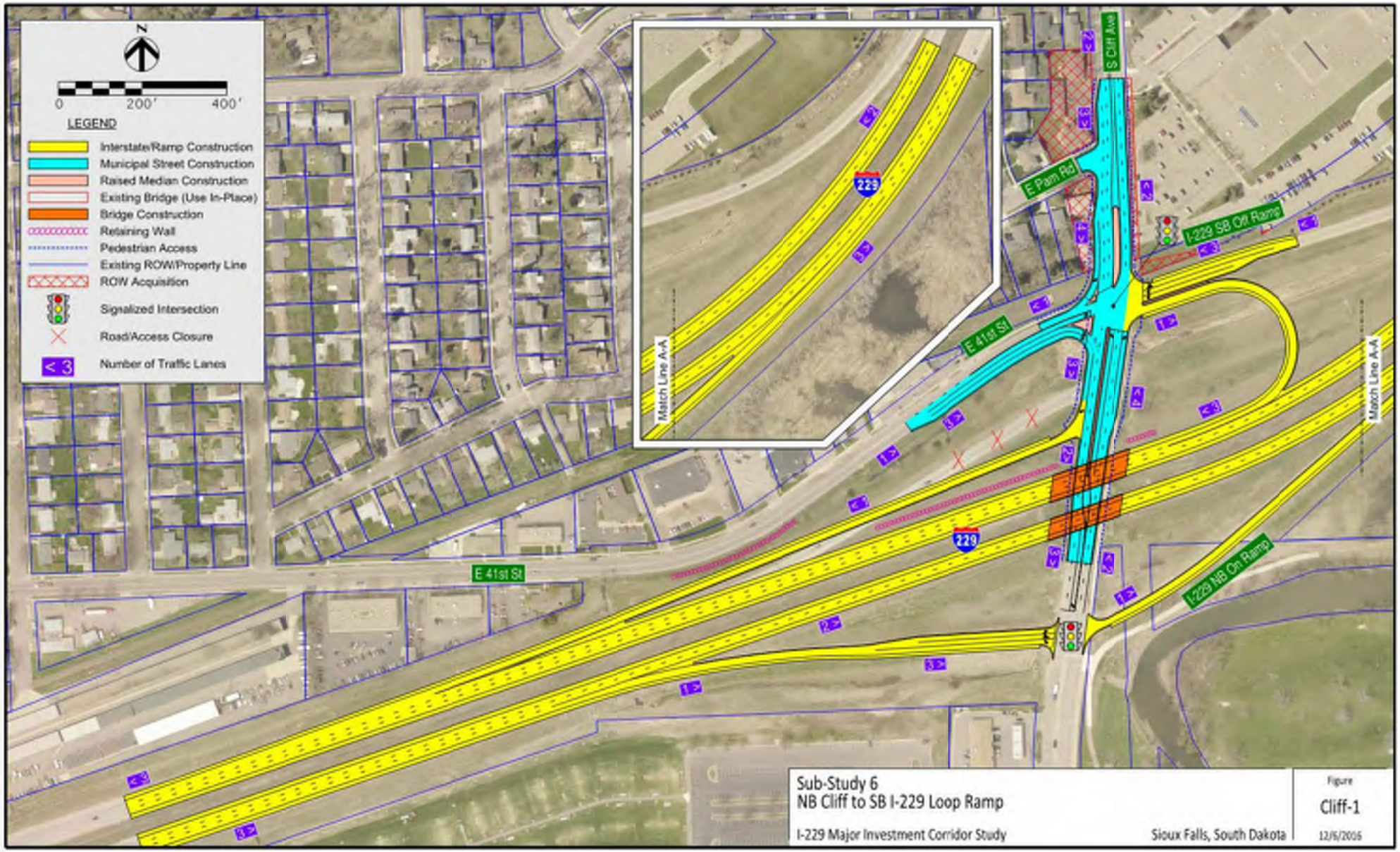
- Evaluation Factors:

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

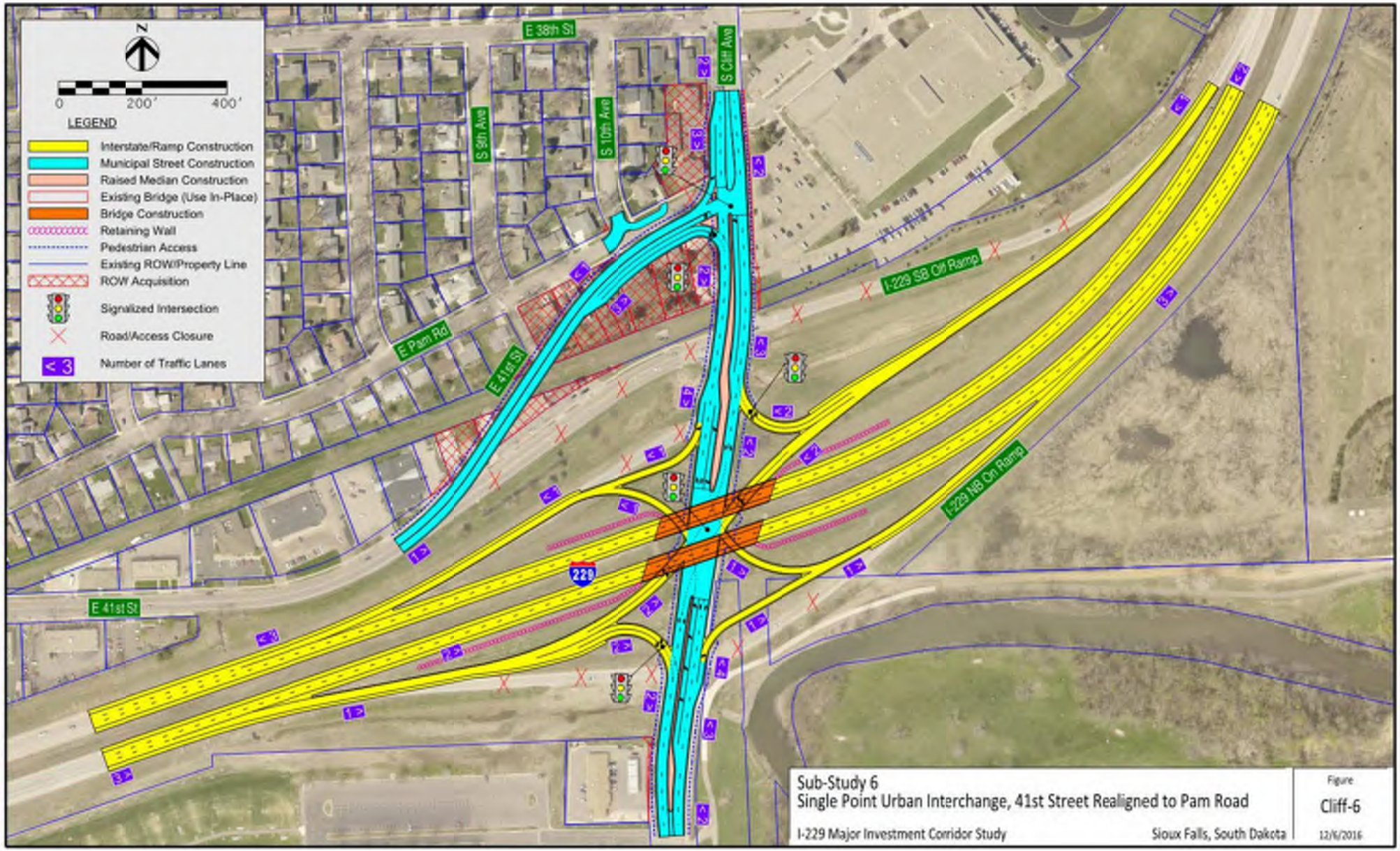
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF-1



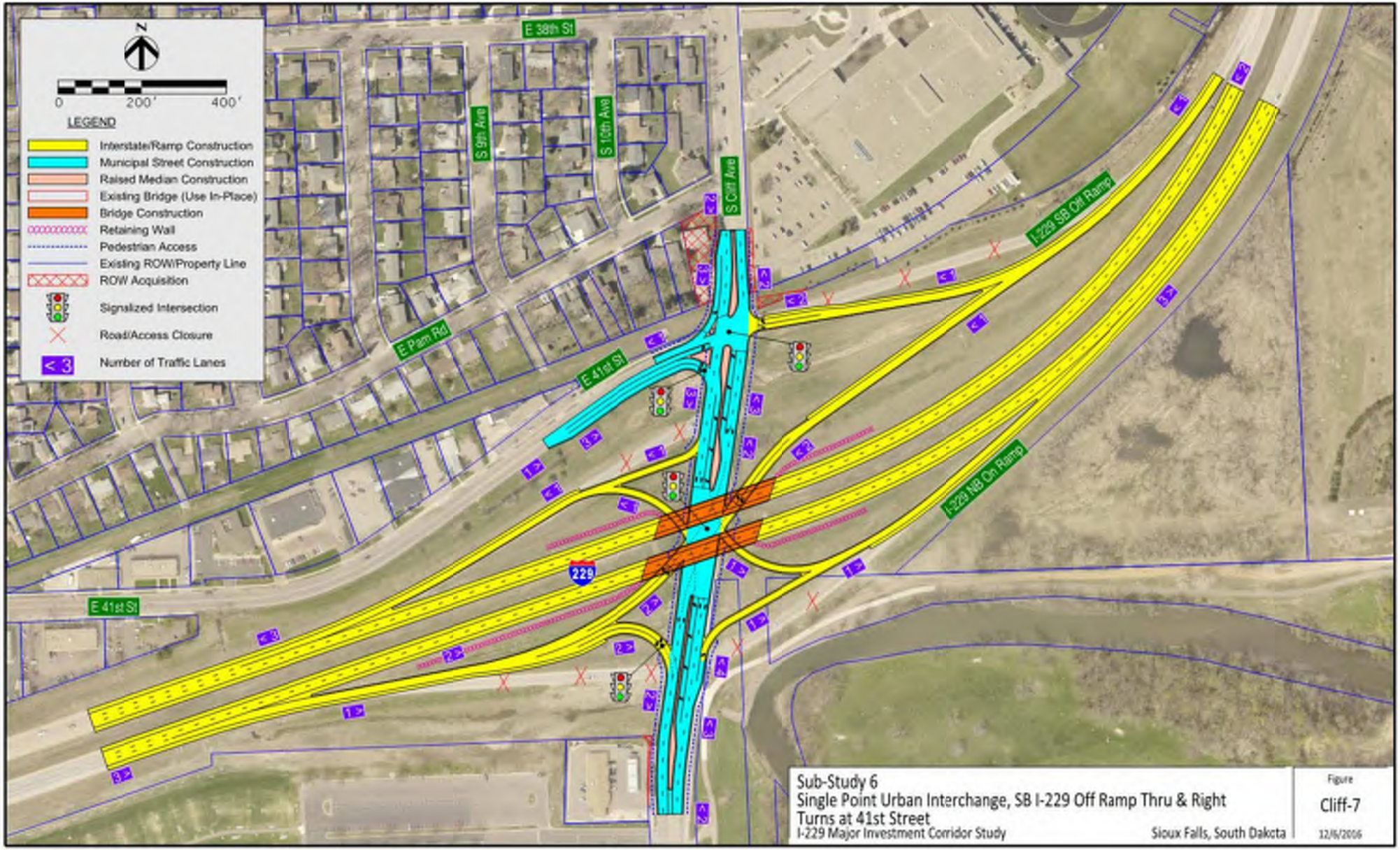
CONCEPTS FOR FURTHER CONSIDERATION

CLIFF- 6

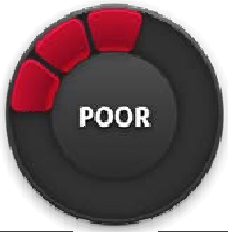
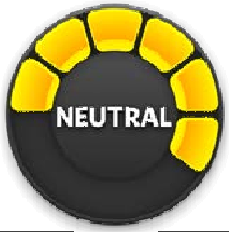
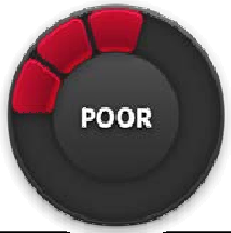
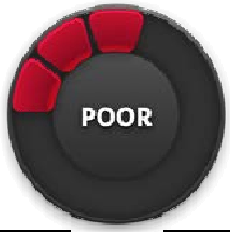


CONCEPTS FOR FURTHER CONSIDERATION

CLIFF - 7



CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						Advance
Cliff-1	NB Cliff to SB I-229 Loop Ramp						Advance
Cliff-6	Single Point Urban Interchange, 41st St Realigned to Pam Rd						Advance
Cliff-7	Single Point Urban Interchange, SB I-229 Off-Ramp Thru & Right Turns at 41st St						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.

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	Beth & Fern Pearson	2904 E Rice St. SF, SD	334-3160	beth.eastgatetowing@midconetwork.com
4	Kim Meester	1811 N Lowell Ave	367-9871	ArcheryOutfitter@live.com
5	Myrl + Rays Paving Chad Hartman	1300 N Bahnson	334-3204	Chad.h@marpaving.com
6	Myrl + Rays Paving Luke Klein	" "	334-3204	luke.k@marpaving.com
7	DAN KEARNEY	47046 259 St SF	351-5705	DKSL5489@Aol.com
8	Jason Ljenstad	6300 S. Old Village Place Suite 100 SF SD	977-7740	jason.ljenstad@bdrinc.com
9	Bob Schmidt	1500 N Sweetman Pl. SF, SD	605-728-2966	bschmidt@cmcsd.com
10	Clark Meyer	~~1500~~ " "	605-336-5763	cmeyer@cmcsd.com
11	Shawn Ausen	224 W. 9th St SF SD	605-367-8607	sausen@siouxfalls.org
12	Judy Hartman	2908 E. Rice SF SD	605-728-2459	
13	Patty Nohr	1300 N. Bahnson Ave	334-3204	Patty.n@marpaving.com
14	Stu Horsted	4001 E. Rice St	231-1763	shorsted@cmcsd.com
15	Eva Sadat	1410 E Rice St	605-271-1099	gsautosales@midconetwork.com
16	Qadar Sadat	"	"	"
17				
18				
19				
20				

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. Johnson	605-940-8501	GAIRUBIN@YAHOO.COM
3	Tammy Meland	1205 N. Caleb Ave	605-408-6763	
4	Hank Docken	3501 River BLUFF RD	605 366 2179	
5	Cory Hart	3408 Sycamore A	376 7328	
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







INTERSTATE 229 MAJOR INVESTMENT STUDY

Exit 7 – Rice Street Sub-Study

Stakeholder Meeting

December 6th, 2016
2:00 pm to 3:00 pm

HDR

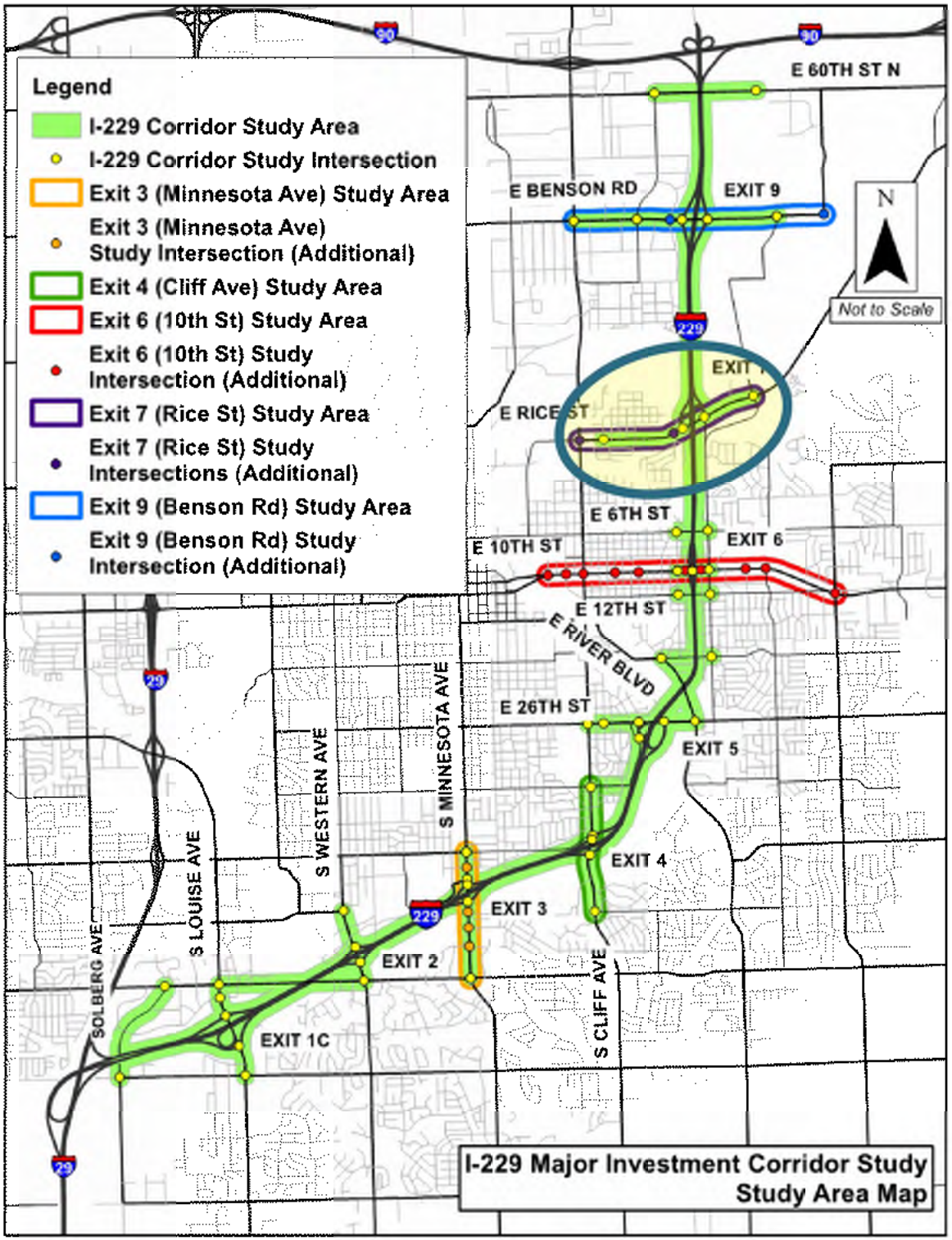
STUDY AREA MAP

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

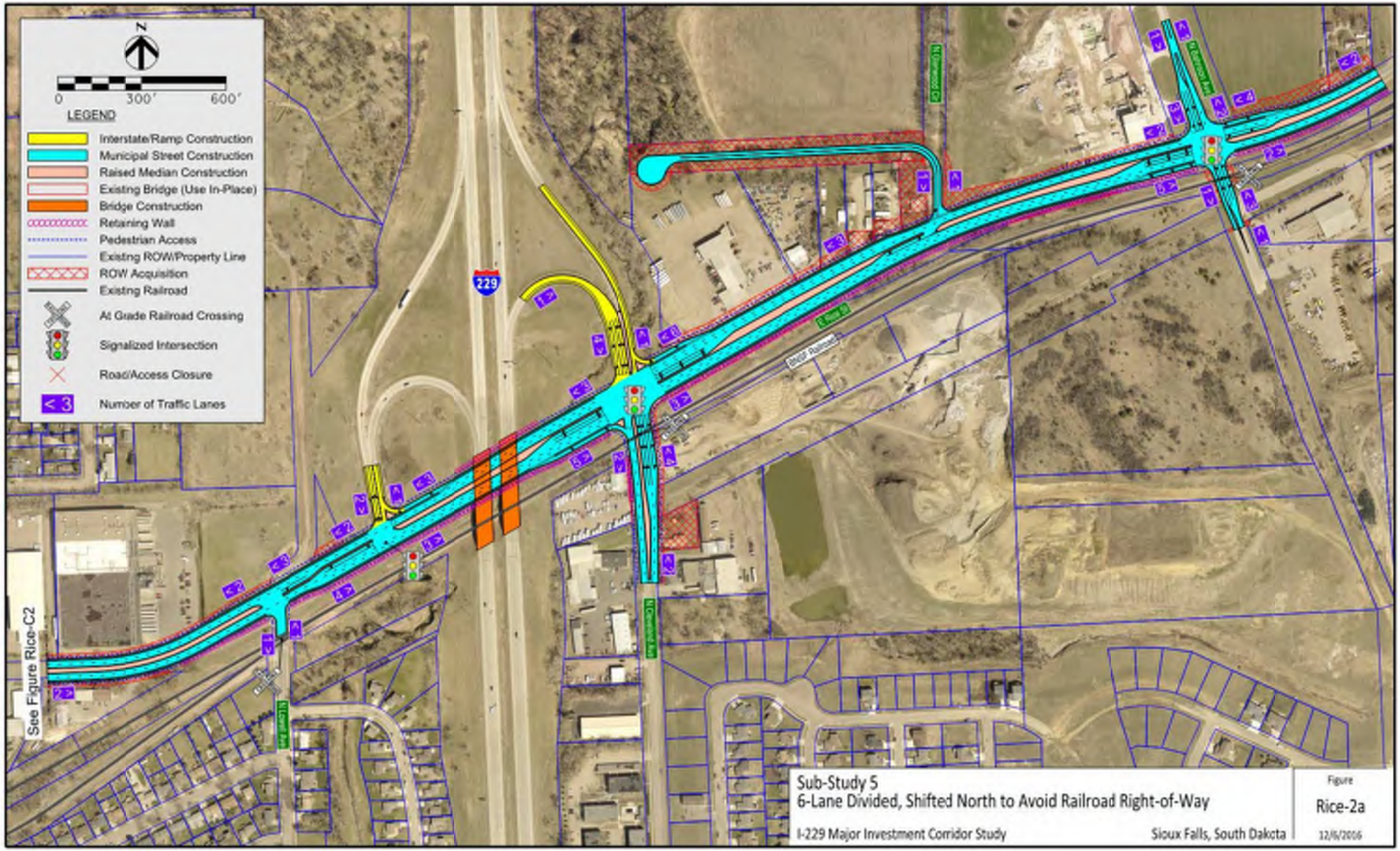
- Evaluation Factors:

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

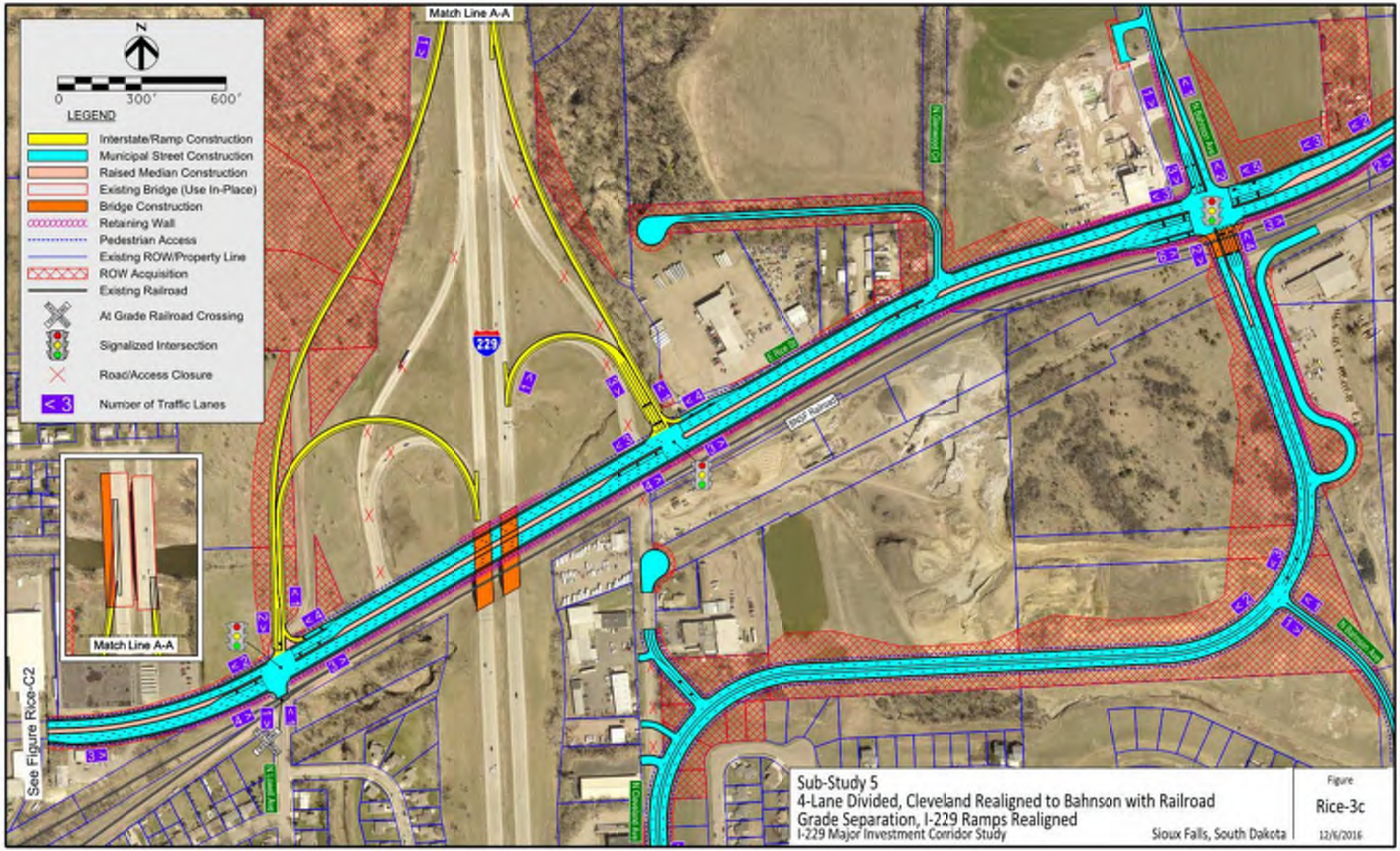
CONCEPTS FOR FURTHER CONSIDERATION

RICE-2A



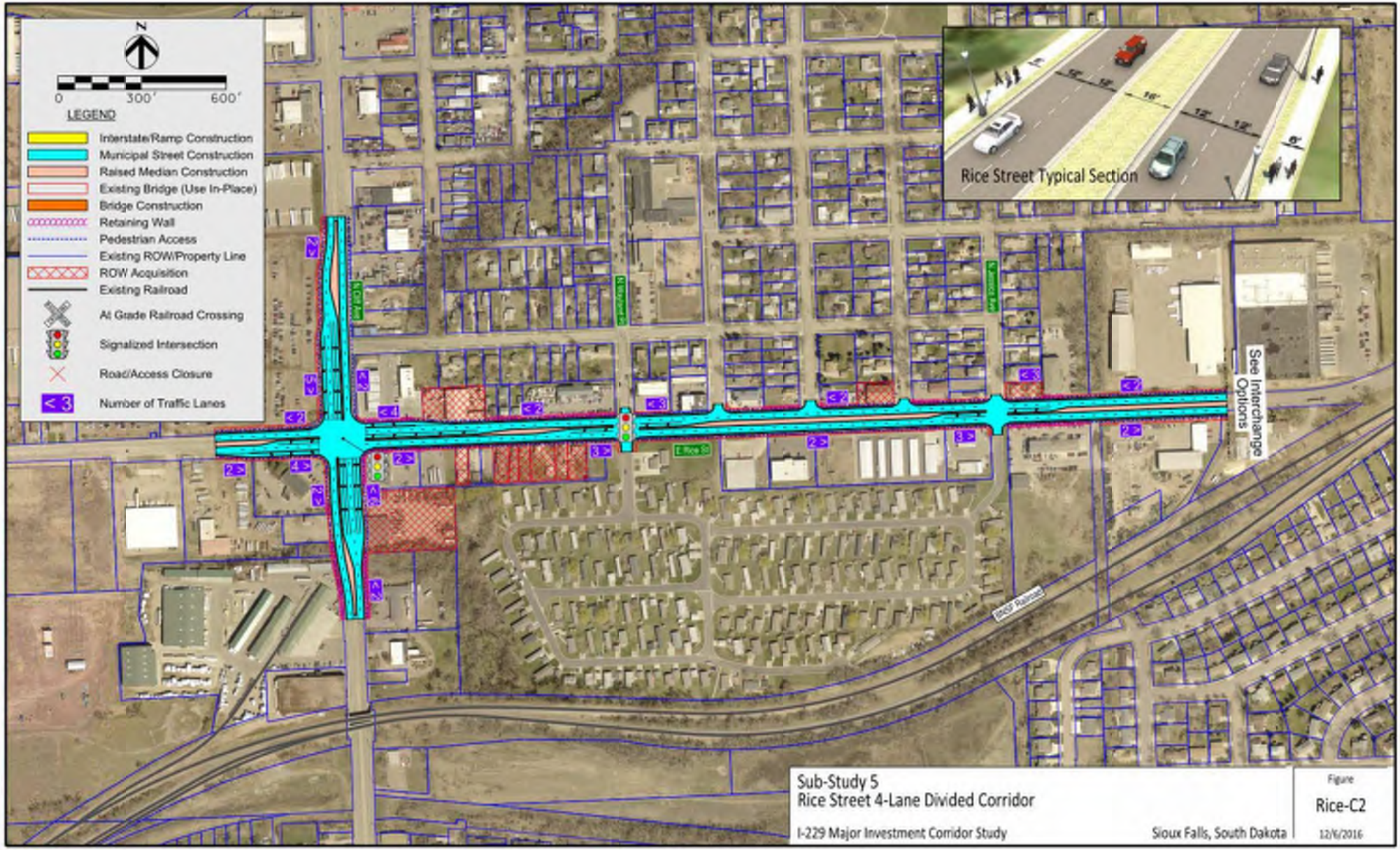
CONCEPTS FOR FURTHER CONSIDERATION

RICE-3C

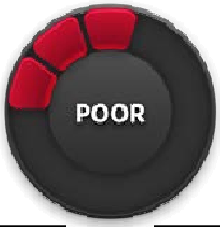
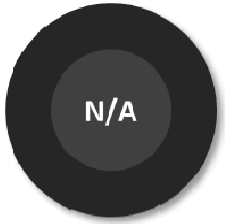
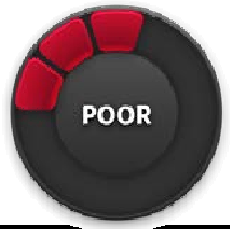
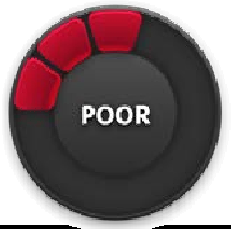
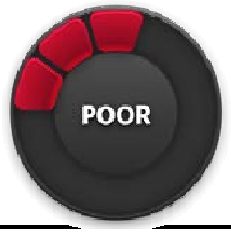


CONCEPTS FOR FURTHER CONSIDERATION

RICE-C2



CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						Advance
Rice-2	6-Lane Divided						Advance
Rice-2A	6-Lane Divided, Shifted North to Avoid Railroad Right-of-Way						Advance
Rice-3C	4-Lane Divided, Cleveland Realigned to Bahnson with Railroad Grade Separation, I-229 Ramps Realigned						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!

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.

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	brad.ty.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@q.com
6	Shally Rogen	48274 258 St Brandon SD 57005	321-3806	drogen3061@aol.com
7	Brian Frisbee	4101 S. Minnesota	338-6321	info@frisbeesinc.com
8	Lee Lewis	309 W 43rd St Ste 105	335-8805	LAL2966@basec.net
9	Mike Van Buckirk	5800 S Remington Pl #100	361 8211	Mike@VBClink.com
10	Kevin R Nyberg	330 W. 41st, SF	336-6474	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.midcoaT
14	Jason Kjenstad	6300 S. Old Village suite 100 SF SD	977-7740	jason.kjenstad@hdrinc.com
15				
16				
17				
18				
19				
20				

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	4802 S Minnesota Ave SF SD 57105	940-0756	carotwedt@sio.midco.net
3	Alex Connelly	1510 W. 51st SF, SD 57105	336-2165	alex.connelly@stantec.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	
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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	Frisbeans, Inc Berry Howe	4101 S. Minnesota Ave.	605-338-6321	berryh@frisbeanine.com
2	Dianne Metli	4204 S. Minnesota St, SD 57105	605-339-2864	metli@sio.midco.net
3	Kevin Kroeze	Boeve Associates 307 W. 41st 57105	605-336-0425	KevinK@BoeveAssociates.com
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				







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

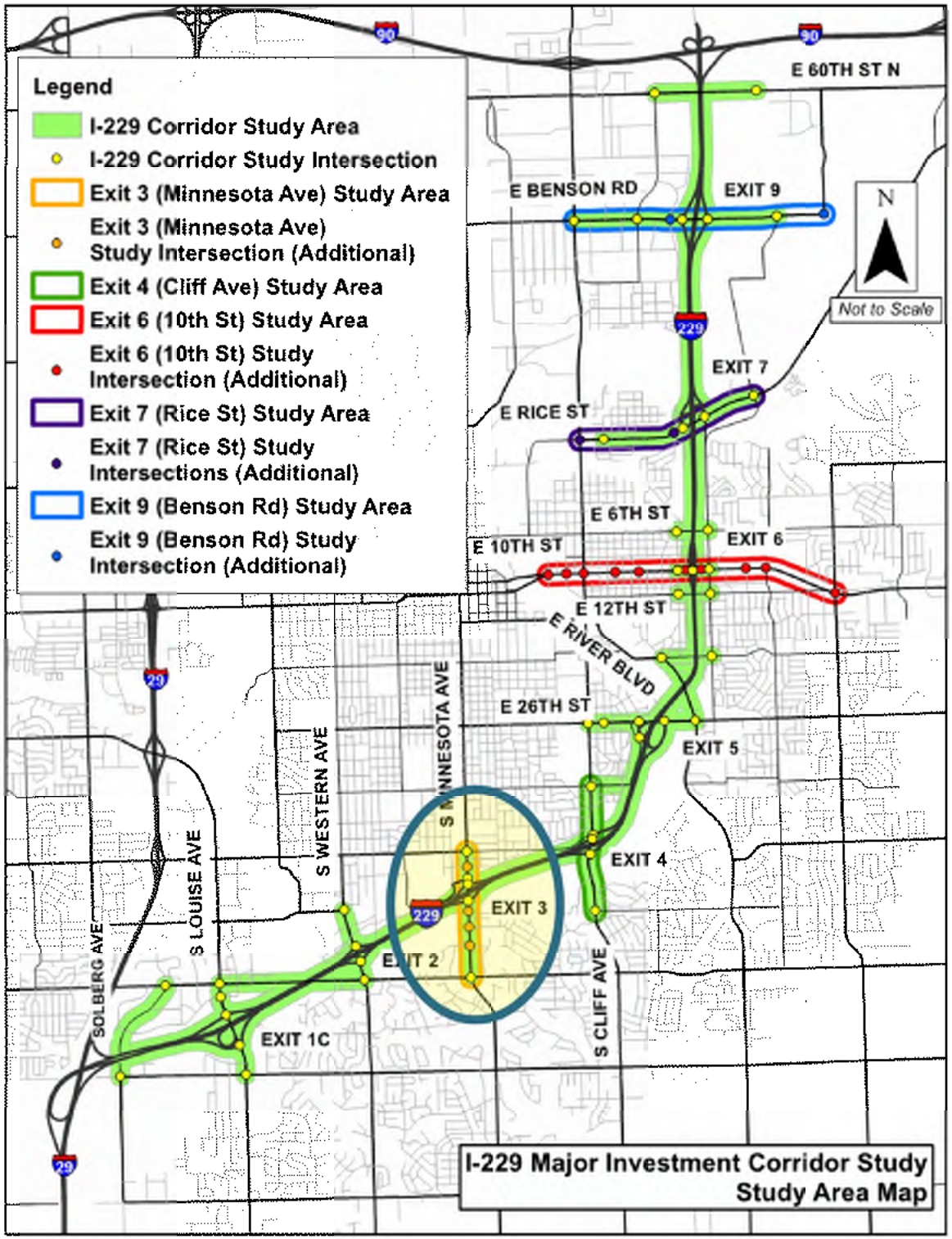
STUDY AREA MAP

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

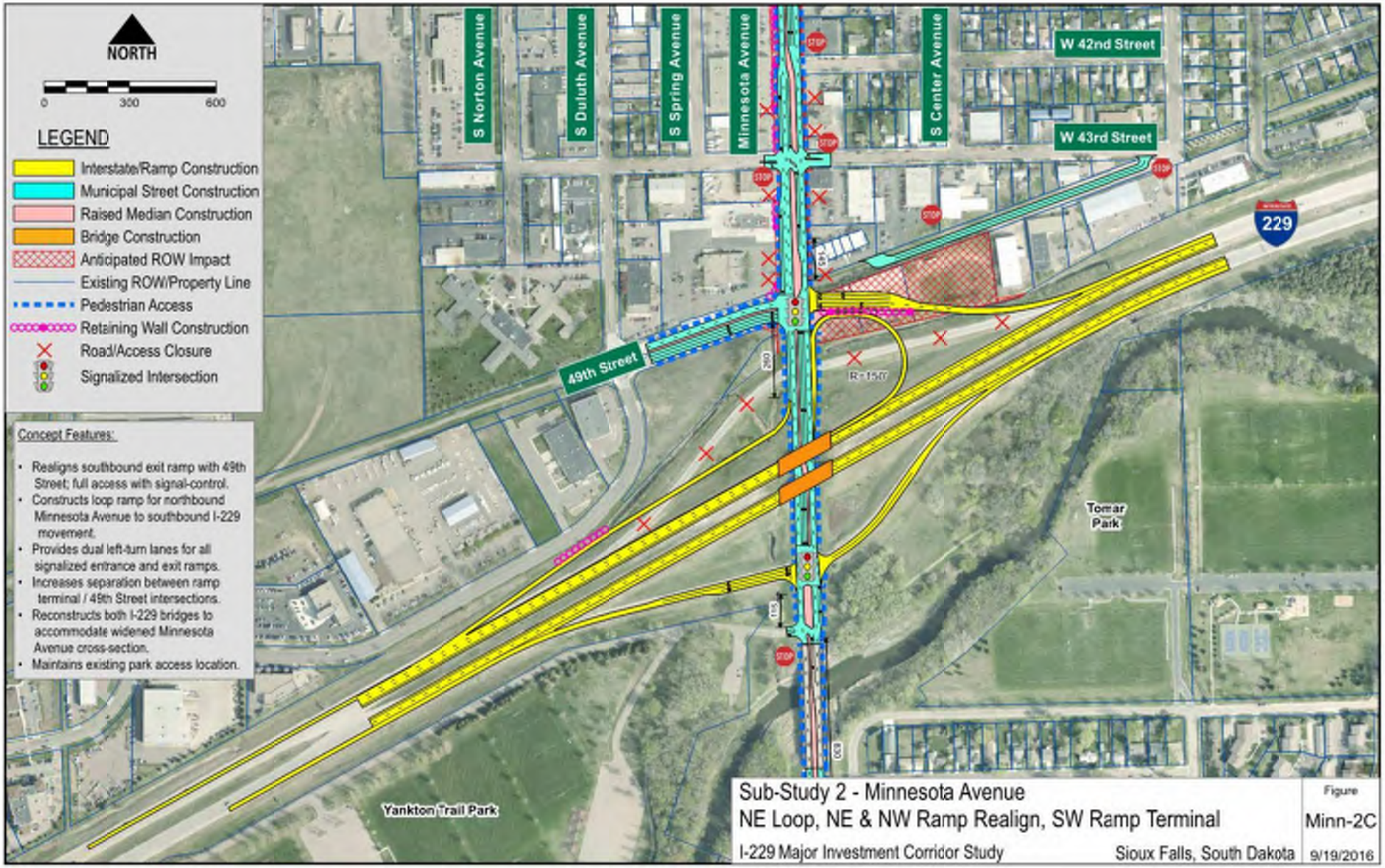
- Evaluation Factors:

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

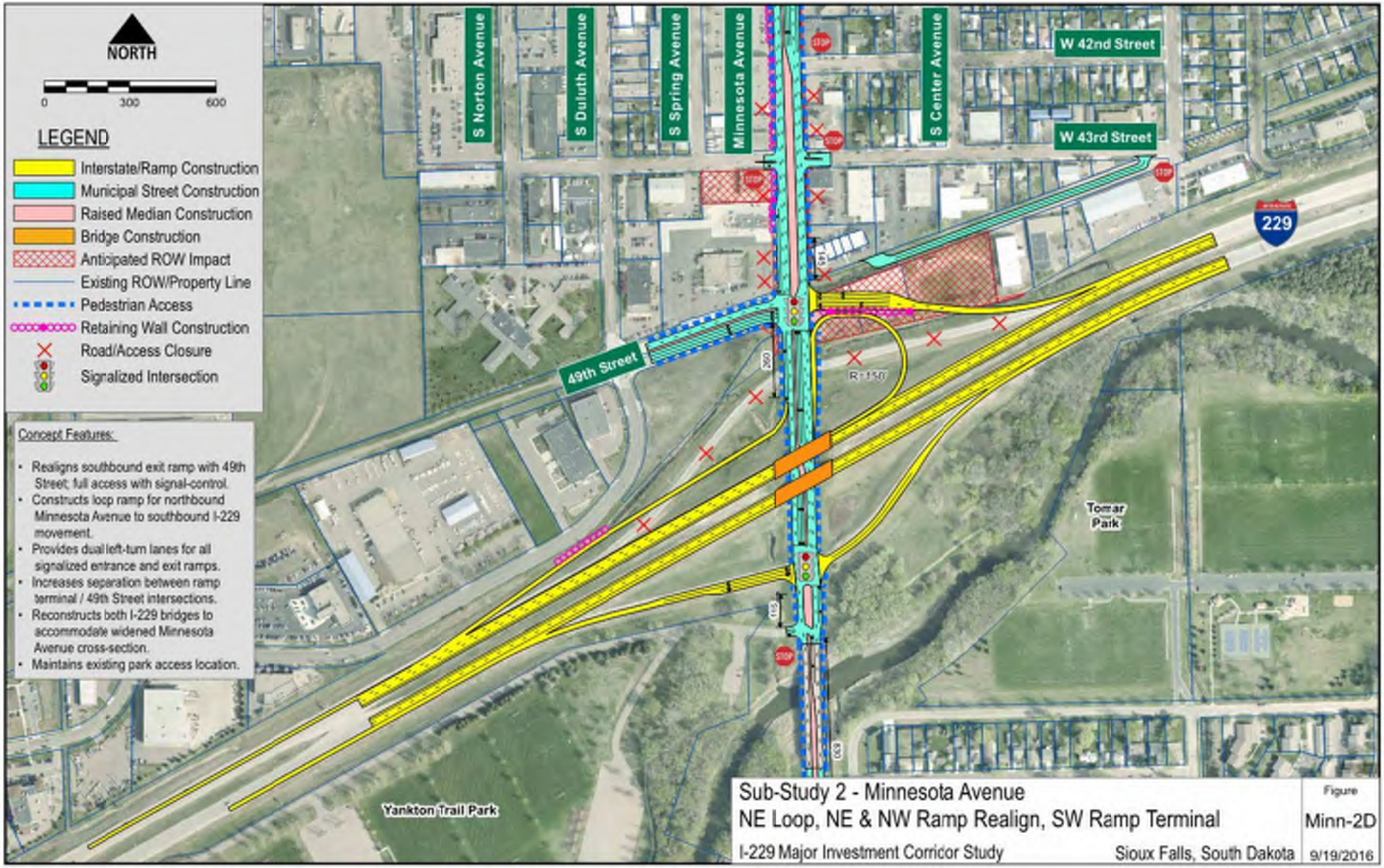
CONCEPTS FOR FURTHER CONSIDERATION

MINN-2C

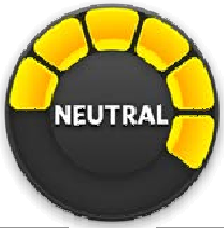
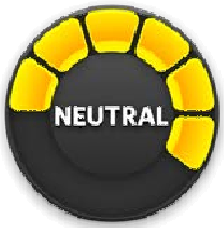


CONCEPTS FOR FURTHER CONSIDERATION

MINN-2D

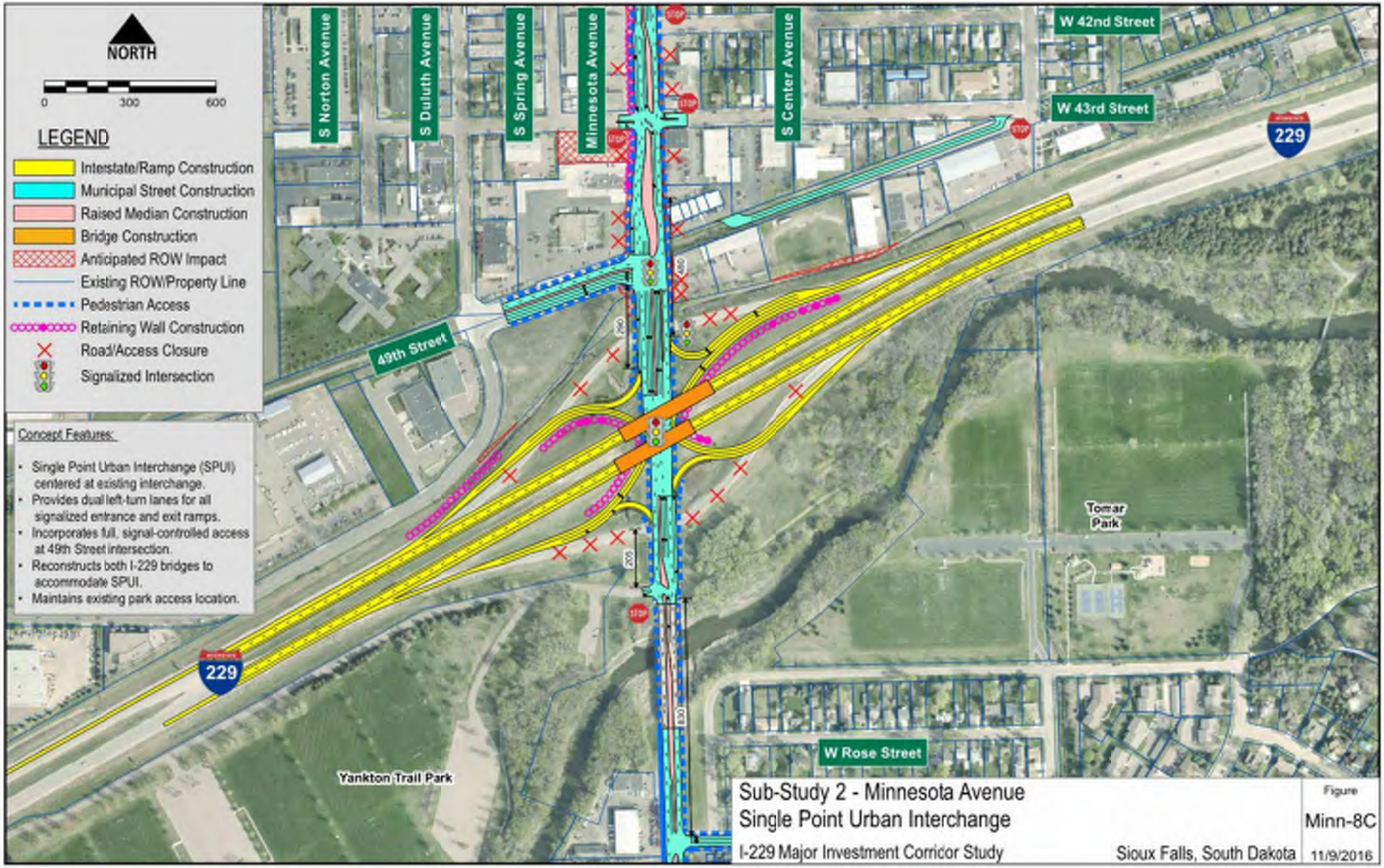


CONCEPT EVALUATION RESULTS

Option	Description	Traffic Operations	Safety	Environmental	Property Impacts	Construction & ROW Cost	DRAFT Recommendation
No-Build	No-Build						**Advance**
Minn-2C	Diamond with Loop, Direct Connect to 49th St, 5-Lane Big Sioux River to 41st St						**Advance**
Minn-2D	Diamond with Loop, Direct Connect to 49th St, 6-Lane Big Sioux River to 41st St						**Advance**
Minn-5D	Diverging Diamond Interchange, 6-Lane Big Sioux River to 41st St, 49th St Right-In Right-Out						**Eliminate** Closure of 49th Street Access

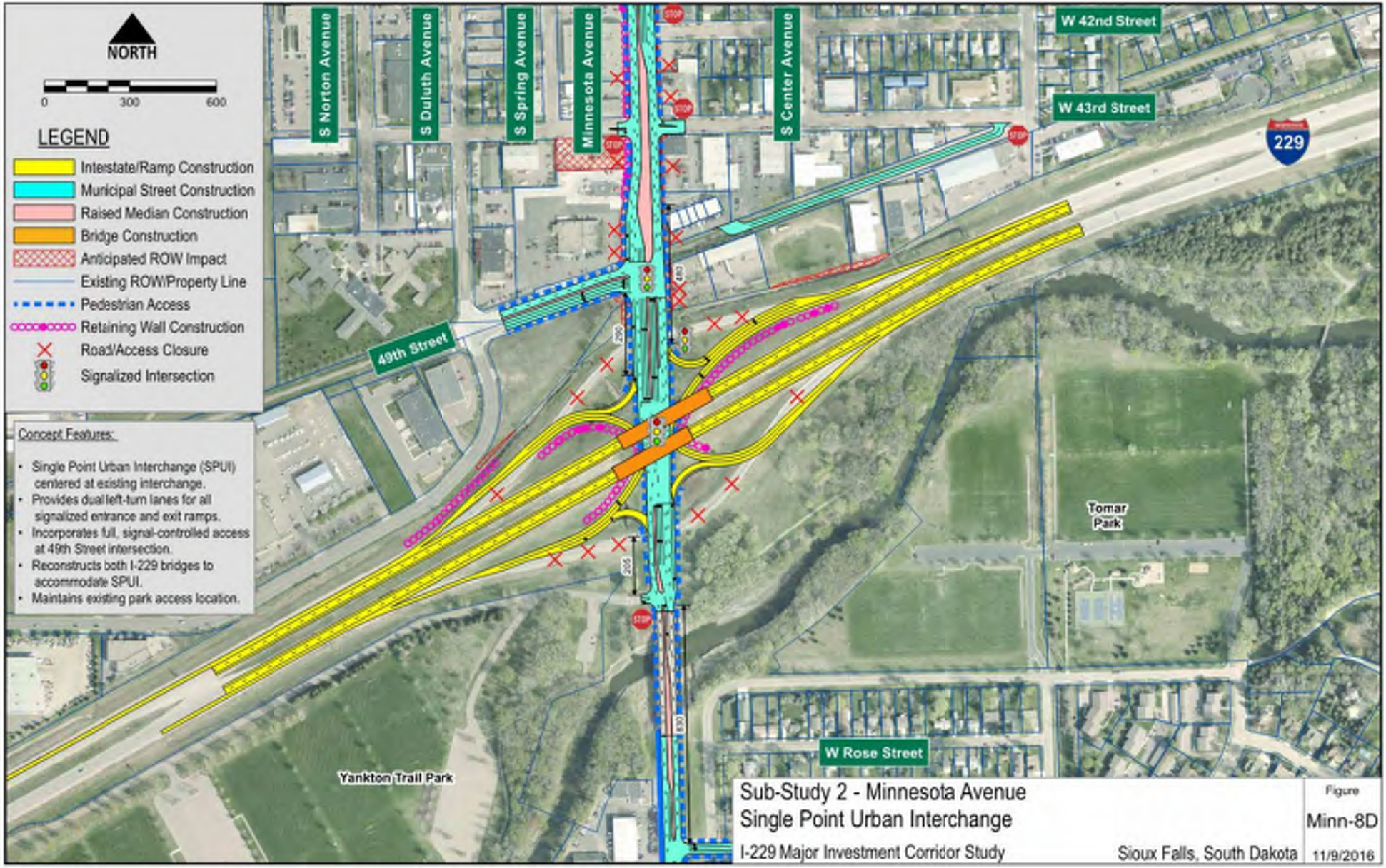
CONCEPTS FOR FURTHER CONSIDERATION

MINN-8C



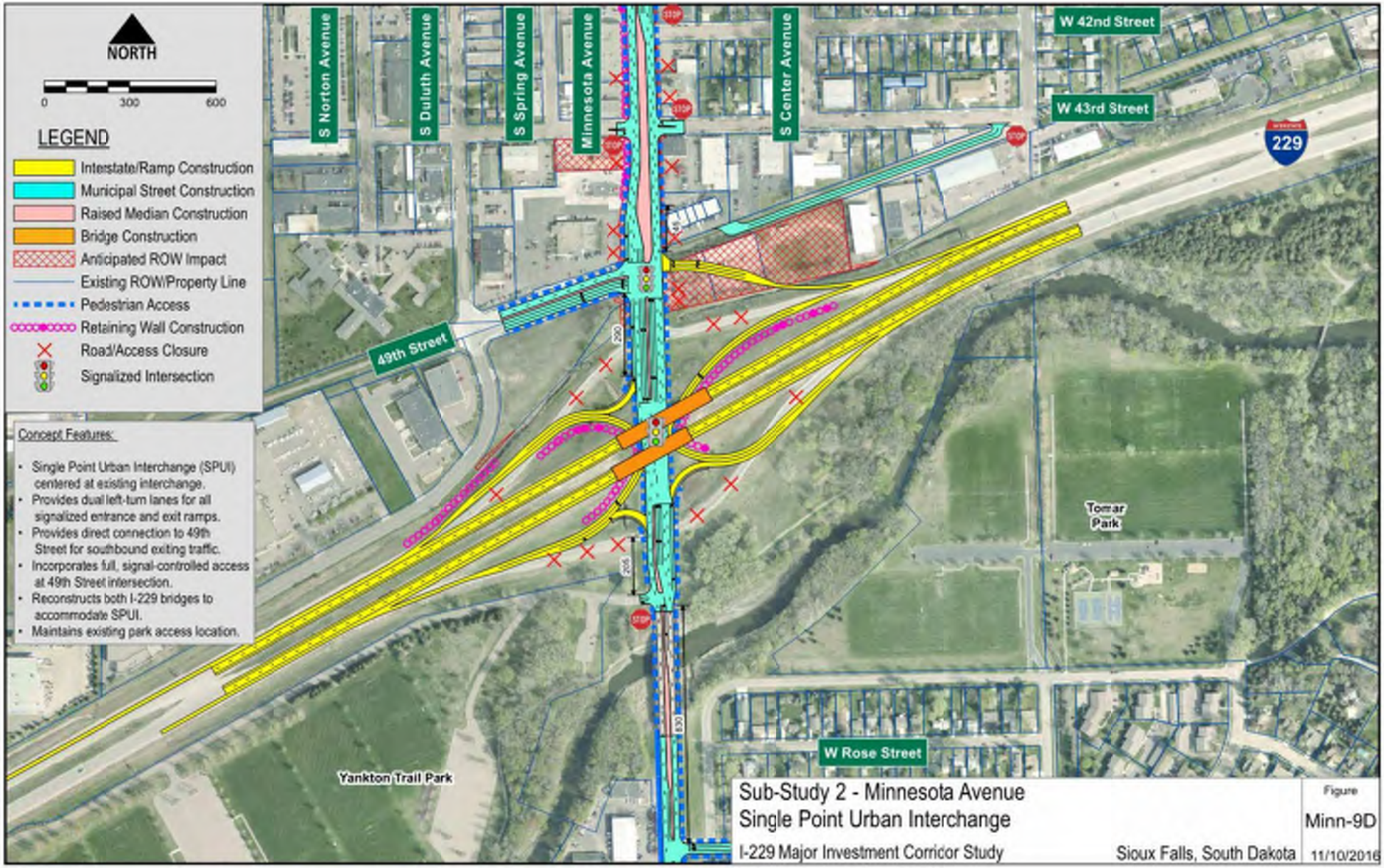
CONCEPTS FOR FURTHER CONSIDERATION

MINN-8D

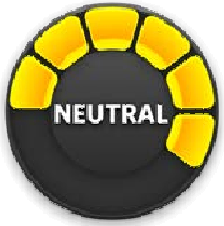
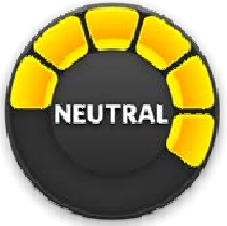
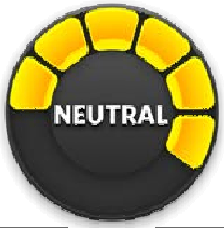
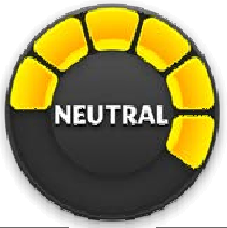
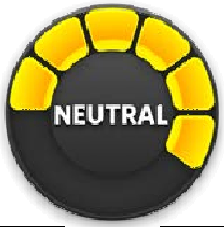
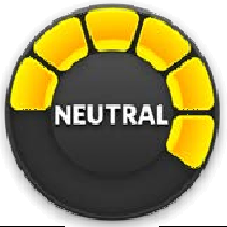


CONCEPTS FOR FURTHER CONSIDERATION

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						Advance
Minn-8D	Single Point Urban Interchange, 6-Lane Big Sioux River to 41st St, 49th St Full Access						Advance
Minn-9D	Single Point Urban Interchange, Exit Ramp Connection to 49th St, 5-Lane Big Sioux River to 41st St						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:

Jason Kjenstad – HDR Engineering, Inc.
605-977-7740 or jason.kjenstad@hdrinc.com

Jon Wiegand– HR Green, Inc.
605-221-2656 or jwiegand@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!

HDR

HRGreen

APPENDIX I -

EXISTING ACCESS CONTROL FIGURES

N

0 200′ 400′

LEGEND

Existing Control of Access

Existing R.O.W. / Property Lines

W. 49th Street

S. Grange Avenue

INTERSTATE 229

INTERSTATE 229

Big Sioux River

S. Minnesota Avenue

W. Twin Oaks Road

Existing Control of Access
S. Minnesota Avenue Interchange

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 1

June 2017

N

0 200′ 400′

LEGEND

Existing Control of Access

Existing R.O.W. / Property Lines

E. Pam Road

E. 41st Street

S. Cliff Avenue

Big Sioux River

INTERSTATE 229

INTERSTATE 229

Existing Control of Access
S. Cliff Avenue Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 2

June 2017

N

0 200′ 400′

LEGEND

Existing Control of Access

Existing R.O.W. / Property Lines

S. Lowell Avenue

S. Conklin Avenue

229

229

S. Blaine Avenue

E. 12th Street

S. Cleveland Avenue

E. 10th Street

E. 8th Street

E. 6th Street

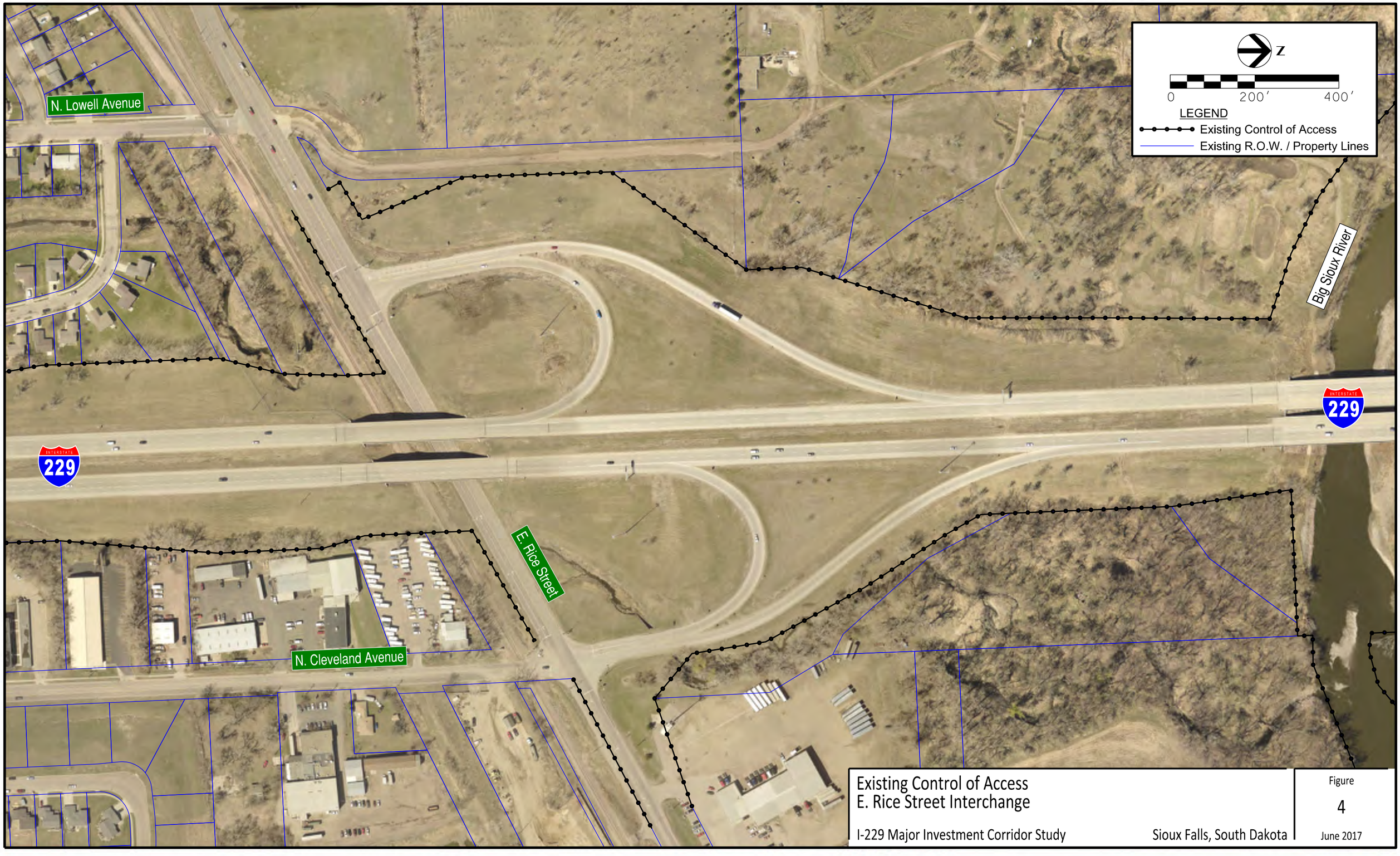
Existing Control of Access
E. 10th Street Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 3

June 2017



Existing Control of Access
E. Rice Street Interchange

I-229 Major Investment Corridor Study — Sioux Falls, South Dakota

Figure 4

June 2017

N

0 200′ 400′

LEGEND

Existing Control of Access

Existing R.O.W. / Property Lines

N. Potsdam Avenue

N. Potsdam Avenue

N. Hairnie Avenue

INTERSTATE 229

E. Benson Road

INTERSTATE 229

Existing Control of Access
E. Benson Road Interchange

I-229 Major Investment Corridor Study

Sioux Falls, South Dakota

Figure 5

June 2017