I-229/26th Street Interchange Modification Justification Report

October, 2014

Interchange Modification Justification Report

I-229/26th Street Interchange
Exit 5

Sioux Falls, South Dakota
October, 2014

Prepared for:

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"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."

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FIGURES AND TABLES

Special Note on Figure Numbering and Contents

Many of the figures contained in this document have appeared in previous technical memoranda and reports prepared as part of the I-229/26th Street (Exit 5) Corridor Study and the Environmental Assessment for the I-229/26th Street interchange. In some cases, the original figure numbers have been maintained to provide continuity to those other documents, even though they result in non-sequential numbering in this report. Figures from the Corridor Study also include information on intersections that were included in the original study area. The study area for this Interchange Modification Justification Report has been trimmed to include the subject interchange, the subject crossroad, adjacent interchanges and short segments of the crossroads for the adjacent interchanges.

EXECUTIVE SUMMARY

This Interchange Modification Justification Report (IMJR) provides technical analysis related to proposed changes to the existing 26th Street interchange (Exit 5) on Interstate 229 in Sioux Falls, SD. The IMJR supports a companion Environmental Assessment (EA).

The proposed action is a reconfiguration and possible realignment of the existing 26th Street interchange on Interstate 229 in Sioux Falls, SD. The action is proposed to bring the existing interchange up to current design standards and provide appropriate operational capacity for future traffic demand. No adverse impacts to the Interstate highway system are forecast due to the proposed change.

The Federal policy considerations and requirements have been addressed beginning on page 67 and summary responses to the eight requirements are provided below.

1. The proposed change improves the interchange configuration and capacity. The proposed change does not result in any new access points on the Interstate Highway System.
2. The retained interchange options involve changes to correct an unconventional ramp configuration and meet the transportation needs in the study area. Mass transit and HOV facilities will not correct design deficiencies or provide sufficient relief to future travel demand within the study planning horizon.
3. The operational and safety analysis contained in this study shows that the I-229 mainline between 10th Street and 26th Street will need to be expanded by one lane in each direction by 2035, regardless of whether the 26th Street interchange is changed. (See the Future Year Traffic section of this report for more information on traffic forecasts.) If that section of I-229 is expanded, Interstate mainline and ramp facilities will operate within operational and safety goals with any of the retained alternatives. The ramp terminal intersections, however, will fail with the No-Build option, but continue to operate acceptably with the other options.
4. The proposed action is a reconfiguration of an existing interchange with an arterial city street and includes all movements. The conceptual drawings have been prepared to illustrate the proposed improvements reflecting standardization of the interchange for the SB I-229 movements as well as improvements to meet traffic capacity requirements at the ramp intersections with 26th Street.
5. The proposal is the result of land use and transportation plans prepared within the MPO process. This Interstate Modification Justification Report supplements an Environmental Assessment and Section 4(f) De Minimis Impact Finding.
6. The South Dakota Department of Transportation has prepared the Decennial Interstate Corridor Study (2010), which considered all proposed additions to the Interstate Highway System within the state of South Dakota. The proposed interchange reconfiguration was addressed in the Decennial study and no additional interchanges were anticipated within the IMJR study area.
7. The proposed access change results not from any particular development, but from overall growth within the metropolitan area. It is part of a planned program

of transportation improvements throughout the metropolitan area to address future transportation needs.

8. The Public Availability Draft EA for the 26th Street Corridor has been submitted for review. The I-229/26th Street (Exit 5) Corridor Study, the EA and this IMJR have been prepared as part of one continuous planning and preliminary engineering process, including numerous opportunities for public input. All interchange and intersection options are uniform throughout the process.

Analysis techniques included evaluation of operational capacity using Highway Capacity Manual 2010 techniques via HCS 2010, current version. Highway Safety Manual techniques were used to the extent possible in this report. Other techniques and reference materials are detailed in a Methods and Assumptions document prepared for this study and signed by South Dakota Department of Transportation and Federal Highway Administration participants in August, 2012.

INTRODUCTION

Background

SDDOT, the City of Sioux Falls, the Sioux Falls Metropolitan Planning Organization, and the Federal Highway Administration are conducting a study to evaluate the design, operations, policy and funding implications of replacing the 26th Street interchange (Exit 5) on I-229 in Sioux Falls, SD. This existing interchange serves an urban arterial corridor that carries a significant amount of commuting traffic. This Interchange Modification Justification Report is being prepared in conjunction with an EA document and will provide traffic analysis for the selection of a preferred alternative in the EA.

Purpose

The southbound I-229 on and off ramps connect to Yeager Road, a parallel local collector roadway, rather than the 26th Street interstate crossing. The SDDOT 2010 Decennial Interstate Corridor Study (2010 Decennial Study) prioritized correction of this unconventional ramp configuration. Other deficiencies noted in the 2010 Decennial Study included substandard curve radii, k values below the desirable levels, and inadequate stopping sight distance; neither the safety analysis in the 2010 Decennial Study nor the safety analysis prepared for this project (HDR, April 2014) identified these deficiencies as a safety concern that needed to be addressed.

During the planning stage of the Project, the existing interchange was analyzed to determine whether standardization of the southbound ramp configuration was needed to accommodate existing and future traffic conditions. From this analysis, concept options were developed, all of which eliminated the connection of the southbound ramps to Yeager Road.

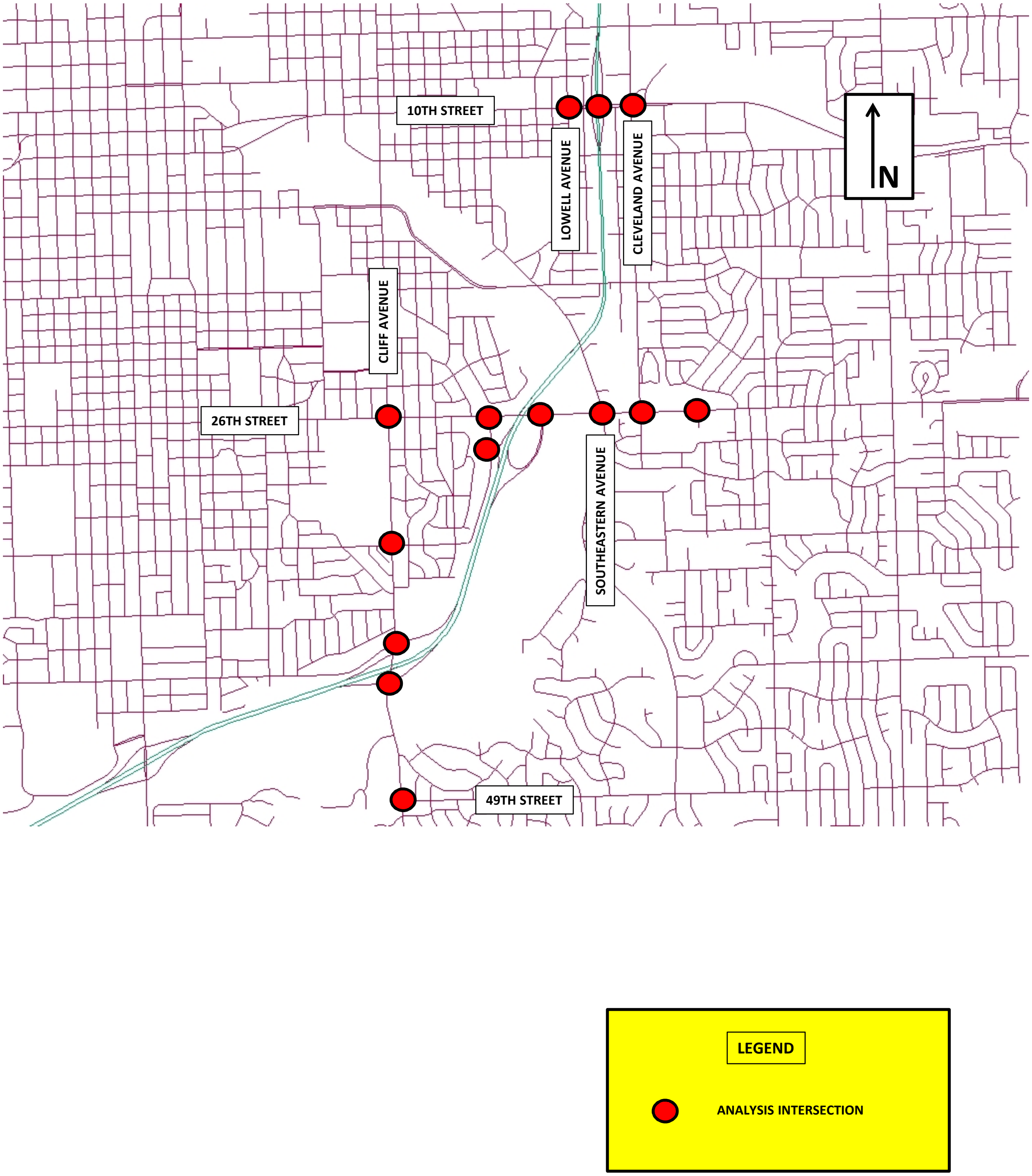
Project Location

The subject interchange is at mileage reference marker 5 on Interstate 229, in eastern Sioux Falls, SD. This location is within the Sioux Falls MPO and also within the developed Sioux Falls urban area. The adjacent interchanges on I-229 are Cliff Avenue (Exit 4) and 10th Street (Exit 6). Therefore, interchange spacing is approximately 1 mile to either side of the subject interchange.

There are many local roadways in the vicinity of the interchange. The crossroad, 26th Street, is a three-lane roadway west of the interchange that transitions to a four-lane roadway within the interchange and to a 5-lane roadway east of the interchange. Twenty-Sixth Street is intersected by Yeager Road, a two-lane road, which also serves as access to the ramps for southbound I-229. Approximately 0.4 mile west of the interchange, 26th Street is intersected by Cliff Avenue. The closest intersecting roadway east of the interchange is Southeastern Avenue, a multi-lane urban street .24 miles away. Other minor streets intersect 26th Street between Cliff Avenue and Yeager Road and a number of commercial and park driveways exist between the interchange and Southeastern

Avenue. The 26th/Cliff, 26th/Yeager, 26th/I-229 NB, and 26th/Southeastern intersections are controlled by traffic signals, while the other minor streets and driveways are controlled by stop signs. Portions of 26th Street, including the Cleveland Avenue and Village Square Place intersections, also may be impacted by long peak hour queues extending back from the existing ramp termini. An at-grade railroad crossing between the existing interchange and Southeastern Avenue also can produce long vehicle queues through the interchange area and extending along 26th Street east and west of the crossing. Improvements within the study area, including projects undertaken by the City of Sioux Falls, will be planned to help alleviate congestion and queuing issues on 26th Street. City projects may include intersection improvements and grade separation of the railroad crossing.

Other local streets intersect I-229 at the adjacent interchanges or lie within the street network in the vicinity of the subject interchange. The study area, therefore, has been defined as Interstate 229, from MRM 4 to MRM 6, including Exits 4, 5, and 6, 26th Street from Cliff Avenue to Village Square Place, and portions of 10th Street and Cliff Avenue that are part of the local street network served by the subject interchange and the adjoining interchanges. The study area is shown in **Figure IMJR-1**.



I-229/26TH STREET (EXIT 5)
INTERCHANGE MODIFICATION
JUSTIFICATION REPORT

FIGURE IMJR 1
STUDY AREA

METHODOLOGY

Preparation of this report included the following work tasks:

1. Data gathering
2. Review previous Interstate studies and coordinate with preparation of the EA document, including feasible alternatives and the recommended alternative.
3. Determine existing and future operational characteristics of Interstate and local street facilities.
4. Estimate the safety effects of the primary alternatives.
5. Prepare deliverable report.

Traffic forecasts were prepared using output from the regional travel demand model maintained by the City of Sioux Falls. Traffic operations were analyzed using Highway Capacity Manual techniques using HCS 2010 and Highway Safety Manual techniques.

This IMJR document is organized in accordance with section 2.5.2 of FHWA's *Interstate System Access Information Guide,* August 2010.

Additional details on methodology can be found in the Methods and Assumptions agreement (August, 2012) prepared for this project located in the appendix.

EXISTING CONDITIONS

Demographics

The Sioux Falls metropolitan area enjoys a robust economy and sustained population growth. During the period 1980 – 2000 the population grew at a steady rate of between 2% and 3% per year. Even in the face of the recent recession, the population continued to grow at an annual rate of 1%-2% per year and the 2010 Census shows the city with a population of 153,888, while the Metropolitan Statistical Area had a population of 228,261 and the market area had a population of 1,043,450. (Market area is a term used in economics and human geography describing the area surrounding a central place, from which people are attracted to use the place's goods or services.)

Generally, employment for the Sioux Falls area has grown at approximately the same rate as the population and unemployment is approximately 3.3% in Sioux Falls, compared with a national unemployment rate of 6.3%.

Existing Land Use

The study area is comprised mainly of residential neighborhoods, with commercial uses along the arterial streets and scattered institutional and office uses. The flood plain of the Big Sioux River and associated parks and open space are also present. The study area Traffic Analysis Zones (TAZ's) currently reflect the existing population and employment inputs. The future-year TAZ's show limited increases in population and employment inputs in these established urban neighborhoods.

The future land use plan for Sioux Falls shows no changes in land use for this well-established portion of the urban area.

Existing Roadway Network

As previously identified, the existing major roadways within the study area include:

- Interstate 229 – currently two lanes in each direction, with auxiliary lanes between 26th Street and Cliff Avenue.
- 26th Street – varying between 3- and 5-lane urban arterial roadway.
- 10th Street – 5-lane urban arterial roadway.
- Cliff Avenue – 5-lane urban arterial roadway
- Southeastern Avenue – 3-lane, transitioning to 4-lane urban arterial roadway.

Alternative Travel Modes

Travel within the study area is primarily by automobile. Pedestrian and bicycle modes are used mainly for recreation, although bicycle commuters use the River Greenway bike trail system and streets within the study area. The area is currently served by municipal transit routes, with routes operating on portions of 10th Street, 14th Street/River Boulevard/18th Street, Cleveland Avenue, Cliff Avenue, and 26th Street. Buses operate on headways that vary from about 30 to 60 minutes and routes wind through neighborhoods to serve passenger destinations.

Interchanges

Interchanges within the study area include:

- I-229/Cliff Avenue (Exit 4) – a diamond design with the southbound off ramp aligned with 41st Street.
- I-229/26th Street (Exit 5) – the subject interchange is a folded-diamond configuration with the northbound ramp terminal controlled by a traffic signal. The southbound ramps intersect with Yeager Road, which then intersects with 26th Street at a signalized intersection. The *Decennial Interstate Corridor Study (SDDOT)* prioritized correction of this unconventional ramp configuration. Other deficiencies noted in the 2010 Decennial Study included substandard curve radii, k values below the desirable levels, and inadequate stopping sight distance.
- I-229/10th Street (Exit 6) – a single-point configuration. Regional growth has increased the traffic load on this interchange and will likely require future capacity improvements.

Aerial photos of the existing interchanges have been included in the Appendix, Part 5.

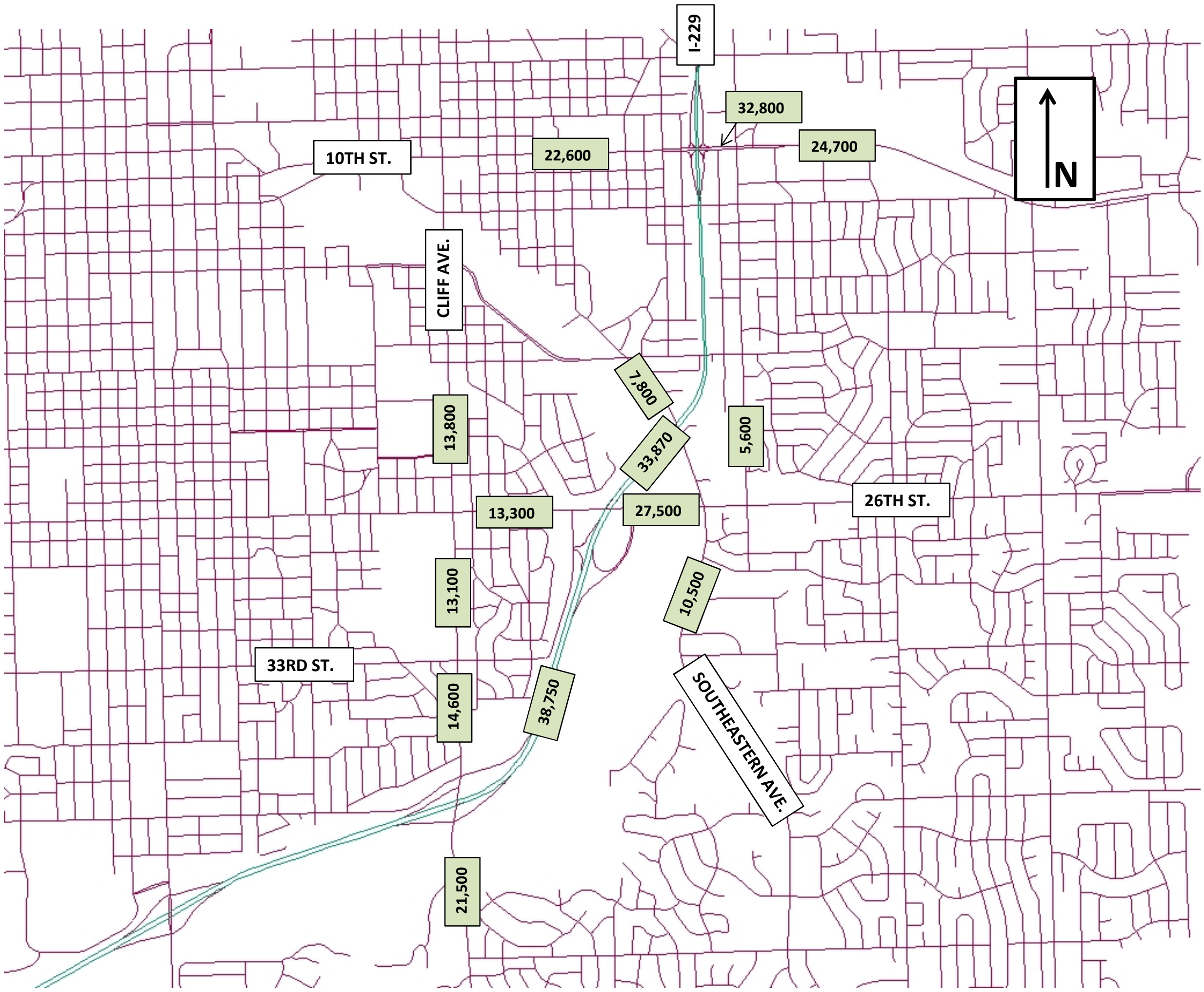
Existing Data

Most study data were available from the participating agencies, including traffic counts, crash data, and raw travel demand model output. The available data was supplemented with additional counts, travel time runs, and traffic observations. The data is recent and of high quality.

Operational Performance

Operation performance of highways is evaluated in terms of the quality of service, which describes how well a transportation facility operates from the traveler's perspective. Quality of service is usually measured with "Level of Service", a letter grade similar to those used in school. Level of service A refers to uncongested traffic conditions, with levels of service B through E describing increasingly more congested conditions and level of service F describing the highest congestion. Level of service is determined in different ways for different roadway facilities, with Interstate highway facilities evaluated in terms of vehicle density, urban intersections evaluated in terms of vehicle delay, and other facilities evaluated using other measures of roadway dynamics. All quality of service is determined using techniques developed for the Highway Capacity Manual, published by the Transportation Research Board.

The existing study area roadways were evaluated using accepted traffic operations techniques for Interstate highways and urban streets. Interstate 229 operates at acceptable levels of service under existing conditions. Many street intersections, including ramp termini operate at unacceptable levels of service during peak hours. Daily traffic volumes in the study area are shown in **Figure IMJR-2**. Peak hour traffic volumes and levels of service are summarized in **Figures 1-3, 1-5, and 1-6**. Supporting analysis printouts are provided in the Appendix in Parts 1 and 2.



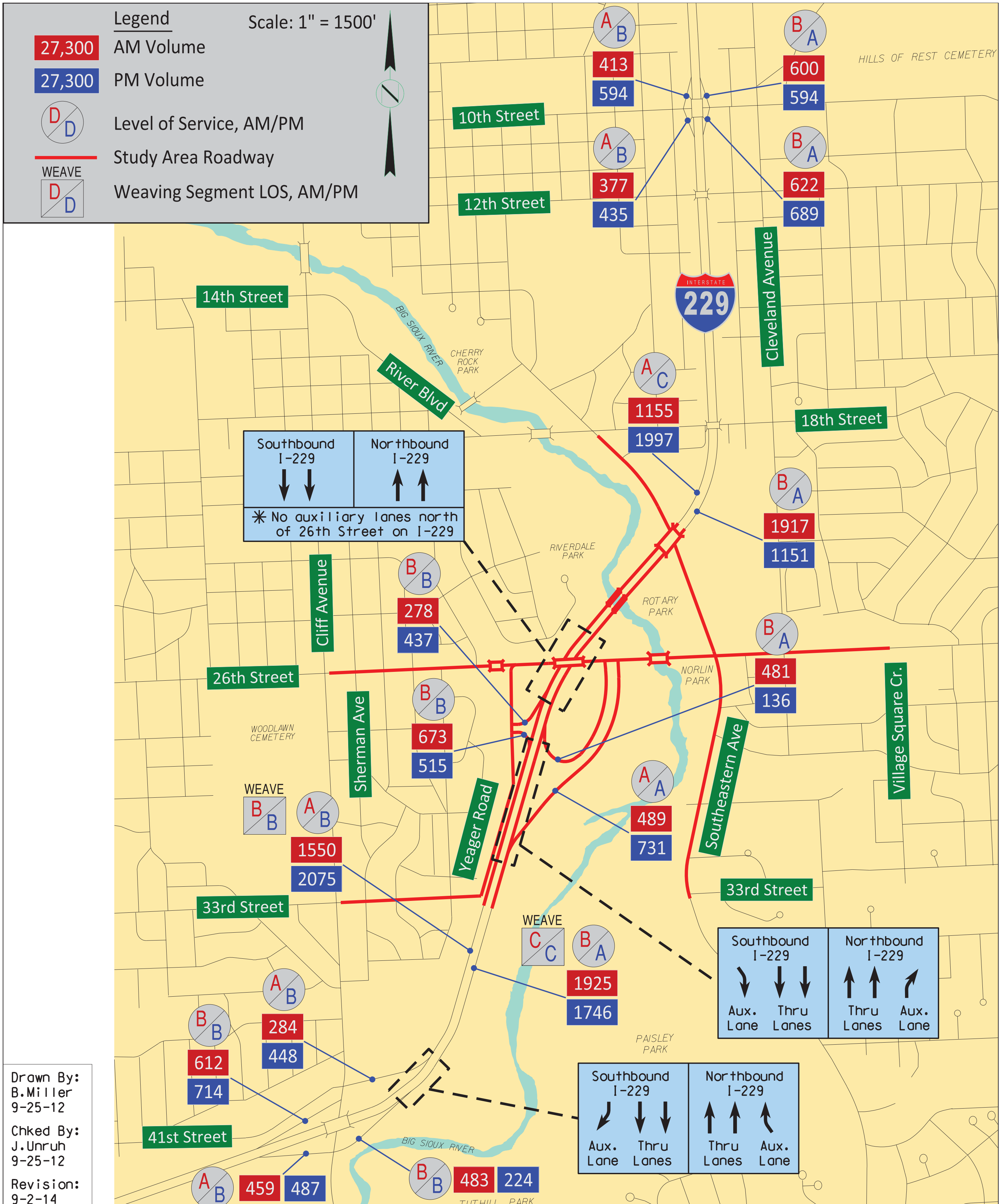
LEGEND

1,234	AVERAGE ANNUAL DAILY TRAFFIC

HDR

I-229/26TH STREET (EXIT 5) INTERCHANGE MODIFICATION JUSTIFICATION REPORT

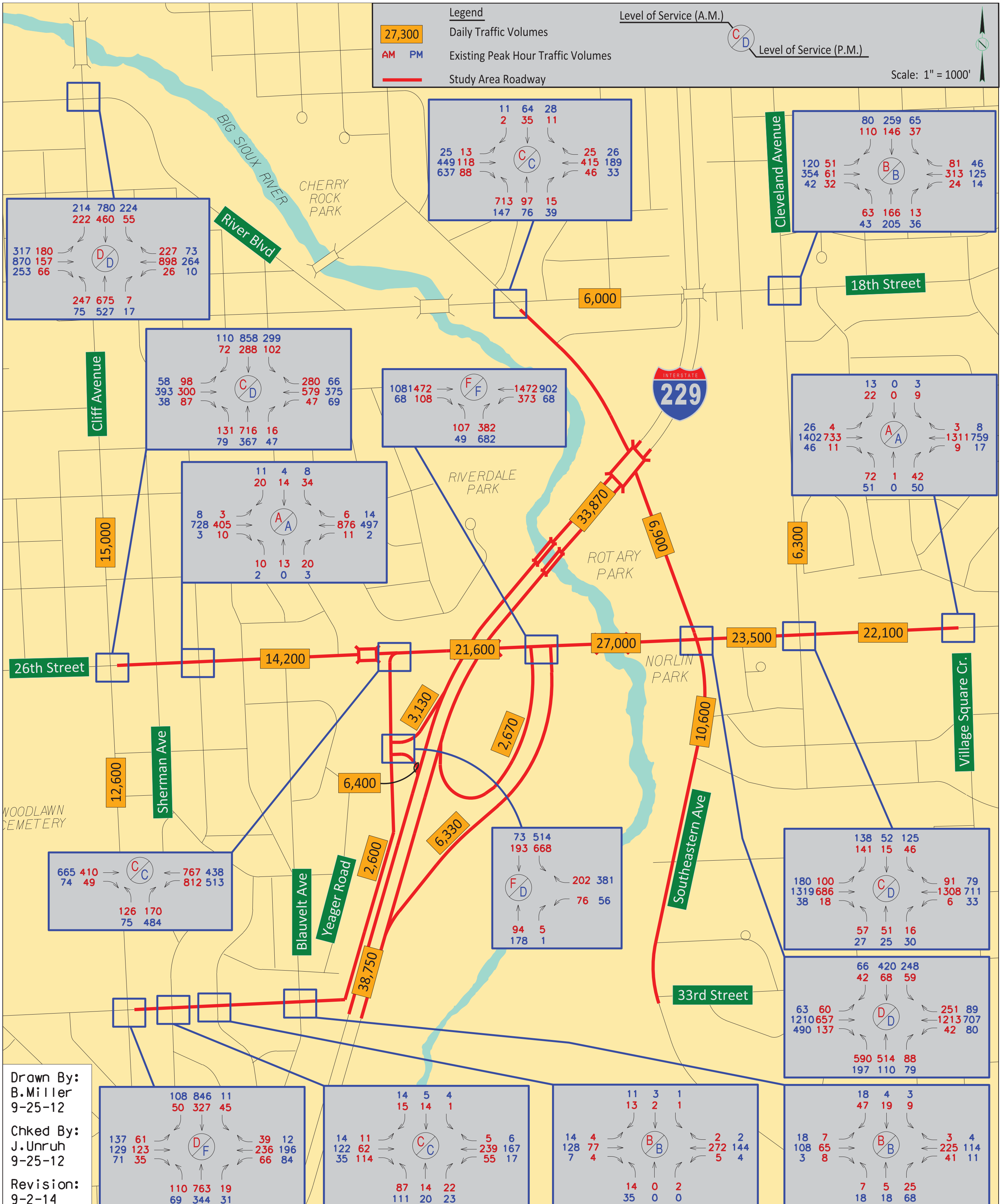
FIGURE IMJR-2
EXISTING DAILY TRAFFIC VOLUMES



2012 Interstate Peak Hour Volumes and LOS

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure 1-3



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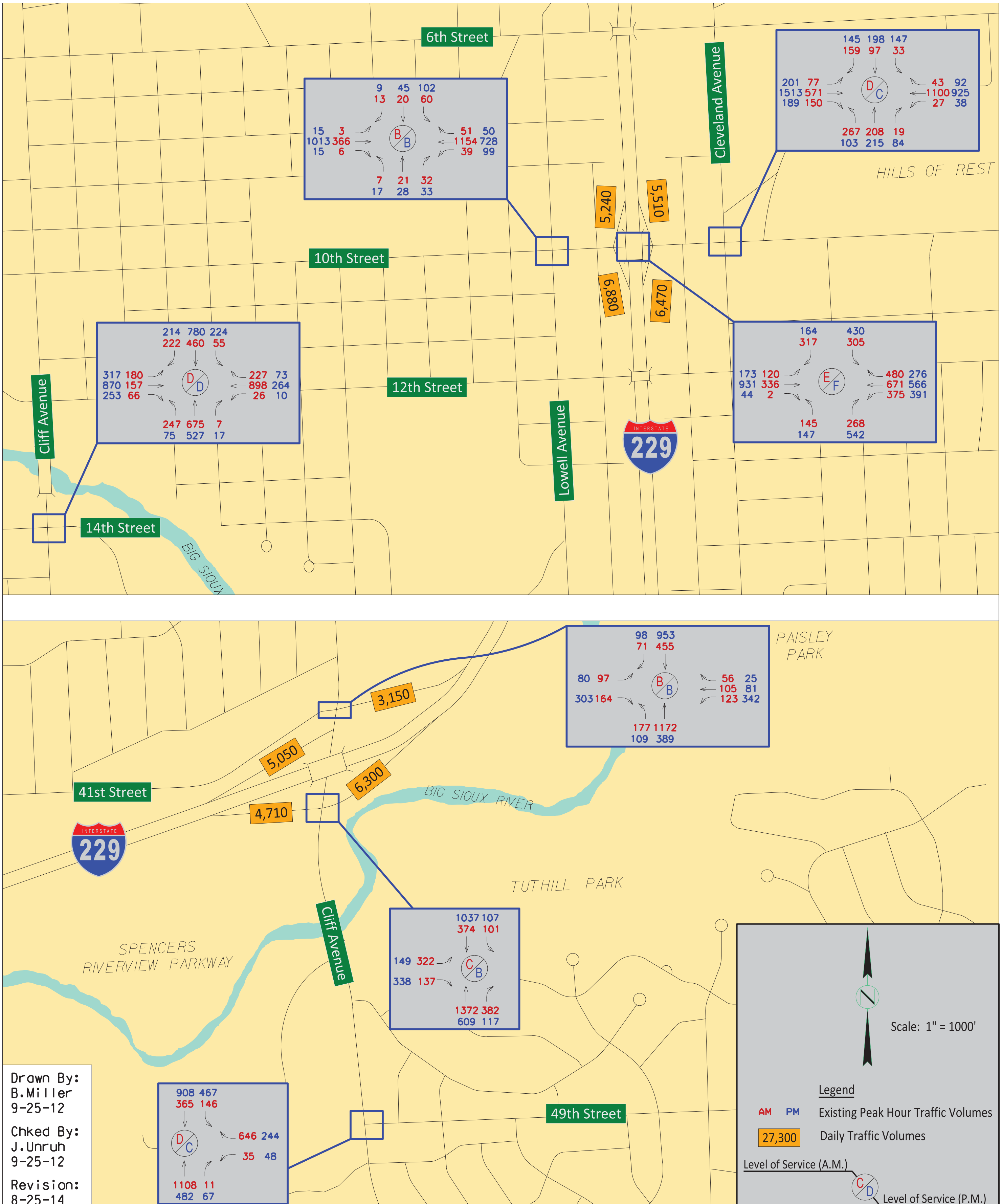
Revision:
9-2-14

Balanced 2012 Turning Volumes within Study Area

I-229 Exit 5 (26th Street) Crossroad Corridor Study Sioux Falls, SD

Figure 1-5



Balanced 2012 Turning Volumes outside Study Area

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure 1-6

Existing Safety Conditions

A safety analysis was conducted based on a database of crashes from 2008-2011 provided by the South Dakota Department of Transportation. The crash records were segregated into crashes for each of the study area major intersections and the non-intersection roadway segments.

Crash severity by roadway type is shown in the following table:

Table 1 - Crash Severity

ROADWAY TYPE	YEAR	PROPERTY DAMAGE ONLY	POSSIBLE INJURY	NON-INCAPACITATING INJURY	INCAPACITATING INJURY	FATAL
ARTERIAL	2008	26	13	4	3	0
	2009	48	20	8	1	0
	2010	51	21	9	1	0
	2011	39	23	9	2	0
INTERSTATE	2008	9	1	1	0	0
	2009	15	1	1	0	0
	2010	12	2	3	0	0
	2011	16	1	2	1	0

Arterial Roadways

The intersection crash rates for the study area intersections were calculated and compared to the most recently calculated critical intersection crash rates for the Sioux Falls area.

Highway Safety Manual definition:

- *Critical Rate Method (CRM) – a method in which the observed crash rate at each site is compared to a calculated critical crash rate that is unique to each site.*

The comparison, shown in **Table 1**, shows that the following intersections exceed the critical rate:

- 26th Street/Cliff Avenue
- 26th Street/Yeager Avenue
- 26th Street/I-229 NB
- 26th Street/Cleveland Avenue

The statistics show a mix of rear-end and angle crashes at 26th/Cliff, distributed evenly around the intersection. No sight distance or other crash-inducing deficiencies were noted. The crash rate appears to be related to the level of congestion at the intersection.

Crashes at 26th/Yeager were mainly rear-end and angle crashes involving traffic in the westbound left turn lane. A number of citations were issued for failure to yield or disregard of the traffic signal, indicating that drivers were making unsafe maneuvers in response to congestion.

Crashes at 26th/I-229 NB were almost exclusively rear-end crashes related to congestion and the lack of an exclusive westbound left turn lane.

Crashes at 26th/Southeastern were mainly rear-end and angle crashes related to congestion. No sight distance deficiencies were noted, but a number of crashes occurred during poor winter driving conditions which may have been related to the slope on the east leg of the intersection.

The crash rates for the study area non-intersection road segments were calculated and compared to average rates for similar Sioux Falls road segments. The comparison figures have been provided in **Table 2**. None of the segments appeared to present crash problems needing correction when compared to average Sioux Falls rates.

Interstate Roadways

While the crash rates for the Interstate Highway segments within the study area do not exceed statewide averages, the crash data reveal a prevalence of incidents during slippery driving conditions. The Interstate in the study area has a relatively high number of bridges and curves. During winter precipitation events, crash data indicate vehicles that have lost control and left the roadway either because they were exceeding a safe travel speed or not paying attention to changing conditions. While warning signs emphasize the curves and potential slippery bridge conditions, run-off-road incidents still occur when the road gets slippery. Improvements recommended by the Highway Safety Manual to address these conditions include measures that would make the Interstate roadway more forgiving, such as greater recovery area, treatments causing high friction surfaces, bridge deicing systems, or special warning devices, would tend to reduce these crashes. It should be noted that in August/September 2014 a high friction surface was placed on Interstate 229 from 12th Street south through the BNSF overpass. This area has a reduced posted speed due to sharp curvature. The original construction of I-229 included an exception placed on this portion of the roadway. The exception was extended when I-229 was reconstructed in 2000 and 2001.

Reference Rates

The intersection critical crash rates (Table 2) used for reference in this report are the most recently calculated by the City of Sioux Falls based on a comprehensive study of intersection crash statistics. The statewide average roadway segment crash rates were calculated by HDR (Table 3) based on statistics published by SDDOT for number of crashes and statewide mileage by roadway functional class. While these statistics may be several years old, they are the best available at this time. As agencies in South Dakota respond to the safety performance measures in the most recent highway bill, MAP-21, and the guidance of the Highway Safety Manual, new reference rates and performance measures will likely be developed. Note that critical and average crash rates in the following tables are dependent on the type of facility. For instance, crash rates for

Interstate highway segments are different from arterial roadway segments because of the differing physical and operating conditions.

TABLE 2 - INTERSECTION CRASH RATE (2008-2011)

I-229/26TH (EXIT 5) CORRIDOR STUDY

INTERSECTION	NUMBER CRASHES	VOLUMES 1	2	3	4	ENTERING VEHICLES	CRASH RATE	CRITICAL RATE	PERCENT DIFFERENCE
18/SOUTHEASTERN	8	1500	6000	6900	6500	10450	0.52	0.59	-11%
26/CLIFF	30	15000	14100	12600	13500	27600	0.74	0.59	26%
26/VAN EPS	5	500	14200	500	14100	14650	0.23	0.59	-60%
26/YEAGER	26		21600	11500	14200	23650	0.75	0.59	28%
26/I-229 NB	46		27000	6300	21600	27450	1.15	0.59	95%
26/SOUTHEASTERN	34	6900	23500	10600	27000	34000	0.68	0.94	-27%
26/CLEVELAND	29	6300	22100	500	23500	26200	0.76	0.59	28%
26/VILLAGE SQUARE	13	300	22100	400	22100	22450	0.40	0.59	-33%
YEAGER/I-229 SB	6	11500	3100	2600		8600	0.48	0.59	-19%
33/CLIFF	14	12600	3900	15000	6500	19000	0.50	0.59	-14%

TABLE 3 - ROADWAY SEGMENT CRASH RATE (2008-2011)

I-229/26TH (EXIT 5) CORRIDOR STUDY

SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	VOLUME	VMT	CRASH RATE	AVERAGE RATE	DIFFERENCE
I-229, WITHIN STUDY AREA	68	1.08	36,310	114,507,216	0.593849	1.57	-62.2%
26TH ST., CLIFF TO VAN EPS	10	0.12	14,200	4,975,680	2.009776	4.29	-53.2%
26TH ST., VAN EPS TO YEAGER	6	0.26	14,200	10,780,640	0.556553	4.29	-87.0%
26TH ST., YEAGER TO I-229 NB	14	0.17	21,600	10,722,240	1.305697	4.29	-69.6%
26TH ST., I-229 NB TO SOUTHEASTERN	8	0.20	27,000	15,768,000	0.507357	4.29	-88.2%
26TH ST., SOUTHEASTERN TO CLEVELAND	5	0.12	23,500	8,234,400	0.607209	4.29	-85.8%
26TH ST., CLEVELAND TO VILLAGE SQUARE	12	0.20	22,100	12,906,400	0.929771	4.29	-78.3%
SOUTHEASTERN AVE., 18TH TO 26TH	4	0.55	6,900	11,081,400	0.360965	4.29	-91.6%
SOUTHEASTERN AVE., 26TH TO 33RD	8	0.51	10,600	15,785,520	0.506794	4.29	-88.2%
33RD ST., CLIFF TO YEAGER	7	0.29	3,900	3,302,520	2.119594	4.29	-50.6%

Existing Environmental Constraints

Environmental constraints are being evaluated through the EA that is being prepared simultaneously with this Interchange Modification Justification Report. The study area includes portions of the Big Sioux River floodplain and associated parks, riparian and wooded areas.

PROJECT NEED

The southbound I-229 on and off ramps connect to Yeager Road, a parallel local collector roadway, rather than the 26th Street interstate crossing. The SDDOT 2010 Decennial Interstate Corridor Study (2010 Decennial Study) prioritized correction of this unconventional ramp configuration. Other deficiencies noted in the 2010 Decennial Study included substandard curve radii, k values below the desirable levels, and inadequate stopping sight distance; neither the safety analysis in the 2010 Decennial Study nor the safety analysis prepared for this project (HDR, April 2014) identified these deficiencies as a safety concern that needed to be addressed.

During the planning stage of the Project, the existing interchange was analyzed to determine whether standardization of the southbound ramp configuration was needed to accommodate existing and future traffic conditions. From this analysis, concept options were developed, all of which eliminated the connection of the southbound ramps to Yeager Road.

ALTERNATIVES

The following interchange concepts were developed and screened through the Environmental Assessment process:

- No-Build Concept Option
- Concept Option 1a: Single Point on Realigned 26th Street – a standard single point interchange with 26th Street curved to the south of the existing alignment to provide a more perpendicular crossing of I-229.
- Concept Option 1b: Single Point on Existing 26th Street – a standard single point interchange with 26th Street on the existing alignment. The skew of 26th Street to I-229 causes more curvature in the interchange ramps.
- Concept Option 2: Tight Diamond on Realigned 26th Street – a standard tight diamond interchange with 26th Street realigned slightly to the south. This configuration enables maintaining traffic across the existing structure during construction, but has roughly the same skew as the existing structure over I-229.
- Concept Option 3a: Diverging Diamond on Realigned 26th Street – a diverging diamond interchange with 26th Street realigned slightly to the south. This configuration enables maintaining traffic across the existing structure during construction, but has roughly the same skew as the existing structure over I-229.
- Concept Option 3b: Diverging Diamond on Realigned 26th Street with Angled Bridge Section - a diverging diamond interchange with 26th Street realigned slightly to the south. This configuration enables maintaining traffic across the existing structure during construction, but has roughly the same skew as the existing structure over I-229. Adding an angle bridge section allows the northwest ramp to lie closer to the I-229 mainline, slightly reducing property impacts.
- Concept Option 4: Tight Diamond on Existing 26th Street – a standard tight diamond interchange with 26th Street on the existing alignment.
- Concept Option 5a: West Side Diamond Adjacent Ramps on Existing 26th Street w/o NE Ramp – this option maintains the existing ramps on the east side of the interchange and replaces the ramps on the west side of the interchange with diamond-type ramps.
- Concept Option 5b: West Side Diamond Adjacent Ramps on Existing 26th Street with NE Ramp – similar to Option 5a, with the addition of an on-ramp in the northeast quadrant of the interchange for westbound-to-northbound turning traffic.
- Concept Option 6a: Diverging Diamond on Existing 26th Street – similar to Option 3a, but with 26th Street on the existing alignment.
- Concept Option 6b: Diverging Diamond on Existing 26th Street with Angled Bridge Section – similar to Option 3b, but with 26th Street on the existing alignment.
- Concept Option 7a: West Side Diamond on Existing 26th Street w/o NE Ramp – this option maintains the existing ramps on the east side of the interchange and replaces the ramps on the west side of the interchange with standard folded-diamond ramps. Yeager Road is maintained and realigned to the west.

- Concept Option 7b: West Side Folded Diamond on Existing 26th Street with NE Ramp – similar to Option 7a, with addition of an on-ramp in the northeast quadrant of the interchange.
- Concept Option 7c: West Side Folded Diamond on Existing 26th Street w/o Yeager Road and w/o NE Ramp – similar to Option 7a, but Yeager Road is eliminated.
- Concept Option 7d: West Side Folded Diamond on Existing 26th Street with NE Ramp and w/o Yeager Road – similar to Option 7b, but Yeager Road is eliminated.
- Concept Option 8: Offset Single Point on Existing 26th Street – a single point concept that brings all movements to a standard urban intersection. This option requires long ramps and several additional structures.
- Concept Option 9a: West Side Diamond with Detached Ramps w/o NE Ramp - this option maintains the existing ramps on the east side of the interchange and replaces the ramps on the west side of the interchange with standard diamond ramps. The southbound off-ramp is separated from the mainline to eliminate the need for retaining walls, but with greater impact on residences.
- Concept Option 9b: West Side Diamond with Detached Ramps and with NE Ramp – similar to Option 9a, with addition of an on-ramp in the northeast quadrant of the interchange.
- Concept Option 10: Roundabouts at Ramp Terminals – a diamond interchange configuration with roundabout ramp termini.
- Concept Option 11: Diverging Diamond on 26th Street Realigned to the North – similar to the other diverging diamond options, but with 26th Street realigned slightly to the north to avoid impacts on properties in the southeast quadrant of the interchange. This option results in a severely skewed crossing of I-229.
- Concept Option 12: Tight Diamond on 26th Street Realigned to the North - similar to the other tight diamond options, but with 26th Street realigned slightly to the north to avoid impacts on properties in the southeast quadrant of the interchange. This option results in a severely skewed crossing of I-229.

The Concept Options are shown in Figures 1 – 12 on the following pages. Each figure includes a cost and impact summary and information on intersection future year delay and level of service.

Concept Options were also prepared for the adjacent 26th St./Southeastern Ave. intersection. Operations at 26th/Southeastern and the nearby railroad crossing are closely tied to operations at the I-229/26th St. (Exit 5) interchange and improvements throughout the corridor are being considered together. Options for the 26th St./Southeastern Ave. intersection include:

- Concept Option A: an elevated intersection on the existing Southeastern Avenue alignment which facilitates a grade-separated railroad crossing.
- Concept Option B: an elevated intersection on the existing Southeastern Avenue which provides grade separation from the Southeastern Avenue thru movements and a grade-separated railroad crossing.

- Concept Option C: similar to Option A, but with the Southeastern Avenue alignment moved to the west to avoid impacts on existing residences and businesses.
- Concept Option D: similar to Option B, but with the Southeastern Avenue alignment moved to the west to avoid impacts on existing residences and businesses.
- Concept Option E: an expanded at-grade intersection at the existing location.
- Concept Option F: grade separation of 26th Street from Southeastern Avenue and the railroad. Turning traffic would be diverted through the 26th Street/Cleveland Avenue and Southeastern Avenue/Pioneer Trail intersections.

The options were screened through a process involving technical analysis and consideration by the Study Advisory Team. The screening process is documented in the Options Evaluation Memos produced in 2013. The screening resulted in the recommendation of two interchange Concept Options and two intersection Concept Options being carried forward for further refinement and evaluation. Those recommended Concept Options include:

- No-Build Concept Option
- Interchange Concept Option 5a – West Side Diamond Adjacent Ramps on Existing 26th Street w/o NE Ramp
- Interchange Concept Option 7a – West Side Folded Diamond on Existing 26th Street w/o NE Ramp
- Intersection Concept Option A – elevated intersection on existing alignment
- Intersection Concept Option C – elevated intersection on shifted alignment

Improvements to adjacent interchanges and Transportation System Management alternatives were not deemed able to satisfy the need of providing an interchange that meets design standards and provides adequate capacity for future traffic demand.

Concept Option 1a

Single Point on Realigned 26th Street

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

1a

7/1/14

Concept Option 1b

Single Point on Existing 26th Street

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 1b

7/1/14

Concept Option 2

Tight Diamond on Realigned 26th Street

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 2

7/1/14

Concept Option 3a

Diverging Diamond on Realigned 26th Street

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 3a

7/1/14

Concept Option 3b

Diverging Diamond on Realigned 26th Street with Angled Bridge Section

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

3b

7/1/14

Concept Option 4

Tight Diamond on Existing 26th Street

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 4

7/1/14

HDR

Concept Option 5a

West Side Diamond Adjacent Ramps on Existing 26th Street w/o NE Ramp

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure 5a

8/25/14

Concept Option 5b

West Side Diamond Adjacent Ramps on Existing 26th Street with NE Ramp

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 5b

7/1/14

Concept Option 6a

Diverging Diamond on Existing 26th Street

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 6a

7/1/14

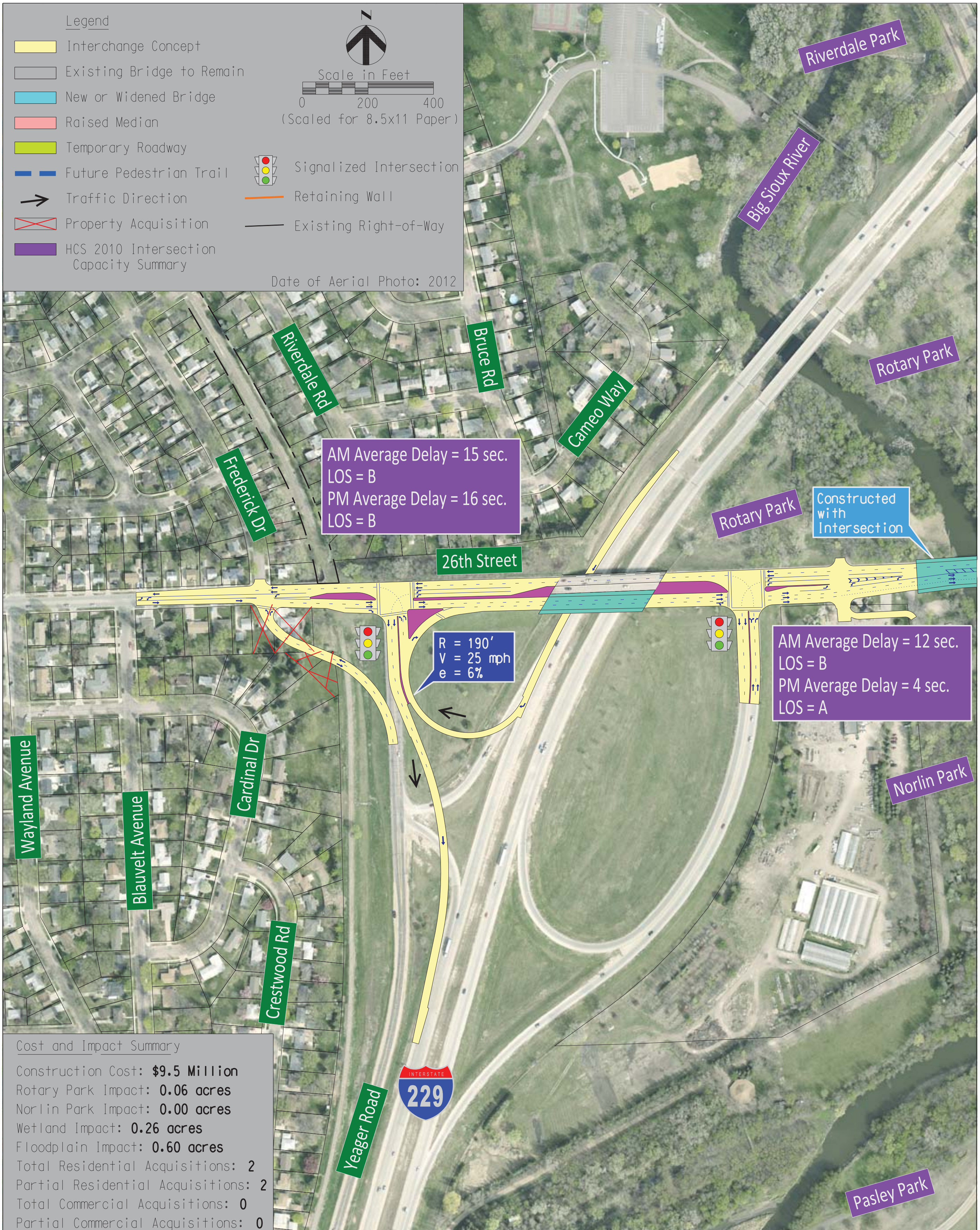
Concept Option 6b

Diverging Diamond on Existing 26th Street with Angled Bridge Section

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure 6b

7/1/14



Concept Option 7a

West Side Folded Diamond on Existing 26th Street w/o NE Ramp

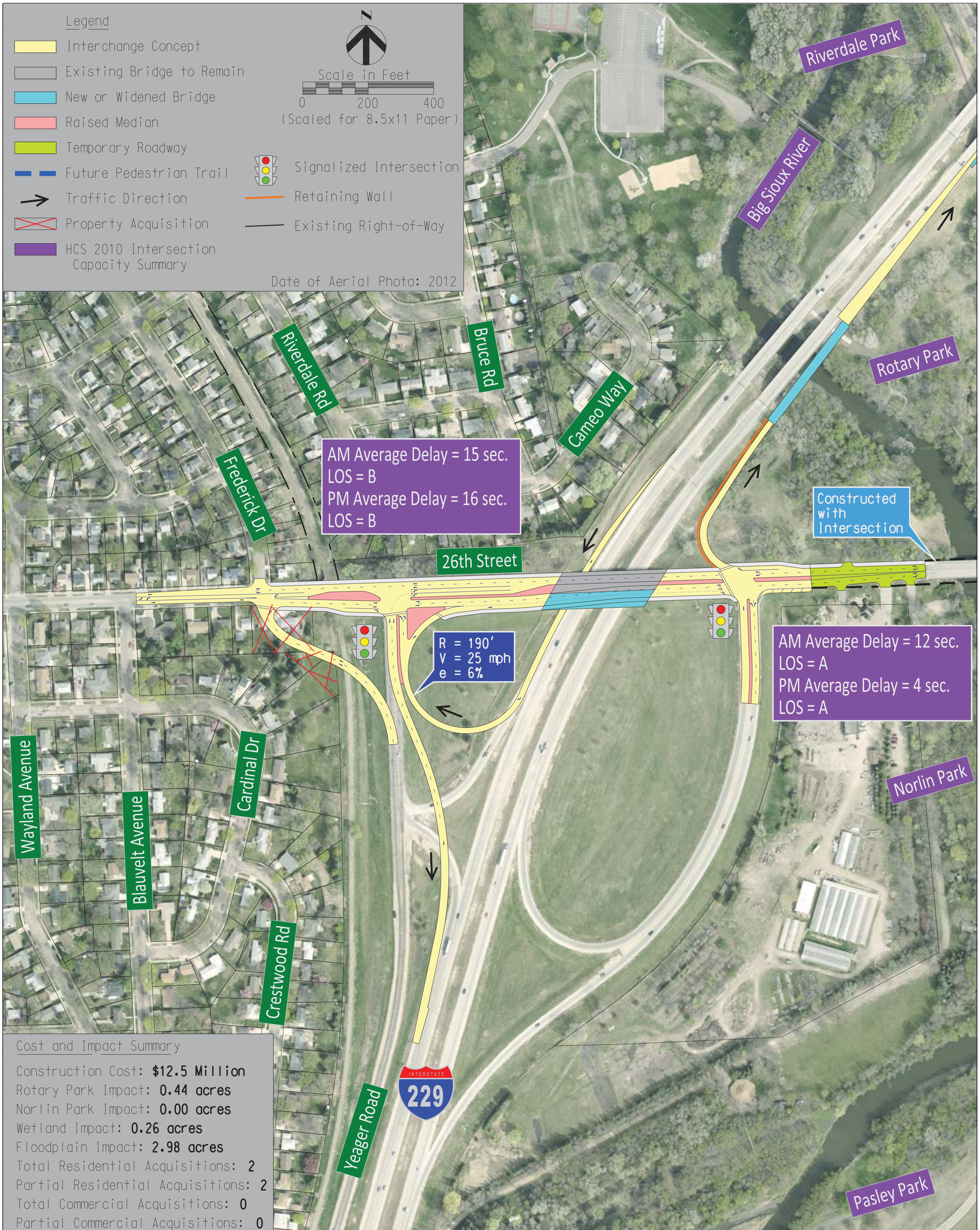
I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

7a

9/2/14



Concept Option 7b

West Side Folded Diamond on Existing 26th Street with NE Ramp

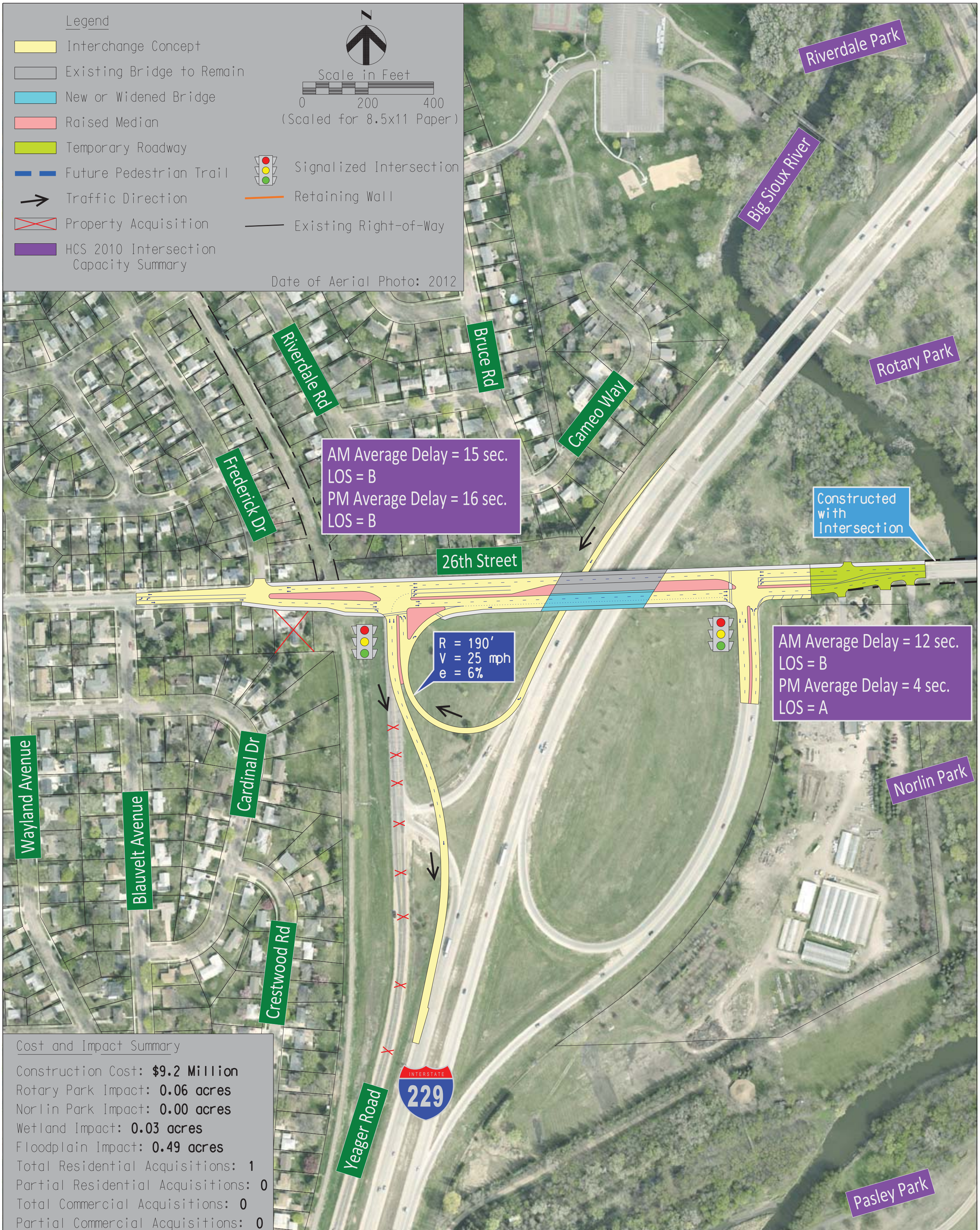
I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

7b

9/2/14



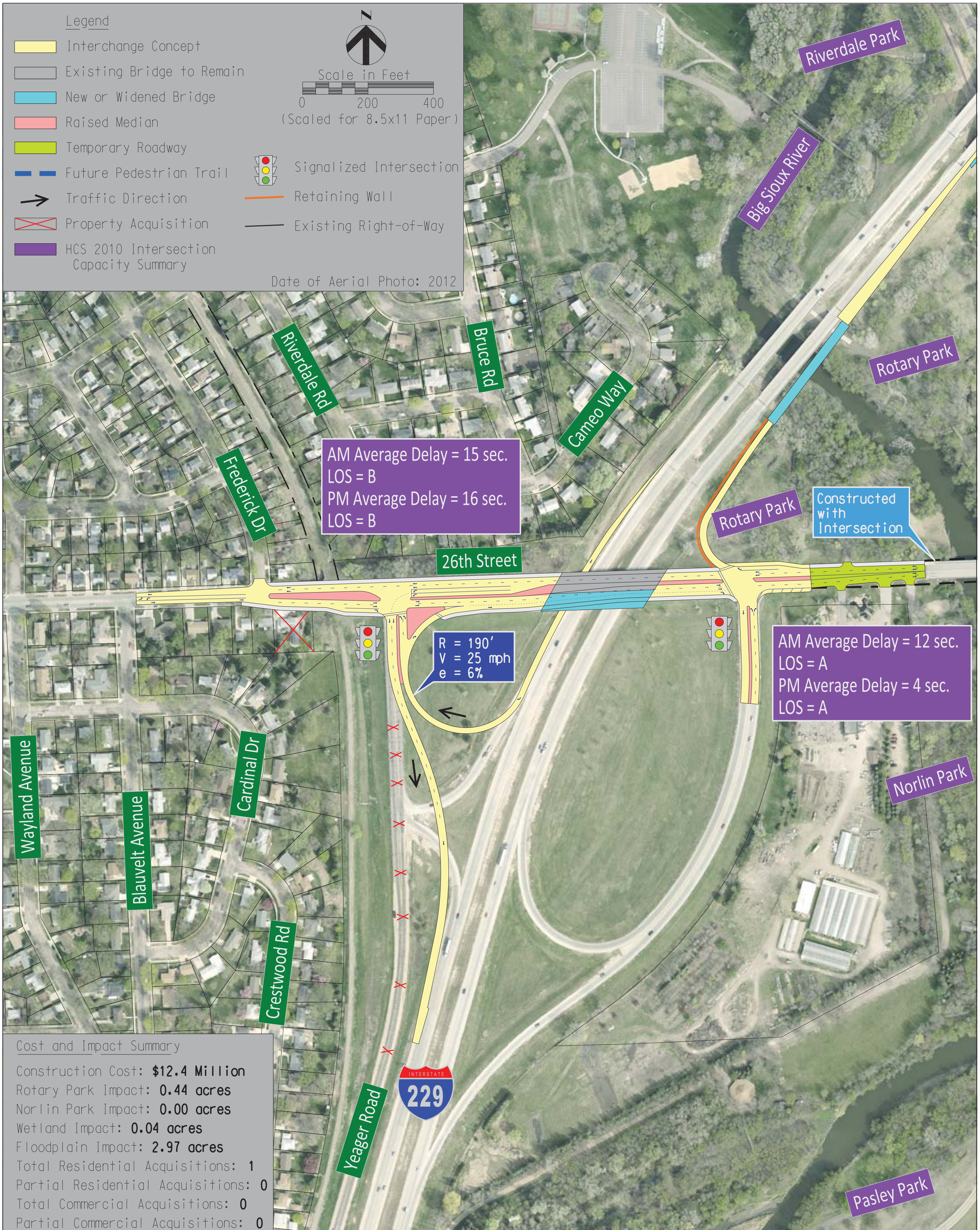
Concept Option 7c

West Side Folded Diamond on Existing 26th Street w/o Yeager Road and w/o NE Ramp

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure 7c

9/2/14



Concept Option 7d

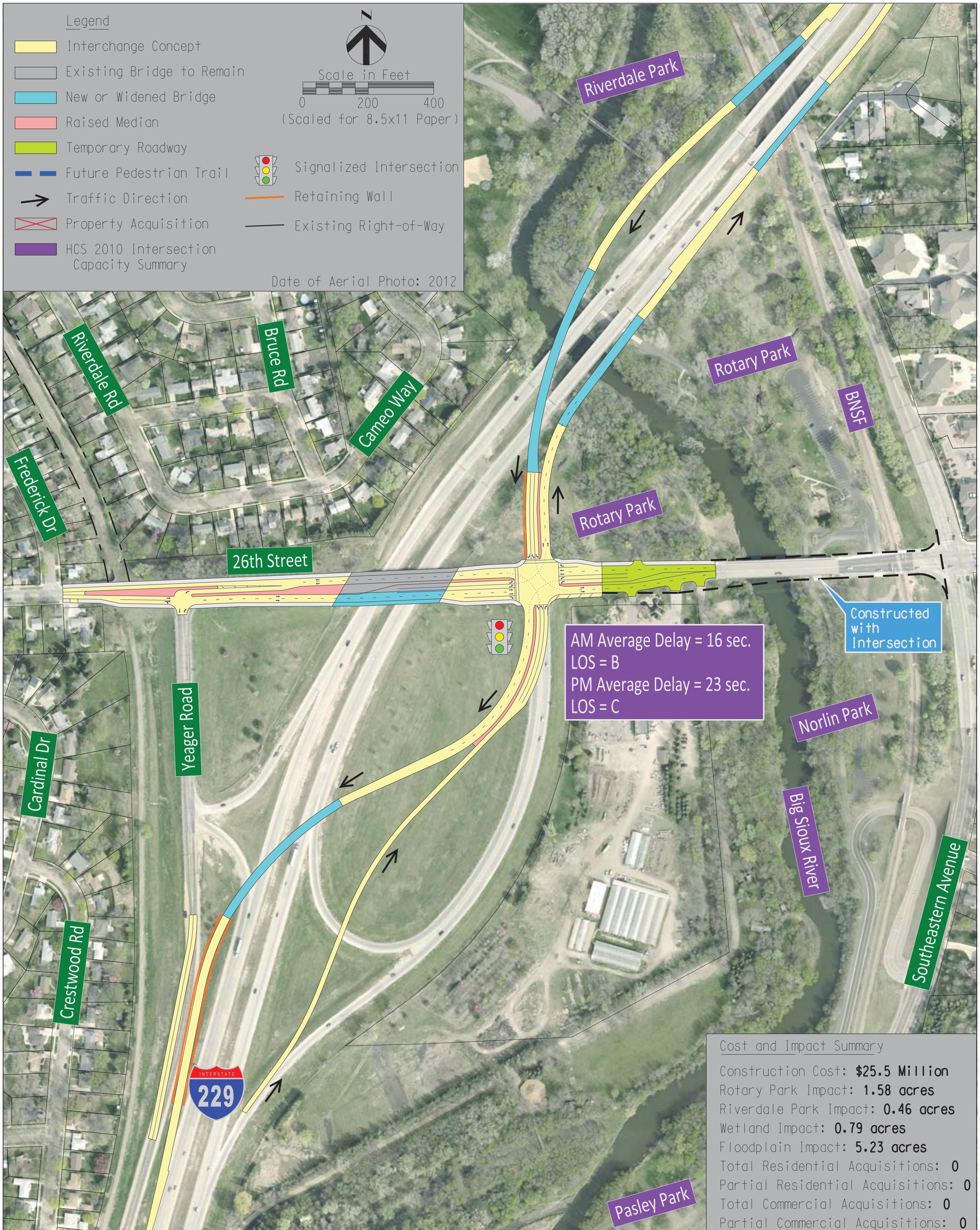
West Side Folded Diamond on Existing 26th Street with NE Ramp and w/o Yeager Road

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 7d

9/2/14



Concept Option 8

Offset Single Point on Existing 26th Street

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

8

7/1/14

Concept Option 9a

West Side Diamond with Detached Ramps w/o NE Ramp

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure 9a

7/1/14

Concept Option 9b

West Side Diamond with Detached Ramps and with NE Ramp

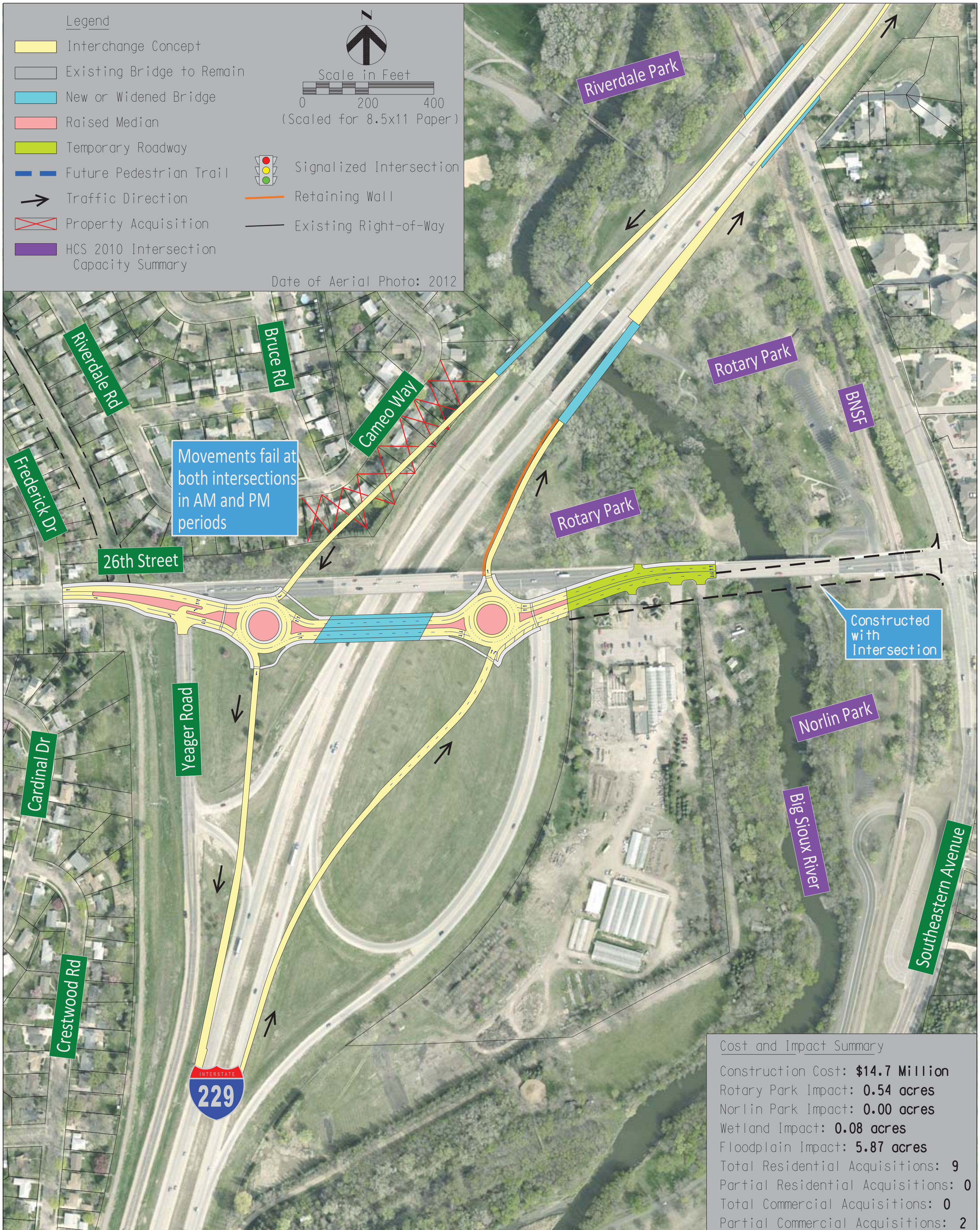
I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

9b

7/1/14



Cost and Impact Summary

Construction Cost: **$14.7 Million**
Rotary Park Impact: **0.54 acres**
Norlin Park Impact: **0.00 acres**
Wetland Impact: **0.08 acres**
Floodplain Impact: **5.87 acres**
Total Residential Acquisitions: **9**
Partial Residential Acquisitions: **0**
Total Commercial Acquisitions: **0**
Partial Commercial Acquisitions: **2**

Concept Option 10

Roundabouts at Ramp Terminals

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

10

7/1/14

Concept Option 11

Diverging Diamond on 26th Street Realigned to the North

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 11

7/1/14

Concept Option 12

Tight Diamond on 26th Street Realigned to the North

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 12

7/1/14

Concept Option A

Elevated Intersection on Existing Southeastern Avenue Alignment

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure A

3/20/14

Concept Option B

Tunnels on Existing Southeastern Avenue Alignment

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure B

3/20/14

Concept Option C

Elevated Intersection with Southeastern Avenue Shifted

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

C

3/20/14

Concept Option D

Tunnels with Southeastern Avenue Shifted

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

D

3/20/14

Concept Option E

Expaned At-Grade Intersection

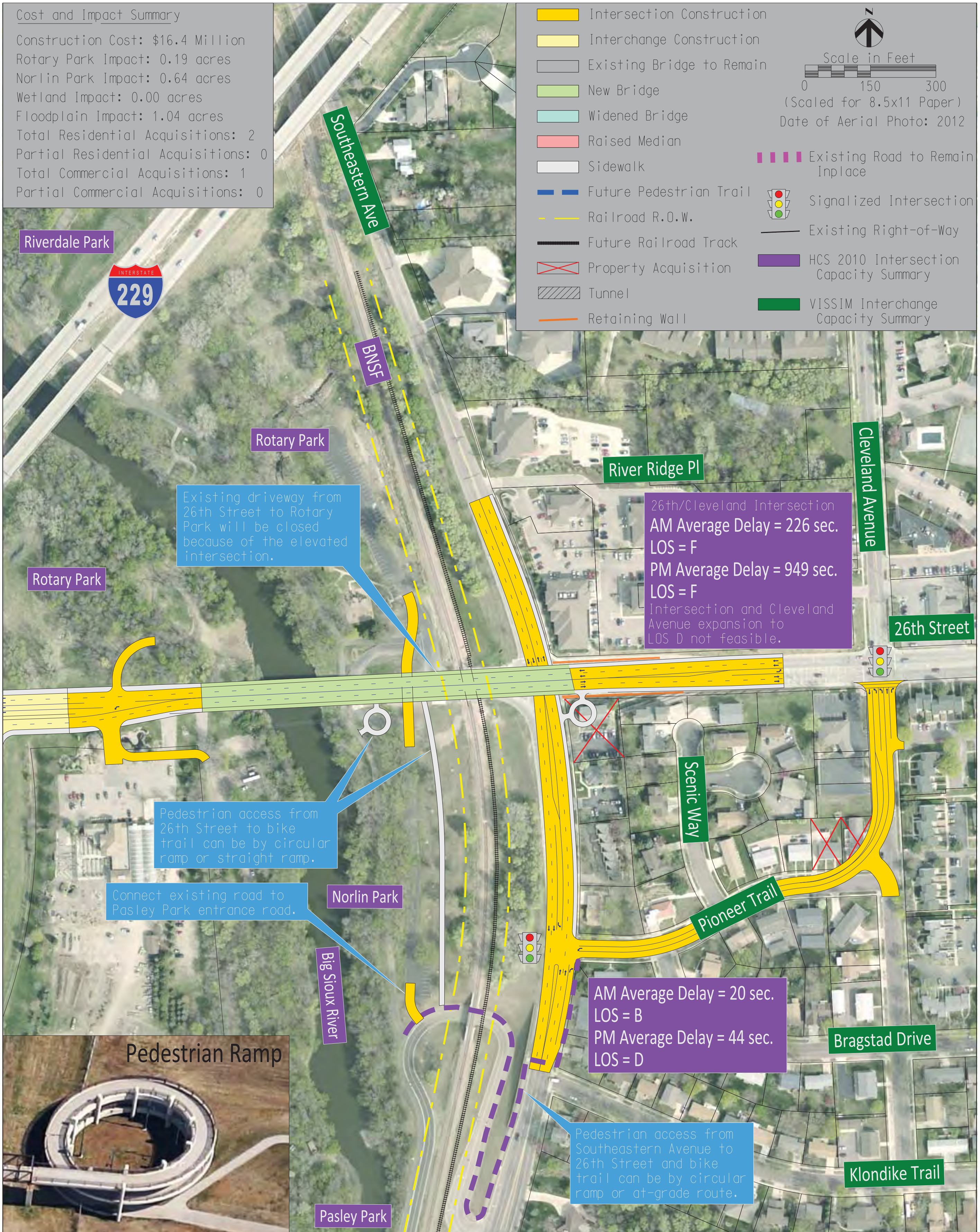
I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

E

3/20/14



Concept Option F

Grade Separated Intersection

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

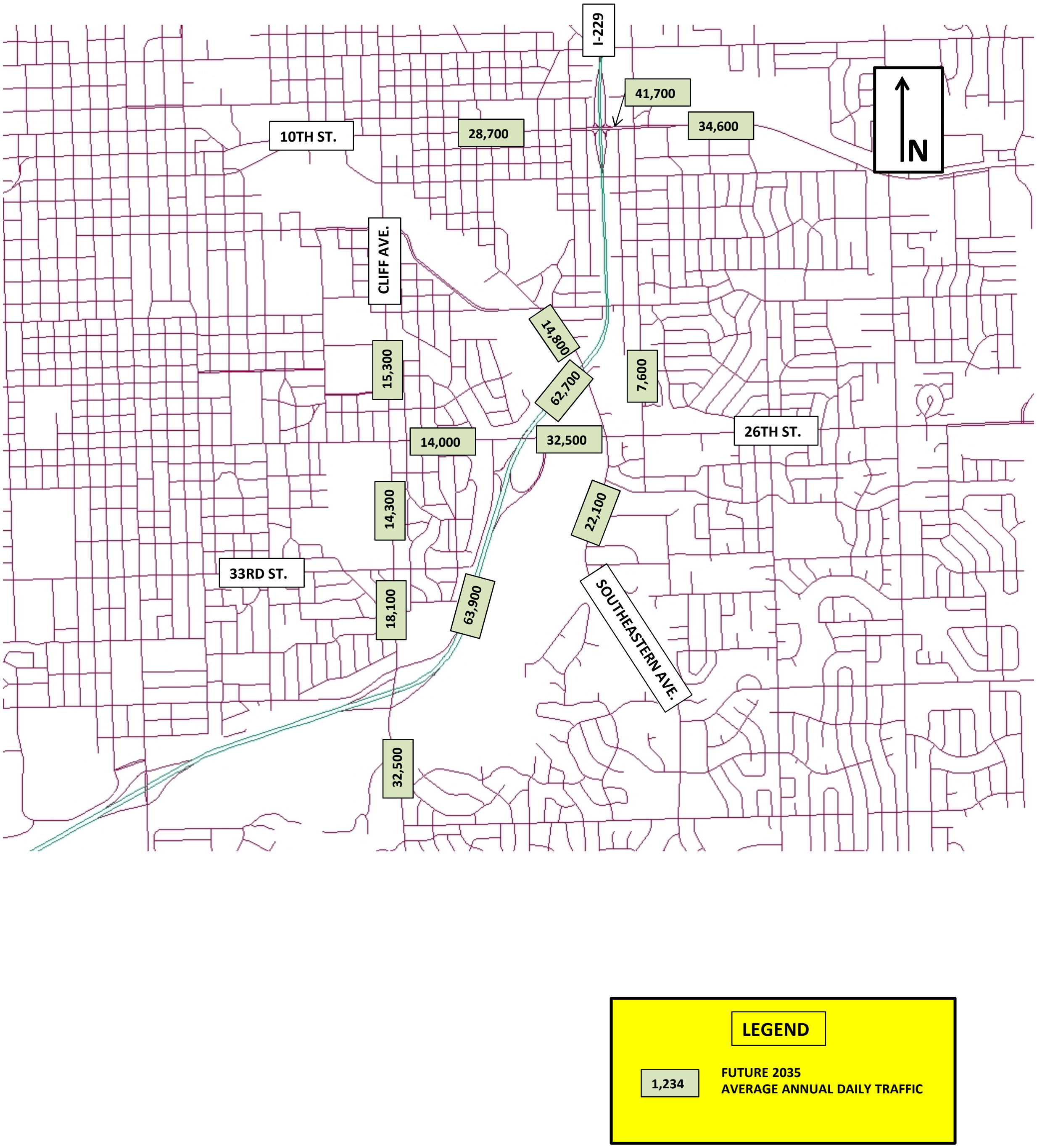
Figure F

3/20/14

2035 FUTURE YEAR TRAFFIC

Traffic forecasts for the study area were prepared using the regional travel demand model maintained by the City of Sioux Falls and the Sioux Falls MPO. The model horizon year is 2035 and is based on local land use plans. Forecasted daily traffic volumes are shown in **Figure IMJR-3**. Peak hour traffic volumes and levels of service for the no-build option are shown in **Figures 1-4, 1-7, and 1-8.** Level of service output sheets from HCS 2010 are included in the Appendix in Part 3 and Part 4.

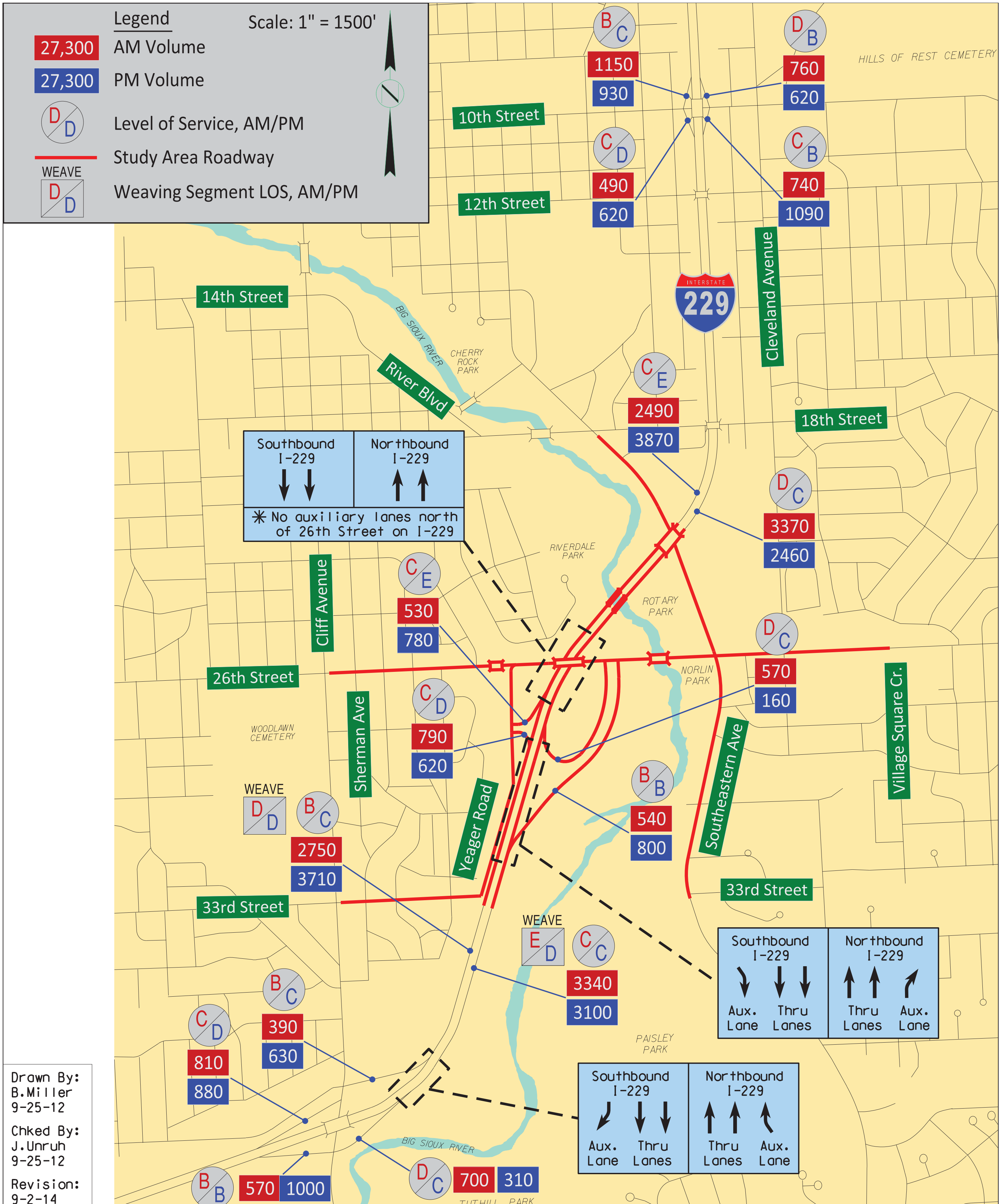
To confirm that the corridor and interchange will provide acceptable level of service, traffic projections for 20 years from the planned year of construction will be reviewed by SDDOT during final design.



HDR

I-229/26TH STREET (EXIT 5)
INTERCHANGE MODIFICATION
JUSTIFICATION REPORT

FIGURE IMJR-3
2035 FUTURE DAILY
TRAFFIC VOLUMES



Drawn By:
B.Miller
9-25-12

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J.Unruh
9-25-12

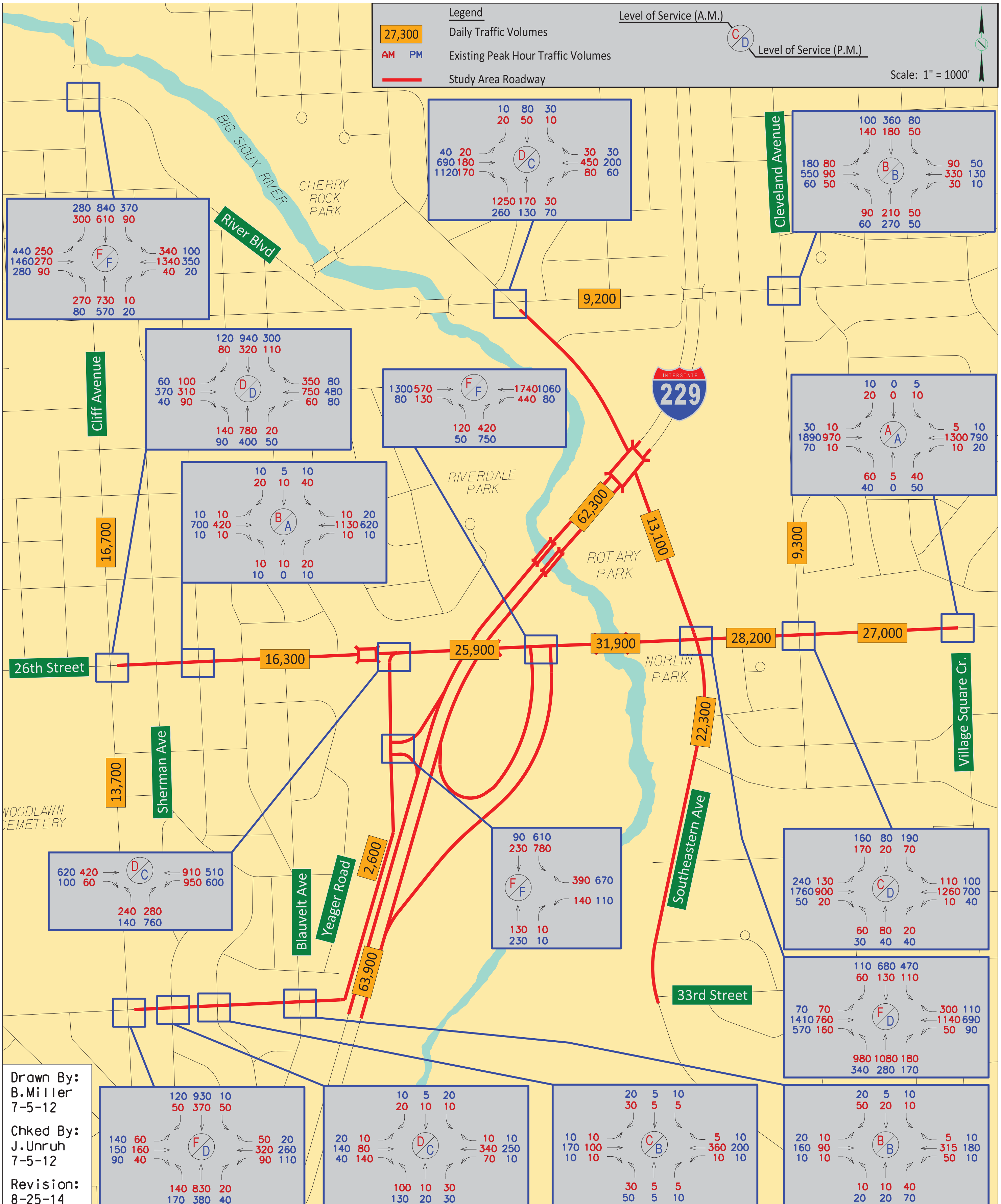
Revision:
9-2-14

HDR

2035 Interstate Peak Hour Volumes and LOS
No-Build Scenario

I-229 Exit 5 (26th Street) Crossroad Corridor Study   Sioux Falls, SD

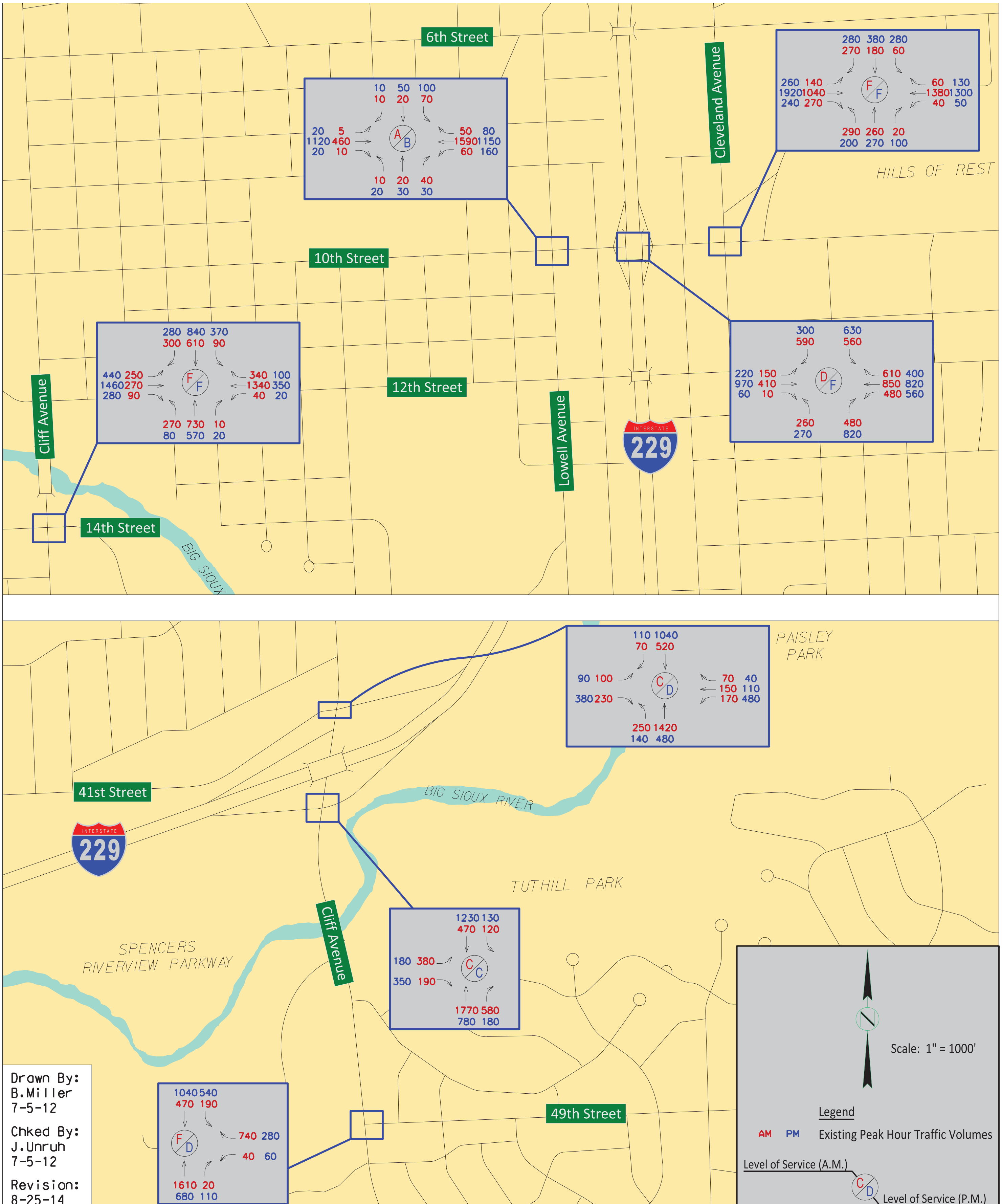
Figure 1-4



Balanced 2035 Turning Volumes
No-Build Scenario

I-229 Exit 5 (26th Street) Crossroad Corridor Study Sioux Falls, SD

Figure 1-7



Drawn By:
B.Miller
7-5-12

Chked By:
J.Unruh
7-5-12

Revision:
8-25-14

Balanced 2035 Turning Volumes outside Study Area

I-229 Exit 5 (26th Street) Crossroad Corridor Study Sioux Falls, SD

Figure 1-8

ALTERNATIVES ANALYSIS

The retained interchange improvement options were analyzed and compared to determine which may be most suitable for meeting the project need. The areas of analysis and comparison are discussed in the following sections.

Conformance with Transportation Plans

Local (MPO and City) and State transportation plans, including the Sioux Falls MPO Long Range Transportation Plan and the 2010 Decennial Interstate Corridor Study have identified a need for an improved interchange at I-229/26th Street that meets design standards and provides adequate capacity to serve future travel demand. All retained interchange build options satisfy the existing transportation planning considerations.

Compliance with Policies and Engineering Standards

Each of the interchange build options has used the latest guidance from AASHTO and FHWA and final design of any of the options may be accomplished. It should be noted that the SDDOT Design Manual does provide guidance on the design of loop ramps and in the case of option 7a, a design exception will be required due to the radius of the ramp layout in the southwest quadrant of the interchange. A technical memo was provided to the SDDOT to aid in the completion of the design exception request and documents decisions for both the southwest and southeast quadrant ramps. A copy of the technical memo for the design exception is included in Part 7 of the appendix. The No Build option, however, has several conflicts with current design standards.

SDDOT design standards call for control of access spacing of at least 100’ from the Interstate highway right-of-way line at ramp termini when rebuilding an existing urban interchange, but further recommend extending the control of access to meet the access spacing requirements established by South Dakota Administrative Rule 70:09. The Administrative Rules call for unsignalized access spacing of 100’ to 660’, depending on the classification of the arterial street (26th Street is not within SDDOT jurisdiction and has not been classified in the State system). City of Sioux Falls design standards call for ¼ mile full access spacing on arterial roadways like 26th Street, but list spacing of unsignalized partial access as “varies”. Other guidelines and research recommends signalized intersections no closer than ¼ mile from interchange ramp termini, but allow unsignalized partial access at spacing less than ¼ mile. The two retained interchange options (5a and 7a) show stop-controlled partial access points within ¼ mile of the ramp termini. All these partial access points, however, are spaced greater than 100’ from the ramp termini. Medians have been recommended in each interchange option to limit the movements available at each of these access points. The partial access points in each of the retained options satisfy State and City access standards.

Environmental Impacts

The Preliminary Draft Environmental Assessment compares the impacts of changes to the I-229/26th Street (exit 5) interchange in conjunction with changes to the adjacent 26th Street/Southeastern Avenue intersection. The interchange options are identified as Option 5a and Option 7a, while the intersection options are identified as Option A and Option C. The preliminary environmental impacts of each option are summarized in Table 4-1, reproduced on the following two pages from the EA document.

Table 4-1. Impact Summary of Build Alternatives

Resource	5aA	5aC	7aA	7aC
	Summary			
Land use	Consistent with land use plans			
Social environment	No effect			
Economic resources	Relocation of 2 commercial properties. Businesses east and west of I-229 would be temporarily impacted during construction.			
Acquisitions and relocations	6 condominium (total) 1 single family (total) 2 commercial (total)	1 single family (total) 2 commercial (total)	6 condominium (total) 3 single family (total) 2 single family (partial) 2 commercial (total)	3 single family (total) 2 single family (partial) 2 commercial (total)
Pedestrians and bicycles	All Build Alternatives would require a new 26th Street bridge across the BNSF Railway tracks. The existing vehicular and pedestrian entrance into Rotary Park from 26th Street would be eliminated. Extensive coordination with the Sioux Falls Parks and Recreation Department has resulted in a mitigation plan for pedestrian access to the Rotary and Norlin Parks (see Section 3.18). Sidewalks would be provided on both sides of 26th Street throughout the Study Area. The bridge over the Big Sioux River and the railroad tracks would provide 10-foot-wide sidewalks to allow for pedestrian and bicycle traffic.			
Air quality	No effect			
Noise	The noise study determined that mitigation of noise impacts is not feasible with this Project; therefore, noise mitigation is not proposed as a part of any alternatives.			
Water quality	It is anticipated that the Build Alternatives would not impact the water resources in the area due to the incorporation of best management practices (BMPs) into final design and construction.			
Wetlands and other waters of the U.S.	0.06 acre of wetland impact 118 linear feet of crossing; crosses Big Sioux River.	0.06 acre of wetland impact 118 linear feet of crossing; crosses Big Sioux River.	0.19 acre of wetland impact 94 linear feet of crossing; crosses Big Sioux River.	0.19 acre of wetland impact 94 linear feet of crossing; crosses Big Sioux River.
Vegetation, fish, and wildlife	Although habitat is limited due to the urban area, the Big Sioux River riparian area is located within the Study Area. BMPs would be implemented into the Project plans to minimize impacts on the fisheries within the Big Sioux River.			
Floodplain	HEC-RAS modeling has determined that the 100 year flood elevation in this section of the Big Sioux River would decrease as a result of the greater waterway opening of the new bridge.			
Threatened and endangered species	Topeka shiner – *No Effect*, western prairie fringed orchid – *No Effect*, northern long-eared bat- *Not likely to jeopardize*, rufa red knot- *Not present in Study Area*. State-listed species are not anticipated to inhabit the area.			
Cultural resources	No adverse effect.			
Regulated materials	The preliminary work limits for the Build Alternatives are not expected to encounter contamination associated with the identified RECs. The exception would be construction below the flood zone in the vicinity of the Big Sioux River, where contaminant impacts from hazardous waste and petroleum products transported along the river during former flooding events may be present.			

Resource	5aA	5aC	7aA	7aC
	Summary			
Visual impacts and aesthetics	A visual barrier would be incorporated into the interchange southbound off-ramp design to prevent headlights from shining into adjacent homes. The Intersection would be raised approximately 25 feet, affecting the view from commercial properties at the southeast quadrant of the Intersection.		The Intersection would be raised approximately 25 feet, affecting the view from commercial properties at the southeast quadrant of the Intersection.	
Energy	All Build Alternatives would increase overall traffic flow, thereby likely reducing overall fuel consumption for vehicles using the roads within the area. Temporarily, fuel consumption during construction would increase within the Study Area.			
Environmental justice	Environmental justice populations would not be adversely or disproportionately affected.			
Section 4(f)	*De minimis* impact			
Section 6(f)	Temporary non-conforming use			
Utilities	The most significant private utility adjustment would be a potential shift of the Xcel power line along the south side of 26th Street. The Xcel representative stated that adjustments can be addressed during final design. Adjustments to City utilities can be addressed during final design.			
*Note: Reference Figures 2-2, 2-3, 2-4 and 2-5 for property acquisition information and Level of Service information.				

Safety

While there are currently no Crash Modification Factors (CMF's) to directly compare the safety effects of different interchange configurations, there are CMF's related to relevant aspects of the interchange design. In general, increasing the deceleration lane length, as provided in options 5a and 7a, results in fewer crashes. The provision of medians and left turn lanes on the interchange crossroad is also expected to reduce crashes.

The ramp-related crashes in the crash records are small relative to the total number of crashes in the study area, so improvements in the general interchange configuration may not produce large crash reductions. There are, however, a significant number of crashes on 26th Street related to the lack of left turn lanes at the ramp termini. The crossroad improvements shown in all the retained options will likely create significant improvement in the study area's safety performance.

Based on a planning-level analysis of safety, option 5a may have a very slight advantage over option 7a in crash reduction. All the retained options should provide similar improvements to crossroad crash reduction.

Operational Performance

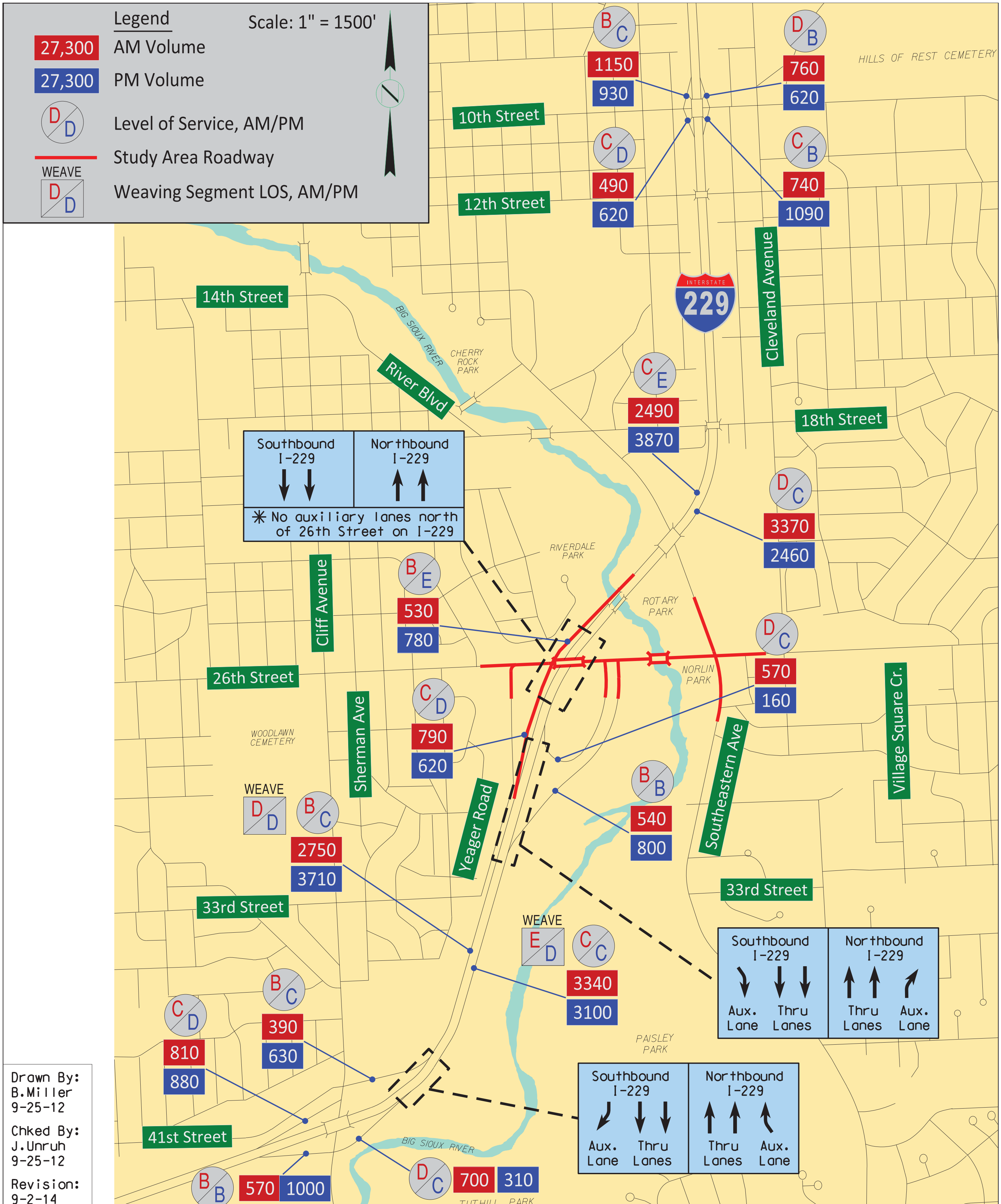
The operations of the alternative interchange configurations were evaluated using appropriate level of service techniques. Performance was analyzed for forecast traffic conditions with each of the retained interchange options in place. Results of the operational analyses are shown in **Figures IMJR 4, IMJR 5, Figure 2-2, Figure 2-3, Figure 2-4, & Figure 2-5.**

The analysis indicates that the mainline level of service between 10th Street and 26th Street would benefit from expansion from the existing two lanes in each direction to three lanes in each direction, regardless of the interchange configuration at 26th Street. Such an expansion of the mainline capacity will result in future level of service C or better under AM and PM peak hour conditions.

The southbound off-ramp at 26th Street diverge movement is shown at LOS E under Option 5a; with the existing 2-lane section on the I-229 southbound mainline. If an additional mainline lane is added, the off-ramp diverge movement LOS improves to C.

If the I-229 mainline is expanded by one additional lane in each direction between 10th Street and Cliff Avenue, both Option 5a and Option 7a result in acceptable operations during the 2035 future peak traffic demand periods. During the I-229 Design-Build project in 2000 it was determined through preliminary engineering that additional lanes would be added to the median side in this segment from 26th Street south and west towards Cliff Avenue. Between 26th Street and the BNSF overpass on I-229 again additional lanes would be located in the median separated by a barrier. North of the I-229 BNSF rail overpass a transition would be needed to best fit under the 18th Street and 12th Street bridges with additional lanes on the outside of I-229 versus in the median. Since the SDDOT is studying the I-229 corridor and evaluating improvements to the I-229 mainline in the Major Investment Study it is reasonable to not associate the improvements needed to the mainline with this project. The operational analysis indicated that the proposed improvements for options 5a and 7a will mitigate the interchange to meet the level of service requirements set forth in the Methods and Assumptions document. The I-229 mainline currently is operating with minor delay and improvements are likely not needed within the next decade.

Arterial and ramp intersections under the build scenarios result in acceptable operations during the 2035 future peak periods.



Drawn By:
B.Miller
9-25-12

Chked By:
J.Unruh
9-25-12

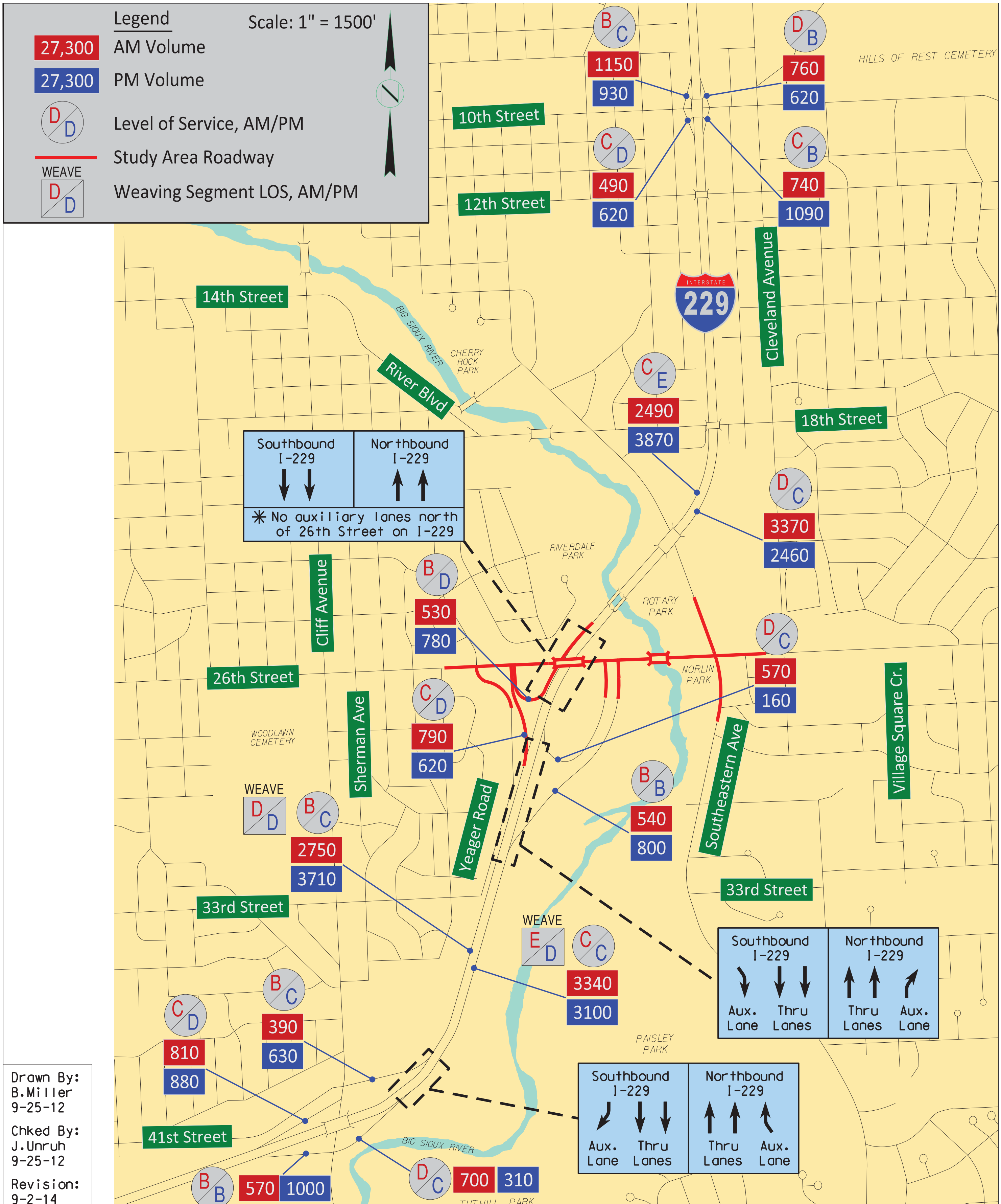
Revision:
9-2-14

MPO | DOT | HDR

2035 Interstate Peak Hour Volumes and LOS
Option 5a

I-229 Exit 5 (26th Street) Crossroad Corridor Study — Sioux Falls, SD

Figure
IMJR-4



Drawn By: B.Miller 9-25-12

Chked By: J.Unruh 9-25-12

Revision: 9-2-14

2035 Interstate Peak Hour Volumes and LOS
Option 7a

I-229 Exit 5 (26th Street) Crossroad Corridor Study Sioux Falls, SD

Figure IMJR-5

Drawn By: B.Miller
Date: 1-3-2014
Chked By: J.Unruh
Date: 1-3-2014
Revision: 4-17-14

Interchange Opt. 5a - West Side Diamond Adjacent Ramps
Intersection Opt. A - Elevated Intersection on Existing Southeastern Ave. Alignment
I-229 Exit 5 (26th Street) Interchange Environmental Assessment — Sioux Falls, SD

Figure 2-2

Drawn By: B.Miller
Date: 1-3-2014
Chked By: J.Unruh
Date: 1-3-2014
Revision: 4-17-14

Interchange Opt. 5a - West Side Diamond Adjacent Ramps
Intersection Opt. C - Elevated Intersection with Southeastern Ave. Shifted West
I-229 Exit 5 (26th Street) Interchange Environmental Assessment Sioux Falls, SD

Figure
2-3

Drawn By: B.Miller
Date: 1-3-2014
Chked By: J.Unruh
Date: 1-3-2014
Revision: 8-5-14

Interchange Opt. 7a - West Side Folded Diamond
Intersection Opt. A - Elevated Intersection on Existing Southeastern Ave. Alignment
I-229 Exit 5 (26th Street) Interchange Environmental Assessment Sioux Falls, SD

Figure
2-4

Drawn By: B.Miller
Date: 1-3-2014
Chked By: J.Unruh
Date: 1-3-2014
Revision: 8-5-14

Interchange Opt. 7a - West Side Folded Diamond
Intersection Opt. C - Elevated Intersection with Southeastern Ave. Shifted West
I-229 Exit 5 (26th Street) Interchange Environmental Assessment Sioux Falls, SD

Figure
2-5

Evaluation Matrix

Table 2 provides a comparison of the characteristics of each of the interchange alternatives. The table shows that Option 7a provides a slightly better technical solution to the transportation needs at this location, based on operational performance.

Table 4 – Evaluation Matrix

Alternative	Conformance with Plans	Compliance with Standards	Environmental Impacts	Safety	Operational Performance
No Build	No	No	Didn't satisfy project need	Poor	Poor
Option 5a	Yes	Yes	Some wetland and park impacts	Good	Good, SB off ramp/LOS E and SB on ramp/LOS D due to mainline capacity constraints in 2035, mitigation consists of one additional thru lane on I-229.
Option 7a	Yes	Yes	Some residential, wetland and park impacts	Good	Good, SB off/on ramp /LOS D due to mainline capacity constraints in 2035, mitigation consist of one additional thru lane on I-229.

Coordination

The 26th Street Corridor, including its interchange at Interstate 229, has been the subject of agency coordination and public involvement as part of the corridor planning and environmental assessment process, including public meetings. Further details are available in the Draft EA. The interchange alternatives have also been the subject of review and public meeting through the regular meetings of the MPO committees. A significant amount of information can be found at www.26thstreetcorridorstudy.com, which is the project website.

FUNDING PLAN FOR PROJECT(S) IM 2292(06)5, PCN 4778

The 2015-2018 Statewide Transportation Improvements Program (STIP) and the tentative 2015-2018 MPO Transportation Improvements Program (TIP) do not contain projects for the reconstruction of the I-229/26th Street interchange. Construction of the interchange is currently expected in 2019 and the developmental program includes the funding allocations shown below. The inflated estimated cost for the overall 2019 project is $38.730 Million. The city project is also expected to be constructed in 2019 with a completion date of 2020. The anticipated funding is identified below. It is believed at this time that the projects will be one letting with portions of the city project lapsing into 2020.

TABLE 5 - ANTICIPATED FUNDING ALLOCATION BREAKDOWN

Project Number	State Funding Category	Federal Funding Category	Federal Funds	State Funds	City Funds	Total Funds
IM 2292(06)5 PCN 4778	Interstate	National Highway Performance Program	$10.262 Million	$1.318 Million	$0	$11.58 Million
TBD	Local Urban Systems	Surface Transportation Program	$14.994 Million	$3.506 Million	$4.0 Million	$22.50 Million
11016	Sioux Falls Capital Improvements Plan		$0	$0	$1.0 Million	$1.0 Million
TOTAL			$25.256 Million	$4.824 Million	$5.0 Million	$35.08 Million

Note: As funding is fluid, category breakdown may be different at the time of project authorization.

RECOMMENDATIONS

The Preliminary Draft Environmental Assessment and the technical analysis contained in this Interchange Modification Justification Report have found that Options 5a and 7a provide similar solutions for the transportation needs in the study area. The preferred option is being selected as part of the completion of the environmental assessment process.

The eight considerations and requirements for Interstate access are addressed below:

1) The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands.

   The proposed change is a reconfiguration of an existing interchange and improvements to the existing crossroad facility. The changes will improve both safety and capacity at the current interchange and crossroad along 26th Street. The proposed change does not result in any new access points on the Interstate Highway System.

2) The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate with the proposed change(s) in access.

   The retained interchange options (5a & 7a) involve changes to correct an unconventional ramp configuration and meet the transportation needs in the study area. The addition of 1 mainline lane in each direction between 10th Street and Cliff Avenue will mitigate the LOS concerns shown for both the SB and NB ramps at Exit 5. It should be noted that the improvements identified can be constructed now without mainline I-229 reconstruction and maintain an acceptable LOS for quite some time. The interstate operational analysis indicates concerns in 2035. The SDDOT is currently working on the I-229 Major Investment Corridor Study that will identify improvements along the corridor. Based on the analysis completed for this IMJR it is believed that mainline improvements will be identified and programmed as necessary. The concept basis for the I-229 design-build reconstruction project completed in 2001 was that the future additional thru lane for NB and SB will be added to the median side and a barrier placed which would not cause the improvements identified during this project to be reconstructed. Mass transit reaches a limited market in South Dakota and HOV facilities are currently not in use because they have not been shown to be economically feasible. Neither mass transit or HOV facilities will correct design deficiencies or provide sufficient relief to future travel demand within the study planning horizon.

3) An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access. These interchanges shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network. Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network. Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative.

   An operational and safety analysis has concluded that the change in access proposed in Options 5a & 7a does not adversely affect operations of the interstate as there are no reductions in Level of Service to the ramps or mainline when compared to the 2035 no build option. The 2035 no build and proposed build options analyzed I-229 using three lanes south of 26th Street (2 mainline and 1 auxiliary) and two lanes north of 26th Street (2 mainline with no auxiliary) in each direction. The proposed build options however do significantly improve the level of service of the crossroad terminals with the interchange ramps as they all are mitigated to level of service "C" or greater. With ramp improvements to the SW quadrant of the interchange and directing exiting I-229 traffic to an arterial street versus a local street is not only consistent with current design practices but also improves safety by reducing conflict locations. Although through the operational analysis it has been proved that we do not adversely affection I-229 operations, it did become apparent that I-229 mainline between 10th Street and Cliff Avenue will need to be expanded with one additional lane in each direction, regardless of whether the 26th Street interchange is changed in order to attain level of service "C" or better as required in the build year of 2035.

   *The conceptual signing plans for the retained options are shown in **Figures IMJR 6 and IMJR 7**. Figures IMJR 8 and IMJR 9 illustrate the control of access either existing or proposed as well as identifies the distance to the adjacent access points per the SDDOT Road Design Manual.*

4) The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards.

The proposed access is a reconfiguration of an existing interchange with full access to an arterial city street and includes all movements. The conceptual drawings have been prepared to illustrate the proposed improvements reflecting standardization of the interchange for the SB I-229 movements as well as improvements to meet traffic capacity requirements at the ramp intersections with 26th Street. With the exception of the SW & SE quadrant loop ramps, all design standards as defined by the SDDOT have been achieved. Appendix Part 7 includes supporting documentation for the loop design exception and preservation of the existing geometry for the southeast quadrant loop.

5) The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified.

   The proposal is the result of land use and transportation plans prepared within the MPO process, including the Sioux Falls MPO Long Range Transportation Plan. This Interstate Modification Justification Report supplements a draft EA. With a current construction date of 2019, funds are anticipated to be obligated in the 2015-2018 STIP and TIP with construction dollars programmed in the SDDOT 4 year development program.

6) In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan.

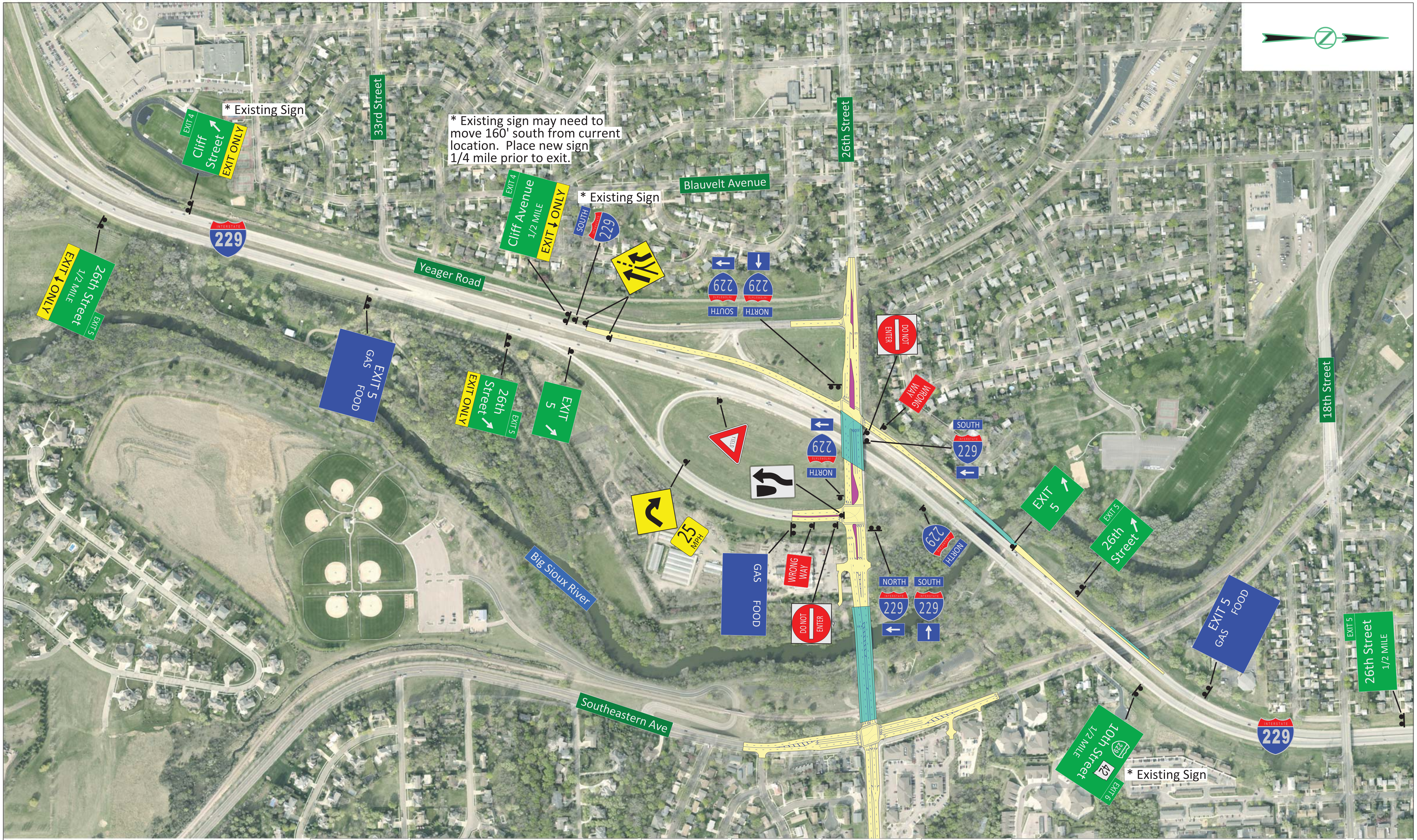
   SDDOT has prepared the Decennial Interstate Corridor Study (2010), which considered all proposed additions to the Interstate Highways System within the state of South Dakota. The proposed interchange reconfiguration was addressed in the Decennial study and no additional interchanges were anticipated within the study area.

7) When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements. The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point.

   The proposed access change results not from any particular development, but from current needs and overall growth within the metropolitan area. It is part of a planned program of transportation improvements throughout the metropolitan area to address future transportation needs. Both the City of Sioux Falls and the SDDOT will be completing improvements that work well together to improve *traffic flow in this area. During final design, sequencing plans will be included that indicate how the projects are coordinated in regards to traffic during construction. Although it is believed at this time that the interchange improvements can be completed in one year, the intersection improvements proposed by the City of Sioux Falls at 26th Street and Southeastern Avenue may lapse into 2020 to best manage traffic during construction. Improvements at Rotary Park may take place prior to 2019 in order to best serve this use during construction.*

8) The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of environmental processing.

The Draft EA for the 26th Street Corridor has been submitted for review. The I-229/26th Street (Exit 5) Corridor Study, the EA and this IMJR have been prepared as part of one continuous planning and preliminary engineering process, including numerous opportunities for public input. The website www.26thstreetcorridorstudy.com has been active during the EA and preliminary engineering process to be the portal of communication activities and documents. As part of the environmental process, option 7a has been recommended as the preferred Option.



Drawn By: B.Miller
Date: 4-24-2012
Checked By: R.Laughlin
Date: 4-24-2012
Revisions: 9-2-2014

U.S. Department of Transportation
Federal Highway Administration

MPO

DOT

HDR

Conceptual Signing Plan - Option 5a

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure

IMJR-6

Drawn By: B.Miller
Date: 4-24-2012

Checked By: R.Laughlin
Date: 4-24-2012

Revisions: 9-2-2014

U.S. Department of Transportation
Federal Highway Administration

MPO

DOT
Connecting South Dakota and the Nation

HDR

Conceptual Signing Plan - Option 7a

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure
IMJR-7

Drawn By:
B.Miller
7-31-14

Chked By:
J.Unruh
7-31-14

Revision:
8-5-14

Control of Access - Alternative 5a Layout

I-229 Exit 5 (26th Street) Crossroad Corridor Study Sioux Falls, SD

Figure
IMJR-8

Control of Access - Alternative 7a Layout

Figure

IMJR-9

I-229 Exit 5 (26th Street) Crossroad Corridor Study   Sioux Falls, SD

APPENDIX

Part 1 – 2012 Interstate Level of Service
Part 2 – 2012 Crossroad Level of Service
Part 3 – 2035 Interstate Level of Service
Part 4 – 2035 Crossroad Level of Service
Part 5 – Interchange Area Air Photos
Part 6 – Methods and Assumption Signed Document

- **Amendment #2 with Appendix A & B (Amendment #1 is Appendix B)**
- **Amendment #1 with Appendix A (Original M&A document is Appendix A)**

Part 7 – Option 7a SW & SE Quadrant Loop Design Analysis Memo

- **Includes Attachment A**

I-229/26th Street Interchange Modification Justification Report

APPENDIX

PART 1

2012 Interstate Level of Service

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	AM Peak
Freeway/Direction:	I-229/SB
From/To:	10th/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	Existing

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	1155	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	321	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	690	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	690	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	10.6	pc/mi/ln
Level of service, LOS	A	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	AM Peak
Freeway/Direction:	I-229/SB
From/To:	26th/41st
Jurisdiction:	City of Sioux Falls
Analysis Year:	Existing

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	1550	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	431	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	588	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	588	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	9.0	pc/mi/ln
Level of service, LOS	A	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	AM Peak
Freeway/Direction:	I-229/NB
From/To:	41st/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	Existing

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	1925	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	535	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	731	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	731	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	11.2	pc/mi/ln
Level of service, LOS	B	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	AM Peak
Freeway/Direction:	I-229/NB
From/To:	26th/10th
Jurisdiction:	City of Sioux Falls
Analysis Year:	Existing

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	1917	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	533	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1145	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1145	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	17.6	pc/mi/ln
Level of service, LOS	B	

HCS 2010: Basic Freeway Segments Release 6.60

Phone:	Fax:
E-mail:	

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	PM Peak
Freeway/Direction:	I-229/SB
From/To:	10th/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	Existing

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	1997	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	555	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1193	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1193	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	18.4	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	PM Peak
Freeway/Direction:	I-229/SB
From/To:	26th/41st
Jurisdiction:	City of Sioux Falls
Analysis Year:	Existing

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2075	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	576	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	788	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	788	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	12.1	pc/mi/ln
Level of service, LOS	B	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	PM Peak
Freeway/Direction:	I-229/NB
From/To:	41st/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	Existing

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	1746	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	485	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	663	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	663	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	10.2	pc/mi/ln
Level of service, LOS	A	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	PM Peak
Freeway/Direction:	I-229/NB
From/To:	26th/10th
Jurisdiction:	City of Sioux Falls
Analysis Year:	Existing

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	1151	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	320	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	687	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	687	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	10.6	pc/mi/ln
Level of service, LOS	A	

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH STREET
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1194	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	413	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	377	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1194		413		377	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	332		115		105	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1426	493	450	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.702 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1148 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1426	6990	No
$v_{FO} = v_F - v_R$	933	6990	No
v_R	493	2100	No
v_3 or v_{av34}	278 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1148 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1148	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 5.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.342

Space mean speed in ramp influence area, S_R = 55.8 mph

Space mean speed in outer lanes, S_0 = 69.1 mph

Space mean speed for all vehicles, S = 58.0 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	778	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	377	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	413	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	778	377	413	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	216	105	115	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           929         450         493       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  929    pc/h
                   12   F   FM

_______________________________Capacity Checks_______________________________

                           Actual        Maximum         LOS F?
     v                     1379          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 929                    (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                1379          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   8.4     pc/mi/ln
         R                    R           12             A
Level of service for ramp-freeway junction areas of influence  A

_____________________________Speed Estimation_________________________________

Intermediate speed variable,                 M  = 0.228
                                              S
Space mean speed in ramp influence area,     S  = 58.2    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 58.2    mph
______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 1/8/2014
Analysis time period: AM PEAK
Freeway/Dir of Travel: I-229 SB
Junction: 26TH ST
Jurisdiction: SIOUX FALLS
Analysis Year: 2014
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1155	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	278	vph
Length of first accel/decel lane	580	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	673	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1155		278		673		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	321		77		187		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1315	317	766	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1315 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1315	4660	No
$v_{FO} = v_F - v_R$	998	4660	No
v_R	317	2100	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 1315 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1315	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 10.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.327	
Space mean speed in ramp influence area,	S_R = 56.1	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 56.1	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 1/8/2014
Analysis time period: AM PEAK
Freeway/Dir of Travel: I-229 SB
Junction: 26TH ST.
Jurisdiction: SIOUX FALLS
Analysis Year: Existing
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	877	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	673	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	278	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	877		673		278	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	244		187		77	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	999	766	317	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 999 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1765	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 999 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1765	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 12.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.254

Space mean speed in ramp influence area, S_R = 57.7 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 57.7 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1550	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	284	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	612	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1550		284		612	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	431		79		170	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1765	323	697	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.701 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1334 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1765	6990	No
$v_{FO} = v_F - v_R$	1442	6990	No
v_R	323	2100	No
v_3 or v_{av34}	431 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1334 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1334	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 6.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.327

Space mean speed in ramp influence area, S_R = 56.1 mph

Space mean speed in outer lanes, S_0 = 69.1 mph

Space mean speed for all vehicles, S = 58.8 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1266	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	612	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	284	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1266	612	284	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	352	170	79	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          1442        697         323       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =             (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1442   pc/h
                   12   F   FM

_______________________________Capacity Checks_______________________________

                           Actual        Maximum         LOS F?
     v                     2139          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1442                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2139          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   15.6    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.264
                                              S
Space mean speed in ramp influence area,     S  = 57.5    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.5    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1901	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	459	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	483	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1901		459		483	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	528		128		134	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2165        523         550       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.682   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  1643   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                2165          6990            No
      Fi   F
     v  = v - v            1642          6990            No
      FO   F   R
     v                     523           2100            No
      R
     v  or v               522  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1643                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                      Actual        Max Desirable        Violation?
     v                1643          4400                 No
      12
_________________Level of Service Determination (if not F)______________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   9.4     pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence A

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.345
                                              S
Space mean speed in ramp influence area,     S  = 55.8    mph
                                              R
Space mean speed in outer lanes,             S  = 69.1    mph
                                              0
Space mean speed for all vehicles,           S  = 58.5    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1442	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	483	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	459	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1442	483	459	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	401	134	128	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1642	550	523	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1642 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2192	4660	No

v_3 or v_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1642 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2192	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 16.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.266

Space mean speed in ramp influence area, S_R = 57.4 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 57.4 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1925	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	489	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	481	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1925		489		481	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	535		136		134	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2192	557	548	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.680 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1668 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2192	6990	No
$v_{FO} = v_F - v_R$	1635	6990	No
v_R	557	2100	No
v_3 or v_{av34}	524 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1668 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1668	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 9.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.348	
Space mean speed in ramp influence area,	S_R = 55.7	mph
Space mean speed in outer lanes,	S_0 = 69.1	mph
Space mean speed for all vehicles,	S = 58.4	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1436	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	481	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	489	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1436	481	489	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	399	134	136	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          1635        548         557       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =             (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1635   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     2183          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1635                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2183          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   15.4    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.257
                                              S
Space mean speed in ramp influence area,     S  = 57.6    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.6    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 1/8/2014
Analysis time period: AM PEAK
Freeway/Dir of Travel: I-229 NB
Junction: 10TH ST.
Jurisdiction: SIOUX FALLS
Analysis Year: Existing
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1917	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	622	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	600	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1917		622		600	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	533		173		167	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2290	743	717	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2290 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2290	4660	No
$v_{FO} = v_F - v_R$	1547	4660	No
v_R	743	2100	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2290 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2290	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 13.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.365

Space mean speed in ramp influence area, S_R = 55.3 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 55.3 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1295	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	600	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	622	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1295	600	622	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	360	167	173	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          1547        717         743        pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =             (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1547   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     2264          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1547                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2264          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   16.5    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.269
                                              S
Space mean speed in ramp influence area,     S  = 57.4    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.4    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 1/8/2014
Analysis time period: PM PEAK
Freeway/Dir of Travel: I-229 SB
Junction: 10TH STREET
Jurisdiction: SIOUX FALLS
Analysis Year: Existing
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2156	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	594	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	435	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2156		594		435	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	599		165		121	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2575	709	520	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.663 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1946 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2575	6990	No
$v_{FO} = v_F - v_R$	1866	6990	No
v_R	709	2100	No
v_3 or v_{av34}	629 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1946 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1946	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 12.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.362	
Space mean speed in ramp influence area,	S_R = 55.4	mph
Space mean speed in outer lanes,	S_0 = 69.1	mph
Space mean speed for all vehicles,	S = 58.2	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1562	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	435	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	594	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1562	435	594	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	434	121	165	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           1866        520         709       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =             (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1866   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     2386          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1866                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2386          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   16.3    pc/mi/ln
          R                   R          12             A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.254
                                              S
Space mean speed in ramp influence area,     S  = 57.7    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.7    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1997	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	437	vph
Length of first accel/decel lane	580	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	515	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1997		437		515	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	555		121		143	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           2274        498         587       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  2274   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                2274          4660            No
      Fi   F
     v  = v - v            1776          4660            No
      FO   F   R
     v                     498           2100            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2274                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                      Actual        Max Desirable        Violation?
     v                2274          4400                 No
      12
________________Level of Service Determination (if not F)______________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   18.6    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.343
                                              S
Space mean speed in ramp influence area,     S  = 55.8    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 55.8    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1560	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	515	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	437	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1560	515	437	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	433	143	121	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           1777        587         498        pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L   =            (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v   = v  (P   ) =  1777   pc/h
                   12   F   FM

_______________________________Capacity Checks_______________________________

                           Actual        Maximum         LOS F?
     v                     2364          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1777                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area______________________
                      Actual        Max Desirable        Violation?
     v                2364          4600                 No
      R12
_________________Level of Service Determination (if not F)______________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   17.4    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.272
                                              S
Space mean speed in ramp influence area,     S  = 57.3    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.3    mph
_______________________________________________________________________________
```

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2075	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	448	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	714	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2075		448		714	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	576		124		198	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2363        510         813       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L   =            (Equation 13-12 or 13-13)
                   EQ
                  P   =    0.677   Using Equation  5
                   FD
                  v   = v  + (v - v ) P  =  1765   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  2363          6990            No
      Fi   F
     v  = v - v              1853          6990            No
      FO   F   R
     v                       510           2100            No
      R
     v  or v                 598  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 1765                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                1765          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   10.4    pc/mi/ln
                        R                   12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.344
                                              S
Space mean speed in ramp influence area,     S  = 55.8    mph
                                              R
Space mean speed in outer lanes,             S  = 69.1    mph
                                              0
Space mean speed for all vehicles,           S  = 58.6    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1627	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	714	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	448	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1627	714	448	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	452	198	124	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          1853        813         510       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =             (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1853   pc/h
                   12   F   FM

_______________________________Capacity Checks_______________________________

                           Actual        Maximum         LOS F?
     v                     2666          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34        12
If yes, v    = 1853                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2666          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   19.6    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.287
                                              S
Space mean speed in ramp influence area,     S  = 57.0    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.0    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2009	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	487	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	224	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	2009		487		224		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	558		135		62		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2288	555	255	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.677 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1729 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2288	6990	No
$v_{FO} = v_F - v_R$	1733	6990	No
v_R	555	2100	No
v_3 or v_{av34}	559 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1729 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1729	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 10.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.348

Space mean speed in ramp influence area, S_R = 55.7 mph

Space mean speed in outer lanes, S_0 = 69.1 mph

Space mean speed for all vehicles, S = 58.5 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1522	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	224	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	487	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1522	224	487	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	423	62	135	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1733	255	555	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1733 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1988	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 1733 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1988	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 14.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.259	
Space mean speed in ramp influence area,	S_R = 57.6	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 57.6	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1746	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	731	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	136	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1746		731		136	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	485		203		38	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1989	833	155	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.672 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1610 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1989	6990	No
$v_{FO} = v_F - v_R$	1156	6990	No
v_R	833	2100	No
v_3 or v_{av34}	379 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1610 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1610	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 9.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.373

Space mean speed in ramp influence area, S_R = 55.2 mph

Space mean speed in outer lanes, S_0 = 69.1 mph

Space mean speed for all vehicles, S = 57.4 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1015	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	136	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	731	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1015	136	731	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	282	38	203	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           1156        155         833        pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1156   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     1311          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1156                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                1311          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   8.7     pc/mi/ln
         R                    R           12            A
Level of service for ramp-freeway junction areas of influence  A

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.236
                                              S
Space mean speed in ramp influence area,     S  = 58.0    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 58.0    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1151	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	689	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	449	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1151		689		449	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	320		191		125	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          1375        823         536       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1375   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                1375          4660            No
      Fi   F
     v  = v - v            552           4660            No
      FO   F   R
     v                     823           2100            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1375                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                1375          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   5.2     pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence A

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.372
                                              S
Space mean speed in ramp influence area,     S  = 55.2    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 55.2    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	Existing

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	462	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	449	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	689	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	462	449	689	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	128	125	191	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           552         536         823       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =             (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  552    pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     1088          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 552                    (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                1088          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   7.4     pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  A

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.243
                                              S
Space mean speed in ramp influence area,     S  = 57.9    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.9    mph
_______________________________________________________________________________
```

FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	AM PEAK

Site Information

Freeway/Dir of Travel	I-229/SB
Weaving Segment Location	26TH TO 41ST
Analysis Year	EXISTING

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2900ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1528	0.90	5	0	1.5	1.2	0.976	1.00	1740
V_{RF}	651	0.90	5	0	1.5	1.2	0.976	1.00	741
V_{FR}	262	0.90	5	0	1.5	1.2	0.976	1.00	298
V_{RR}	22	0.90	5	0	1.5	1.2	0.976	1.00	25
V_{NW}	1765							V =	2804
V_W	1039								
VR	0.371								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1039 lc/h
Weaving lane changes, LC_W	1313 lc/h
Non-weaving lane changes, LC_{NW}	1358 lc/h
Total lane changes, LC_{ALL}	2671 lc/h
Non-weaving vehicle index, I_{NW}	358

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2737 veh/h
Weaving segment capacity, c_w	6105 veh/h
Weaving segment v/c ratio	0.448
Weaving segment density, D	17.3 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.212
Weaving segment speed, S	54.0 mph
Average weaving speed, S_W	59.9 mph
Average non-weaving speed, S_{NW}	51.0 mph
Maximum weaving length, L_{MAX}	6353 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	AM PEAK

Site Information

Freeway/Dir of Travel	I-229/NB
Weaving Segment Location	41ST TO 26TH
Analysis Year	EXISTING

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1909	0.90	5	0	1.5	1.2	0.976	1.00	2174
V_{RF}	467	0.90	5	0	1.5	1.2	0.976	1.00	532
V_{FR}	473	0.90	5	0	1.5	1.2	0.976	1.00	539
V_{RR}	16	0.90	5	0	1.5	1.2	0.976	1.00	18
V_{NW}	2192							V =	3263
V_W	1071								
VR	0.328								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1071 lc/h
Weaving lane changes, LC_W	1347 lc/h
Non-weaving lane changes, LC_{NW}	1473 lc/h
Total lane changes, LC_{ALL}	2820 lc/h
Non-weaving vehicle index, I_{NW}	453

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3184 veh/h
Weaving segment capacity, c_w	6220 veh/h
Weaving segment v/c ratio	0.512
Weaving segment density, D	20.6 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.218
Weaving segment speed, S	52.9 mph
Average weaving speed, S_W	59.8 mph
Average non-weaving speed, S_{NW}	50.1 mph
Maximum weaving length, L_{MAX}	5889 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	PM PEAK

Site Information

Freeway/Dir of Travel	I-229/SB
Weaving Segment Location	26TH TO 41ST
Analysis Year	EXISTING

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2900ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1511	0.90	5	0	1.5	1.2	0.976	1.00	1721
V_{RF}	498	0.90	5	0	1.5	1.2	0.976	1.00	567
V_{FR}	431	0.90	5	0	1.5	1.2	0.976	1.00	491
V_{RR}	17	0.90	5	0	1.5	1.2	0.976	1.00	19
V_{NW}	1740							V =	2798
V_W	1058								
VR	0.378								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1058 lc/h
Weaving lane changes, LC_W	1332 lc/h
Non-weaving lane changes, LC_{NW}	1352 lc/h
Total lane changes, LC_{ALL}	2684 lc/h
Non-weaving vehicle index, I_{NW}	353

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2730 veh/h
Weaving segment capacity, c_w	6085 veh/h
Weaving segment v/c ratio	0.449
Weaving segment density, D	17.3 pc/mi/ln
Level of Service, LOS	B
Weaving intensity factor, W	0.213
Weaving segment speed, S	54.0 mph
Average weaving speed, S_W	59.8 mph
Average non-weaving speed, S_{NW}	50.9 mph
Maximum weaving length, L_{MAX}	6437 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	PM PEAK

Site Information

Freeway/Dir of Travel	I-229/NB
Weaving Segment Location	41ST TO 26TH
Analysis Year	EXISTING

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	1902	0.90	5	0	1.5	1.2	0.976	1.00	2166
V_{RF}	217	0.90	5	0	1.5	1.2	0.976	1.00	247
V_{FR}	724	0.90	5	0	1.5	1.2	0.976	1.00	825
V_{RR}	7	0.90	5	0	1.5	1.2	0.976	1.00	8
V_{NW}	2174							V =	3246
V_W	1072								
VR	0.330								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1072 lc/h
Weaving lane changes, LC_W	1348 lc/h
Non-weaving lane changes, LC_{NW}	1469 lc/h
Total lane changes, LC_{ALL}	2817 lc/h
Non-weaving vehicle index, I_{NW}	449

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3167 veh/h
Weaving segment capacity, c_w	6214 veh/h
Weaving segment v/c ratio	0.510
Weaving segment density, D	20.4 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.218
Weaving segment speed, S	52.9 mph
Average weaving speed, S_W	59.8 mph
Average non-weaving speed, S_{NW}	50.1 mph
Maximum weaving length, L_{MAX}	5911 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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I-229/26th Street Interchange Modification Justification Report

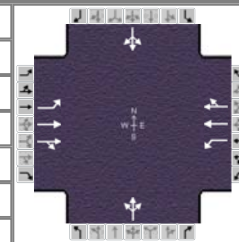
APPENDIX

PART 2

2012 Crossroad Level of Service

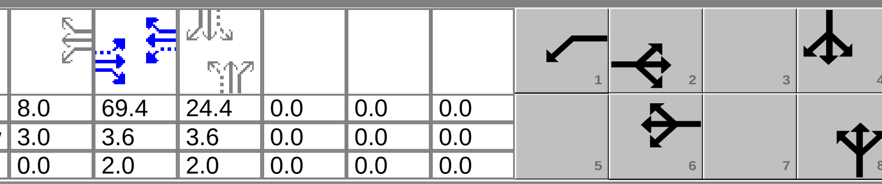
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM existing	PHF	0.90
Intersection	Lowell Avenue	Analysis Year	2013	Analysis Period	1> 7:00
File Name	AM existing.xus				
Project Description	AM existing				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	3	366	6	27	791	35	7	21	32	60	20	13

Signal Information			
Cycle, s	116.0	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	8.0	69.4	24.4	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		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		75.0	11.0	86.0		30.0		30.0
Change Period, (*Y*+*Rc*), s		5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.3		3.3
Queue Clearance Time (*gs*), s			2.9			5.7		8.7
Green Extension Time (*ge*), s		0.0	0.0	0.0		0.3		0.3
Phase Call Probability			1.00			1.00		1.00
Max Out Probability			0.04			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	3	206	205	45	693	684		63			101	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	392	1698	1691	1681	1698	1674		1587			1448	
Queue Service Time (*gs*), s	0.3	3.4	3.4	0.9	26.6	26.6		0.0			2.9	
Cycle Queue Clearance Time (*gc*), s	16.0	3.4	3.4	0.9	26.6	26.6		3.7			6.7	
Green Ratio (*g/C*)	0.60	0.60	0.60	0.68	0.69	0.69		0.21			0.21	
Capacity (*c*), veh/h	244	1016	1012	730	1177	1160		369			356	
Volume-to-Capacity Ratio (*X*)	0.014	0.203	0.203	0.062	0.588	0.590		0.172			0.284	
Available Capacity (*ca*), veh/h	244	1016	1012	730	1177	1160		369			356	
Back of Queue (*Q*), veh/ln (50th percentile)	0.0	1.2	1.2	0.3	9.9	9.7		1.5			2.5	
Queue Storage Ratio (*RQ*) (50th percentile)	0.01	0.00	0.00	0.15	0.00	0.00		0.00			0.00	
Uniform Delay (*d1*), s/veh	9.3	5.1	5.1	5.2	10.7	10.7		37.6			38.7	
Incremental Delay (*d2*), s/veh	0.1	0.4	0.5	0.0	1.3	1.3		0.1			0.2	
Initial Queue Delay (*d3*), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	9.4	5.5	5.5	5.2	12.0	12.0		37.7			38.9	
Level of Service (LOS)	A	A	A	A	B	B		D			D	
Approach Delay, s/veh / LOS	5.5		A	11.8		B	37.7		D	38.9		D
Intersection Delay, s/veh / LOS	12.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	0.8	A	1.3	A	0.6	A	0.7	A

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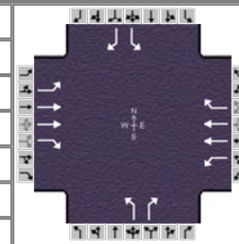
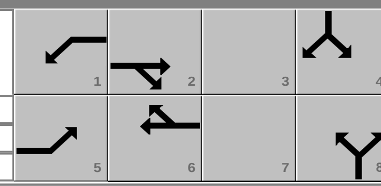
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM existing	PHF	0.90
Intersection	I-229	Analysis Year	2013	Analysis Period	1> 7:00
File Name	AM existing.xus				
Project Description	AM existing				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	120	336	0	375	671	0	305		0	145		0

Signal Information										
Cycle, s	116.0	Reference Phase	2							
Offset, s	104	Reference Point	Begin	Green	31.9	10.0	20.9	31.4	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	4.5	0.0	4.5	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	29.0	39.0	40.0	50.0		37.0		37.0
Change Period, ($Y+R_c$), s	8.1	8.1	8.1	0.0		5.6		5.6
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		2.9		2.9
Queue Clearance Time (g_s), s	9.3		33.9			23.5		11.4
Green Extension Time (g_e), s	1.0	0.0	0.0	0.0		0.6		0.8
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			0.04		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3		18	7		14
Adjusted Flow Rate (v), veh/h	134	375	0	608	1088	0	339		0	161		0
Adjusted Saturation Flow Rate (s), veh/h/ln	1599	1553	1497	1774	1641	1497	1670		1591	1608		1532
Queue Service Time (g_s), s	7.3	10.9	0.0	31.9	34.2	0.0	21.5		0.0	9.4		0.0
Cycle Queue Clearance Time (g_c), s	7.3	10.9	0.0	31.9	34.2	0.0	21.5		0.0	9.4		0.0
Green Ratio (g/C)	0.18	0.27	0.27	0.27	0.43	0.43	0.27		0.27	0.27		0.27
Capacity (c), veh/h	288	828	399	488	1415	645	514		431	497		415
Volume-to-Capacity Ratio (X)	0.465	0.453	0.000	1.246	0.769	0.000	0.659		0.000	0.324		0.000
Available Capacity (c_a), veh/h	288	828	399	488	1415	645	514		431	497		415
Back of Queue (Q), veh/ln (50th percentile)	2.6	4.1	0.0	31.1	14.2	0.0	8.8		0.0	3.6		0.0
Queue Storage Ratio (RQ) (50th percentile)	0.21	0.00	0.00	2.51	0.00	0.00	1.54		0.00	0.63		0.00
Uniform Delay (d_1), s/veh	31.9	31.8	0.0	53.3	32.8	0.0	38.7		0.0	34.3		0.0
Incremental Delay (d_2), s/veh	0.4	1.8	0.0	117.0	1.5	0.0	2.5		0.0	0.1		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	32.3	33.5	0.0	170.3	34.3	0.0	41.2		0.0	34.4		0.0
Level of Service (LOS)	C	C		F	C		D			C		
Approach Delay, s/veh / LOS	33.2		C	83.0		F	41.2		D	34.4		C
Intersection Delay, s/veh / LOS	65.5						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.0	C	3.0	C
Bicycle LOS Score / LOS	0.9	A	1.4	A		F		F

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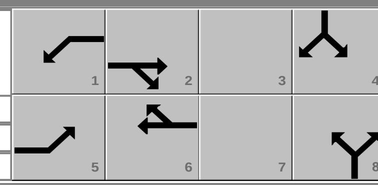
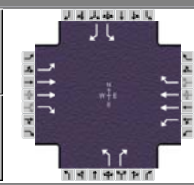
HCS 2010 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	SPUI
Analyst	RL	Analysis Date	Oct 7, 2013	Segment Distance, ft	
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-229	PHF	0.90	Arterial Direction	East-West
File Name	AM existing.xus				
Project Description	AM existing				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection Demand (v), veh/h	120	336	0	375	671	0	305		0	145		0

Signal Information								
Cycle, s	116.0							
Offset, s	104	Green	31.9	10.0	20.9	31.4	0.0	0.0
Uncoordinated	No	Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Force Mode	Fixed	Red	4.5	0.0	4.5	2.0	0.0	0.0





Interchange Results					
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL	339	NBL	41.2	C
B	NBR	0	NBR	0.0	A
C	SBR	0	SBR	0.0	A
D	SBL	161	SBL	34.4	C
E	EBL	134	EBL	32.3	C
F	EBR	0	EBR	0.0	A
G	WBR	0	WBR	0.0	A
H	WBL	608	WBL	170.3	F
I	EBT	375	EBT	33.5	C
J	WBT	1088	WBT	34.3	C
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M		0		-	-
N		0		-	-

Signalized Intersection Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	32.3	33.5	0.0	170.3	34.3	0.0	41.2		0.0	34.4		0.0
Level of Service (LOS)	C	C		F	C		D			C		
Approach Delay, s/veh / LOS	33.2		C	83.0		F	41.2		D	34.4		C
Intersection Delay, s/veh / LOS	65.5						E					

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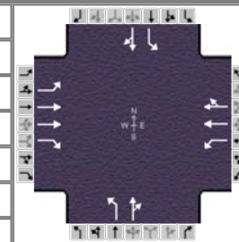
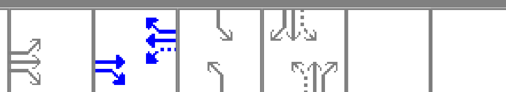
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM existing	PHF	0.90
Intersection	Cleveland Avenue	Analysis Year	2013	Analysis Period	1> 7:00
File Name	AM existing.xus				
Project Description	AM existing				

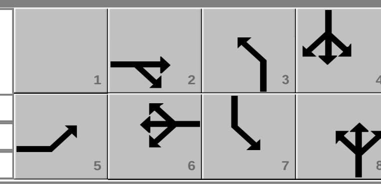


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	77	571	150	27	1100	43	267	208	19	33	97	159

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	10.0	48.4	14.0	26.4	0.0	0.0
Yellow	3.0	3.6	3.0	3.6	0.0	0.0
Red	0.0	2.0	0.0	2.0	0.0	0.0

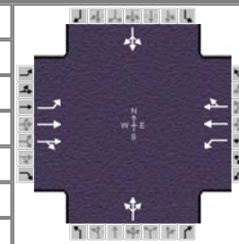


Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	3.0		6.3	1.1	4.0	1.1	4.0
Phase Duration, s	13.0	67.0		54.0	17.0	32.0	17.0	32.0
Change Period, (*Y+R*$_c$), s	3.0	5.6		5.6	3.0	5.6	3.0	5.6
Max Allow Headway (*MAH*), s	3.2	0.0		0.0	3.2	3.2	3.2	3.2
Queue Clearance Time (g_s), s	5.4				16.0	16.2	3.6	18.1
Green Extension Time (g_e), s	0.0	0.0		0.0	0.0	0.8	0.0	0.7
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	0.11				1.00	0.02	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	50	374	79	30	633	626	297	247		37	251	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1641	1511	1001	1681	1663	1672	1735		1681	1594	
Queue Service Time (g_s), s	3.4	3.2	0.7	1.6	38.9	38.9	14.0	14.2		1.6	16.1	
Cycle Queue Clearance Time (g_c), s	3.4	3.2	0.7	1.6	38.9	38.9	14.0	14.2		1.6	16.1	
Green Ratio (*g/C*)	0.09	0.53	0.53	0.42	0.42	0.42	0.35	0.23		0.35	0.23	
Capacity (*c*), veh/h	147	1737	800	480	701	694	344	395		364	363	
Volume-to-Capacity Ratio (*X*)	0.343	0.215	0.098	0.063	0.902	0.903	0.863	0.625		0.101	0.692	
Available Capacity (c_a), veh/h	147	1737	800	480	701	694	344	395		364	363	
Back of Queue (*Q*), veh/ln (50th percentile)	1.5	1.1	0.3	0.4	16.6	16.5	8.1	5.9		0.6	6.4	
Queue Storage Ratio (*RQ*) (50th percentile)	0.28	0.00	0.05	0.07	0.00	0.00	1.46	0.00		0.12	0.00	
Uniform Delay (d_1), s/veh	54.7	5.8	2.9	15.4	23.6	23.6	33.0	36.1		25.1	36.8	
Incremental Delay (d_2), s/veh	0.5	0.3	0.2	0.3	17.0	17.3	18.9	2.3		0.0	4.7	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	55.2	6.0	3.2	15.6	40.6	40.9	51.9	38.5		25.2	41.5	
Level of Service (LOS)	E	A	A	B	D	D	D	D		C	D	
Approach Delay, s/veh / LOS	10.5		B	40.2		D	45.8		D	39.4		D
Intersection Delay, s/veh / LOS	35.6						D					

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	1.2	A	1.6	A	1.4	A	1.0	A

HCS 2010 Signalized Intersection Results Summary

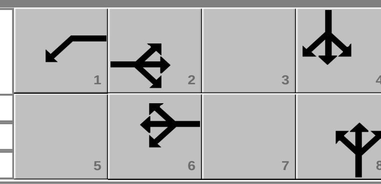


General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM existing	PHF	0.90
Intersection	Lowell Avenue	Analysis Year	2013	Analysis Period	1> 7:00
File Name	PM existing.xus				
Project Description	PM existing				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	15	1013	15	99	728	50	17	28	33	102	45	9

Signal Information			
Cycle, s	116.0	Reference Phase	2
Offset, s	72	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	12.0	65.4	24.4	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



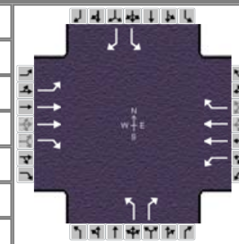
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		71.0	15.0	86.0		30.0		30.0
Change Period, (Y+R_c), s		5.6	3.0	5.6		5.6		5.6
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.3		3.3
Queue Clearance Time (g_s), s			4.4			6.7		14.1
Green Extension Time (g_e), s		0.0	0.1	0.0		0.5		0.4
Phase Call Probability			1.00			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	17	571	569	99	390	382		80			171	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	693	1698	1690	1681	1698	1661		1593			1457	
Queue Service Time (g_s), s	0.7	17.6	17.6	2.4	5.7	5.4		0.0			7.4	
Cycle Queue Clearance Time (g_c), s	0.7	17.6	17.6	2.4	5.7	5.4		4.7			12.1	
Green Ratio (*g/C*)	0.56	0.56	0.56	0.68	0.69	0.69		0.21			0.21	
Capacity (*c*), veh/h	453	957	953	439	1177	1151		374			358	
Volume-to-Capacity Ratio (*X*)	0.037	0.597	0.597	0.225	0.331	0.332		0.214			0.478	
Available Capacity (c_a), veh/h	453	957	953	439	1177	1151		374			358	
Back of Queue (*Q*), veh/ln (50th percentile)	0.1	5.2	5.2	0.9	1.7	1.6		1.9			4.4	
Queue Storage Ratio (*RQ*) (50th percentile)	0.03	0.00	0.00	0.44	0.00	0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	6.4	8.5	8.5	9.2	3.2	3.0		38.0			40.8	
Incremental Delay (d_2), s/veh	0.2	2.7	2.8	0.1	0.6	0.6		0.1			0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	6.5	11.2	11.2	9.3	3.8	3.6		38.1			41.2	
Level of Service (LOS)	A	B	B	A	A	A		D			D	
Approach Delay, s/veh / LOS	11.1	B		4.3	A		38.1	D		41.2	D	
Intersection Delay, s/veh / LOS	11.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.4	A	1.3	A	0.6	A	0.8	A

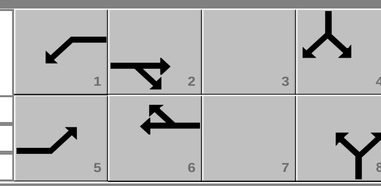
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM existing	PHF	0.90
Intersection	I-229	Analysis Year	2013	Analysis Period	1> 7:00
File Name	PM existing.xus				
Project Description	PM existing				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	173	931	0	391	566	0	147		0	430		0

Signal Information										
Cycle, s	116.0	Reference Phase	2							
Offset, s	100	Reference Point	Begin	Green	24.9	10.0	23.9	35.4	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	4.5	0.0	4.5	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	32.0	42.0	33.0	43.0		41.0		41.0
Change Period, (Y+R_c), s	8.1	8.1	8.1	0.0		5.6		5.6
Max Allow Headway (MAH), s	3.1	0.0	3.1	0.0		2.9		2.9
Queue Clearance Time (g_s), s	14.4		26.9			11.1		32.9
Green Extension Time (g_e), s	2.7	0.0	0.0	0.0		1.1		0.4
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.17		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	200	1076	0	504	729	0	163		0	478		0
Adjusted Saturation Flow Rate (s), veh/h/ln	1621	1640	1497	1733	1596	1497	1609		1533	1722		1641
Queue Service Time (g_s), s	12.4	33.9	0.0	24.9	22.8	0.0	9.1		0.0	30.9		0.0
Cycle Queue Clearance Time (g_c), s	12.4	33.9	0.0	24.9	22.8	0.0	9.1		0.0	30.9		0.0
Green Ratio (g/C)	0.21	0.29	0.29	0.21	0.37	0.37	0.31		0.31	0.31		0.31
Capacity (c), veh/h	334	959	438	372	1183	555	553		468	588		501
Volume-to-Capacity Ratio (X)	0.598	1.122	0.000	1.355	0.616	0.000	0.295		0.000	0.813		0.000
Available Capacity (c_a), veh/h	334	959	438	372	1183	555	553		468	588		501
Back of Queue (Q), veh/ln (50th percentile)	4.8	20.6	0.0	29.2	9.3	0.0	3.4		0.0	13.8		0.0
Queue Storage Ratio (RQ) (50th percentile)	0.39	0.00	0.00	2.35	0.00	0.00	0.60		0.00	2.40		0.00
Uniform Delay (d_1), s/veh	37.8	32.8	0.0	54.6	33.6	0.0	31.2		0.0	38.8		0.0
Incremental Delay (d_2), s/veh	1.6	66.3	0.0	169.1	1.3	0.0	0.1		0.0	8.0		0.0
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0
Control Delay (d), s/veh	39.5	99.1	0.0	223.7	34.9	0.0	31.3		0.0	46.7		0.0
Level of Service (LOS)	D	F		F	C		C			D		
Approach Delay, s/veh / LOS	89.8		F	112.0		F	31.3		C	46.7		D
Intersection Delay, s/veh / LOS	88.9						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.5	A	1.4	A		F		F

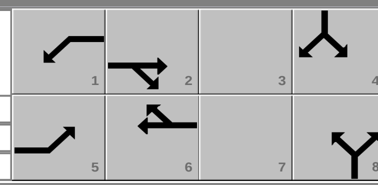
HCS 2010 Interchanges Results Summary

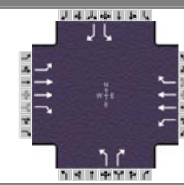
General Information				**Interchange Information**	
Agency	HDR			Interchange Type	SPUI
Analyst	RL	Analysis Date	Oct 7, 2013	Segment Distance, ft	
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-229	PHF	0.90	Arterial Direction	East-West
File Name	PM existing.xus				
Project Description	PM existing				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection Demand (v), veh/h	173	931	0	391	566	0	147		0	430		0

Signal Information	
Cycle, s	116.0
Offset, s	100
Uncoordinated	No
Force Mode	Fixed

Green	24.9	10.0	23.9	35.4	0.0	0.0
Yellow	3.6	0.0	3.6	3.6	0.0	0.0
Red	4.5	0.0	4.5	2.0	0.0	0.0





Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL	163	NBL	31.3	C
B	NBR	0	NBR	0.0	A
C	SBR	0	SBR	0.0	A
D	SBL	478	SBL	46.7	D
E	EBL	200	EBL	39.5	C
F	EBR	0	EBR	0.0	A
G	WBR	0	WBR	0.0	A
H	WBL	504	WBL	223.7	F
I	EBT	1076	EBT	99.1	F
J	WBT	729	WBT	34.9	C
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M		0		-	-
N		0		-	-

Signalized Intersection Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	39.5	99.1	0.0	223.7	34.9	0.0	31.3		0.0	46.7		0.0
Level of Service (LOS)	D	F		F	C		C			D		
Approach Delay, s/veh / LOS	89.8	F		112.0	F		31.3	C		46.7	D	
Intersection Delay, s/veh / LOS	88.9						F					

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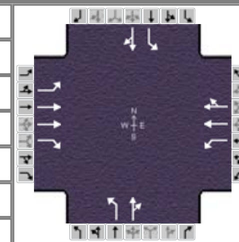
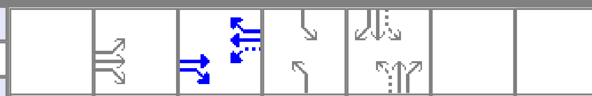
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM existing	PHF	0.90
Intersection	Cleveland Avenue	Analysis Year	2013	Analysis Period	1> 7:00
File Name	PM existing.xus				
Project Description	PM existing				

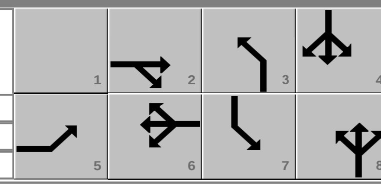


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	201	1513	189	38	925	92	163	215	84	147	198	145

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	15.0	44.4	12.0	27.4	0.0	0.0
Yellow	3.0	3.6	3.0	3.6	0.0	0.0
Red	0.0	2.0	0.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	3.0		6.3	1.1	4.0	1.1	4.0
Phase Duration, s	18.0	68.0		50.0	15.0	33.0	15.0	33.0
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	3.2	0.0		0.0	3.2	3.2	3.2	3.2
Queue Clearance Time (g_s), s	12.1				11.3	23.0	10.2	26.4
Green Extension Time (g_e), s	0.1	0.0		0.0	0.0	0.8	0.1	0.2
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	0.58	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	151	1135	123	42	568	551	181	327		163	359	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1641	1511	493	1681	1631	1672	1672		1681	1645	
Queue Service Time (g_s), s	10.1	21.9	1.8	5.8	34.9	34.9	9.3	21.0		8.2	24.4	
Cycle Queue Clearance Time (g_c), s	10.1	21.9	1.8	9.9	34.9	34.9	9.3	21.0		8.2	24.4	
Green Ratio (*g/C*)	0.13	0.54	0.54	0.38	0.38	0.38	0.34	0.24		0.34	0.24	
Capacity (*c*), veh/h	221	1765	813	234	643	624	243	395		276	389	
Volume-to-Capacity Ratio (*X*)	0.683	0.643	0.151	0.180	0.882	0.883	0.744	0.827		0.592	0.923	
Available Capacity (c_a), veh/h	221	1765	813	234	643	624	243	395		276	389	
Back of Queue (*Q*), veh/ln (50th percentile)	4.6	6.2	0.5	0.8	15.2	14.8	4.3	9.5		3.4	12.1	
Queue Storage Ratio (*RQ*) (50th percentile)	0.83	0.00	0.10	0.14	0.00	0.00	0.77	0.00		0.61	0.00	
Uniform Delay (d_1), s/veh	52.4	11.3	4.5	21.1	26.1	26.1	30.4	37.5		29.5	38.7	
Incremental Delay (d_2), s/veh	0.7	0.2	0.0	1.7	16.1	16.6	10.4	12.8		2.3	26.9	
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	53.1	11.5	4.6	22.8	42.2	42.6	40.8	50.3		31.9	65.7	
Level of Service (LOS)	D	B	A	C	D	D	D	D		C	E	
Approach Delay, s/veh / LOS	15.3	B		41.7	D		46.9	D		55.1	E	
Intersection Delay, s/veh / LOS	34.1						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	2.2	B	1.4	A	1.3	A	1.3	A

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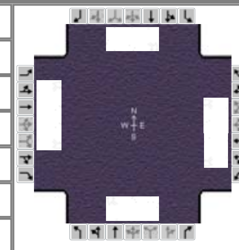
HCS 2010 Signalized Intersection Results Summary

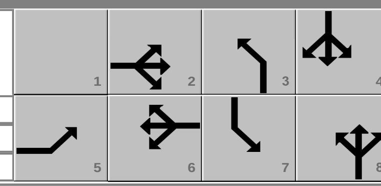
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Intersection	14TH ST.	Analysis Year	EXISTING	Analysis Period	1> 7:00
File Name	AM EXISTING.xus				
Project Description	I-229/26TH IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	180	157	66	26	898	227	247	675	7	55	460	222

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.0	31.6	8.0	2.0	30.3	0.0
Yellow	4.0	3.6	4.0	0.0	3.6	0.0
Red	1.0	1.8	1.0	0.0	2.1	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		5.3	1.1	4.0	1.1	4.0
Phase Duration, s	12.0	49.0		37.0	13.0	36.0	15.0	38.0
Change Period, (Y+R_c), s	5.0	5.4		5.4	5.0	5.7	5.0	5.7
Max Allow Headway (*MAH*), s	3.1	0.0		0.0	3.2	3.1	3.2	3.1
Queue Clearance Time (g_s), s	9.0				10.0	20.2	4.2	20.9
Green Extension Time (g_e), s	0.0	0.0		0.0	0.0	2.7	0.0	2.8
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	0.24	0.02	0.18

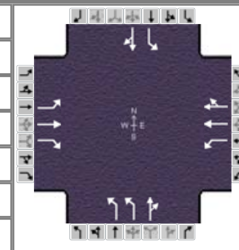
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	200	174	73	29	998	252	274	380	378	61	400	358
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	1205	1680	1496	1664	1748	1741	1664	1748	1555
Queue Service Time (g_s), s	7.0	3.1	2.9	1.9	28.3	13.8	8.0	18.2	18.2	2.2	18.8	18.9
Cycle Queue Clearance Time (g_c), s	7.0	3.1	2.9	1.9	28.3	13.8	8.0	18.2	18.2	2.2	18.8	18.9
Green Ratio (*g/C*)	0.41	0.44	0.44	0.32	0.32	0.32	0.38	0.30	0.30	0.40	0.32	0.32
Capacity (*c*), veh/h	208	1465	652	453	1062	473	285	530	528	323	564	502
Volume-to-Capacity Ratio (*X*)	0.961	0.119	0.112	0.064	0.940	0.534	0.964	0.717	0.717	0.189	0.709	0.712
Available Capacity (c_a), veh/h	208	1465	652	453	1062	473	285	530	528	323	564	502
Back of Queue (*Q*), veh/ln (50th percentile)	8.3	1.2	1.0	0.6	11.6	5.3	6.6	7.4	7.4	0.8	7.4	6.7
Queue Storage Ratio (*RQ*) (50th percentile)	1.24	0.00	0.15	0.15	0.00	1.34	1.30	0.00	0.00	0.14	0.00	0.00
Uniform Delay (d_1), s/veh	28.0	16.8	16.7	28.0	26.7	28.0	31.3	26.2	26.2	19.5	24.6	24.7
Incremental Delay (d_2), s/veh	50.8	0.2	0.3	0.2	14.4	3.6	43.2	4.0	4.0	0.1	3.5	4.1
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	78.8	16.9	17.1	28.2	41.1	31.6	74.5	30.2	30.2	19.6	28.1	28.7
Level of Service (LOS)	E	B	B	C	D	C	E	C	C	B	C	C

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	44.6	D	39.0	D	42.0	D	27.7	C
Intersection Delay, s/veh / LOS	38.0				D			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	3.0	C	2.9	C
Bicycle LOS Score / LOS	0.9	A	1.5	A	1.3	A	1.2	A

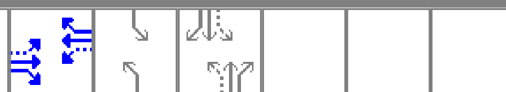
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Intersection	SOUTHEASTERN AVE.	Analysis Year	EXISTING	Analysis Period	1> 7:00
File Name	AM EXISTING.xus				
Project Description	I-229/26TH IMJR				

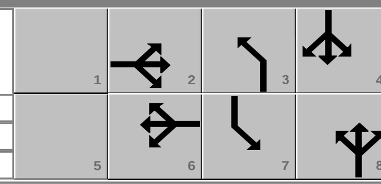


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	13	118	88	46	415	25	713	97	15	11	35	23

Signal Information			
Cycle, s	100.0	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	39.1	10.1	33.1	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	2.3	2.3	2.3	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6	3	8	7	4
Case Number		5.0		6.0	1.1	4.0	1.1	4.0
Phase Duration, s		45.0		45.0	16.0	39.0	16.0	39.0
Change Period, (Y+R_c), s		5.9		5.9	5.9	5.9	5.0	5.9
Max Allow Headway (MAH), s		0.0		0.0	3.2	3.2	3.2	3.2
Queue Clearance Time (g_s), s					12.1	7.2	2.4	4.7
Green Extension Time (g_e), s		0.0		0.0	0.0	0.3	0.0	0.3
Phase Call Probability					1.00	1.00	1.00	1.00
Max Out Probability					1.00	0.00	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	14	131	98	51	246	243	792	124		12	64	
Adjusted Saturation Flow Rate (s), veh/h/ln	904	1765	1496	1254	1765	1729	1632	1723		1681	1647	
Queue Service Time (g_s), s	1.6	5.5	5.3	2.8	9.9	9.9	10.1	5.2		0.4	2.7	
Cycle Queue Clearance Time (g_c), s	11.3	5.5	5.3	8.3	9.9	9.9	10.1	5.2		0.4	2.7	
Green Ratio (g/C)	0.39	0.39	0.39	0.39	0.39	0.39	0.43	0.33		0.44	0.33	
Capacity (c), veh/h	336	690	585	493	690	676	1230	570		609	545	
Volume-to-Capacity Ratio (X)	0.043	0.190	0.167	0.104	0.357	0.359	0.644	0.218		0.020	0.118	
Available Capacity (c_a), veh/h	336	690	585	493	690	676	1230	570		609	545	
Back of Queue (Q), veh/ln (50th percentile)	0.4	2.4	2.7	0.9	4.3	4.2	3.2	2.1		0.2	1.1	
Queue Storage Ratio (RQ) (50th percentile)	0.10	0.00	0.76	0.28	0.00	0.00	0.00	0.00		0.04	0.00	
Uniform Delay (d_1), s/veh	34.3	23.2	25.9	23.0	21.6	21.6	23.5	24.1		15.9	23.3	
Incremental Delay (d_2), s/veh	0.2	0.6	0.6	0.4	1.3	1.3	0.9	0.1		0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	34.5	23.8	26.5	23.4	22.8	22.9	24.4	24.2		15.9	23.3	
Level of Service (LOS)	C	C	C	C	C	C	C	C		B	C	
Approach Delay, s/veh / LOS	25.5		C	22.9		C	24.4		C	22.1		C
Intersection Delay, s/veh / LOS	24.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	2.4	B	2.8	C
Bicycle LOS Score / LOS	0.9	A	0.9	A	2.0	B	0.6	A

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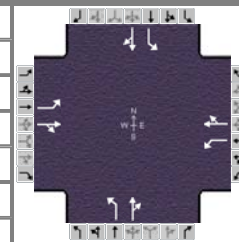
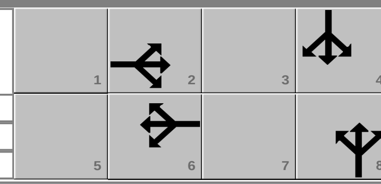
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Intersection	CLEVELAND AVE.	Analysis Year	EXISTING	Analysis Period	1> 7:00
File Name	AM EXISTING.xus				
Project Description	I-229/26TH IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	51	61	32	24	313	81	63	166	13	37	146	110

Signal Information										
Cycle, s	70.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	35.0	25.0	0.0	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		40.0		40.0		30.0		30.0
Change Period, ($Y+R_c$), s		5.0		5.0		5.0		5.0
Max Allow Headway (*MAH*), s		3.3		3.3		3.3		3.3
Queue Clearance Time (g_s), s		17.1		14.1		15.3		11.5
Green Extension Time (g_e), s		1.3		1.4		1.0		1.2
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		0.00		0.04		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	57	103		27	438		70	199		41	284	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	947	1632		1286	1705		1090	1728		1179	1625	
Queue Service Time (g_s), s	3.0	2.4		0.8	12.1		3.7	5.9		1.8	9.5	
Cycle Queue Clearance Time (g_c), s	15.1	2.4		3.2	12.1		13.3	5.9		7.7	9.5	
Green Ratio (g/C)	0.50	0.50		0.50	0.50		0.36	0.36		0.36	0.36	
Capacity (*c*), veh/h	413	816		702	853		344	617		425	580	
Volume-to-Capacity Ratio (*X*)	0.137	0.127		0.038	0.514		0.204	0.322		0.097	0.490	
Available Capacity (c_a), veh/h	413	816		702	853		344	617		425	580	
Back of Queue (*Q*), veh/ln (50th percentile)	0.6	0.8		0.2	4.1		0.9	2.2		0.5	3.3	
Queue Storage Ratio (*RQ*) (50th percentile)	0.23	0.00		0.09	0.00		0.18	0.00		0.09	0.00	
Uniform Delay (d_1), s/veh	16.8	9.3		10.2	11.8		22.7	16.3		19.1	17.5	
Incremental Delay (d_2), s/veh	0.1	0.0		0.0	0.2		0.1	0.1		0.0	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	
Control Delay (*d*), s/veh	16.9	9.4		10.2	12.0		22.8	16.5		19.2	17.8	
Level of Service (LOS)	B	A		B	B		C	B		B	B	
Approach Delay, s/veh / LOS	12.0	B		11.9	B		18.1	B		17.9	B	
Intersection Delay, s/veh / LOS	14.9						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.8	A	1.3	A	0.9	A	1.0	A

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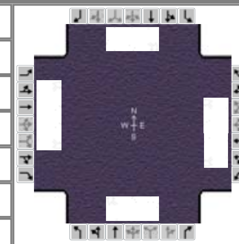
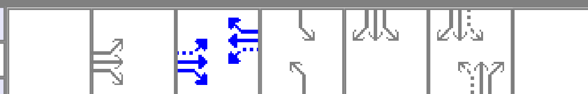
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Intersection	14TH ST.	Analysis Year	EXISTING	Analysis Period	1> 7:00
File Name	PM EXISTING.xus				
Project Description	I-229/26TH IMJR				

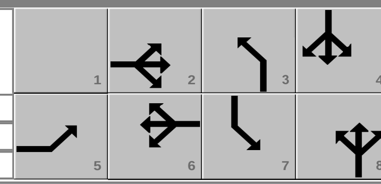


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	317	870	253	10	264	73	75	527	17	224	780	214

Signal Information			
Cycle, s	100.0	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	19.0	21.6	6.0	4.0	28.3	0.0
Yellow	4.0	3.6	4.0	0.0	3.6	0.0
Red	1.0	1.8	1.0	0.0	2.1	0.0



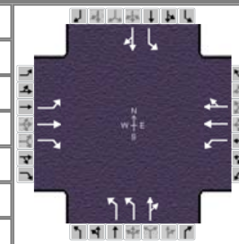
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	1.0	3.0		5.3	1.1	4.0	1.1	4.0
Phase Duration, s	24.0	51.0		27.0	11.0	34.0	15.0	38.0
Change Period, ($Y+R_c$), s	5.0	5.4		5.4	5.0	5.7	5.0	5.7
Max Allow Headway (*MAH*), s	3.1	0.0		0.0	3.2	3.1	3.2	3.1
Queue Clearance Time (g_s), s	17.2				5.4	16.1	12.0	34.3
Green Extension Time (g_e), s	0.2	0.0		0.0	0.0	3.4	0.0	0.0
Phase Call Probability	1.00				1.00	1.00	1.00	1.00
Max Out Probability	1.00				1.00	0.21	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	352	967	281	11	293	81	83	304	301	249	573	531
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	579	1680	1496	1664	1748	1728	1664	1748	1617
Queue Service Time (g_s), s	15.2	22.0	12.6	1.8	7.4	4.8	3.4	14.1	14.1	10.0	32.3	32.3
Cycle Queue Clearance Time (g_c), s	15.2	22.0	12.6	1.8	7.4	4.8	3.4	14.1	14.1	10.0	32.3	32.3
Green Ratio (*g/C*)	0.43	0.46	0.46	0.22	0.22	0.22	0.34	0.28	0.28	0.39	0.32	0.32
Capacity (*c*), veh/h	545	1532	682	197	726	323	172	495	489	353	564	522
Volume-to-Capacity Ratio (*X*)	0.647	0.631	0.412	0.056	0.404	0.251	0.485	0.614	0.615	0.706	1.016	1.017
Available Capacity (c_a), veh/h	545	1532	682	197	726	323	172	495	489	353	564	522
Back of Queue (*Q*), veh/ln (50th percentile)	6.0	8.6	4.5	0.3	3.1	1.9	1.3	5.5	5.5	4.4	18.4	17.3
Queue Storage Ratio (*RQ*) (50th percentile)	0.90	0.00	0.67	0.07	0.00	0.49	0.27	0.00	0.00	0.76	0.00	0.00
Uniform Delay (d_1), s/veh	21.5	20.8	18.2	36.5	33.1	35.6	26.2	26.7	26.7	23.6	28.5	28.5
Incremental Delay (d_2), s/veh	2.1	2.0	1.8	0.5	1.7	1.8	0.8	1.7	1.7	5.4	41.8	43.7
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	23.6	22.8	20.1	37.0	34.7	37.5	26.9	28.4	28.4	29.0	70.3	72.2
Level of Service (LOS)	C	C	C	D	C	D	C	C	C	C	F	F
Approach Delay, s/veh / LOS	22.5	C		35.4	D		28.2	C		63.4	E	
Intersection Delay, s/veh / LOS	38.5						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	0.8	A	1.1	A	1.6	A

HCS 2010 Signalized Intersection Results Summary

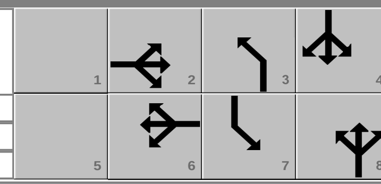
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Intersection	SOUTHEASTERN AVE.	Analysis Year	EXISTING	Analysis Period	1> 7:00
File Name	PM EXISTING.xus				
Project Description	I-229/26TH IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	25	449	637	33	189	26	147	76	39	28	64	11

Signal Information			
Cycle, s	100.0	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	50.1	16.1	16.1	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	2.3	2.3	2.3	0.0	0.0	0.0

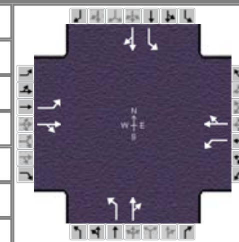


Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6	3	8	7	4
Case Number		5.0		6.0	1.1	4.0	1.1	4.0
Phase Duration, s		56.0		56.0	22.0	22.0	22.0	22.0
Change Period, (Y+R_c), s		5.9		5.9	5.9	5.9	5.0	5.9
Max Allow Headway (*MAH*), s		0.0		0.0	3.2	3.2	3.2	3.2
Queue Clearance Time (g_s), s					5.6	9.0	3.3	6.3
Green Extension Time (g_e), s		0.0		0.0	0.3	0.2	0.0	0.3
Phase Call Probability					1.00	1.00	1.00	1.00
Max Out Probability					0.00	0.02	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	28	499	708	37	121	118	163	128		31	83	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1137	1765	1496	895	1765	1690	1632	1663		1681	1719	
Queue Service Time (g_s), s	2.0	22.4	46.2	3.1	3.7	3.8	3.6	7.0		1.3	4.3	
Cycle Queue Clearance Time (g_c), s	5.6	22.4	46.2	25.5	3.7	3.8	3.6	7.0		1.3	4.3	
Green Ratio (*g/C*)	0.50	0.50	0.50	0.50	0.50	0.50	0.32	0.16		0.33	0.16	
Capacity (*c*), veh/h	599	884	749	320	884	847	927	268		472	277	
Volume-to-Capacity Ratio (*X*)	0.046	0.564	0.945	0.114	0.136	0.140	0.176	0.477		0.066	0.301	
Available Capacity (c_a), veh/h	599	884	749	320	884	847	927	268		472	277	
Back of Queue (*Q*), veh/ln (50th percentile)	0.5	9.9	3.6	0.7	1.5	1.5	1.4	2.9		0.5	1.8	
Queue Storage Ratio (*RQ*) (50th percentile)	0.15	0.00	1.02	0.23	0.00	0.00	0.00	0.00		0.12	0.00	
Uniform Delay (d_1), s/veh	21.9	22.5	33.6	27.2	13.4	13.4	24.4	38.1		23.1	37.0	
Incremental Delay (d_2), s/veh	0.1	1.9	17.4	0.7	0.3	0.3	0.0	0.5		0.0	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	0.0	
Control Delay (*d*), s/veh	22.0	24.4	50.9	27.9	13.7	13.7	24.4	38.6		23.1	37.2	
Level of Service (LOS)	C	C	D	C	B	B	C	D		C	D	
Approach Delay, s/veh / LOS	39.5		D	15.6		B	30.7		C	33.4		C
Intersection Delay, s/veh / LOS	34.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	2.5	B	2.8	C
Bicycle LOS Score / LOS	2.5	B	0.7	A	1.0	A	0.7	A

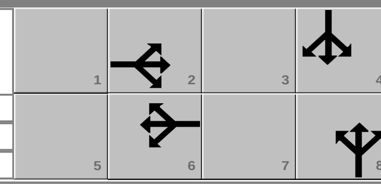
HCS 2010 Signalized Intersection Results Summary



General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Intersection	CLEVELAND AVE.	Analysis Year	EXISTING	Analysis Period	1> 7:00
File Name	PM EXISTING.xus				
Project Description	I-229/26TH IMJR				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	120	354	42	14	125	46	43	205	36	65	259	80

Signal Information										
Cycle, s	70.0	Reference Phase	2							
Offset, s	0	Reference Point	End	Green	35.0	25.0	0.0	0.0	0.0	0.0
Uncoordinated	Yes	Simult. Gap E/W	On	Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		40.0		40.0		30.0		30.0
Change Period, ($Y+R_c$), s		5.0		5.0		5.0		5.0
Max Allow Headway (*MAH*), s		3.2		3.2		3.3		3.3
Queue Clearance Time (g_s), s		14.2		15.0		17.9		15.0
Green Extension Time (g_e), s		1.7		1.6		1.2		1.4
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.00		0.00		0.22		0.07

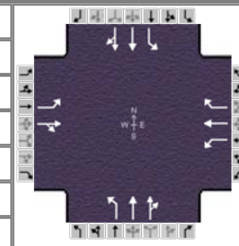
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	133	440		16	190		48	268		72	377	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1188	1701		945	1686		1002	1705		1107	1679	
Queue Service Time (g_s), s	5.0	12.2		0.8	4.4		2.9	8.4		3.7	13.0	
Cycle Queue Clearance Time (g_c), s	9.4	12.2		13.0	4.4		15.9	8.4		12.1	13.0	
Green Ratio (*g/C*)	0.50	0.50		0.50	0.50		0.36	0.36		0.36	0.36	
Capacity (*c*), veh/h	622	850		411	843		274	609		366	600	
Volume-to-Capacity Ratio (*X*)	0.214	0.517		0.038	0.225		0.174	0.440		0.198	0.628	
Available Capacity (c_a), veh/h	622	850		411	843		274	609		366	600	
Back of Queue (*Q*), veh/ln (50th percentile)	1.2	4.1		0.2	1.5		0.7	3.1		0.9	4.9	
Queue Storage Ratio (*RQ*) (50th percentile)	0.44	0.00		0.07	0.00		0.13	0.00		0.18	0.00	
Uniform Delay (d_1), s/veh	12.5	11.8		16.2	9.9		25.2	17.2		21.8	18.6	
Incremental Delay (d_2), s/veh	0.1	0.2		0.0	0.0		0.1	0.2		0.1	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	
Control Delay (*d*), s/veh	12.6	12.0		16.2	9.9		25.4	17.3		21.9	20.2	
Level of Service (LOS)	B	B		B	A		C	B		C	C	
Approach Delay, s/veh / LOS	12.1	B		10.4	B		18.6	B		20.5	C	
Intersection Delay, s/veh / LOS	15.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.4	A	0.8	A	1.0	A	1.2	A

 HCS 2010™ Streets Version 6.60 Generated: 8/25/2014 10:14:54 AM

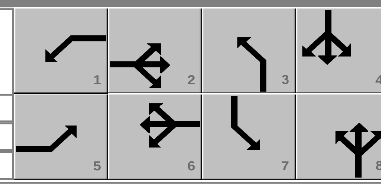
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	CLIFF AVENUE	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING AM phf.xus				
Project Description	AM PEAK				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	98	300	87	47	579	280	131	716	16	102	288	72

Signal Information										
Cycle, s	134.0	Reference Phase	2							
Offset, s	92	Reference Point	Begin	Green	5.4	50.0	7.4	3.4	44.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.4	1.0	1.0	1.4	0.0



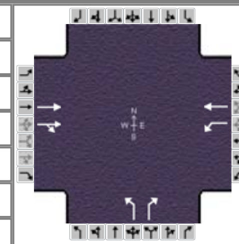
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	55.0	10.0	55.0	20.0	57.0	12.0	49.0
Change Period, ($Y+R_c$), s	4.6	5.0	4.6	5.0	4.6	5.0	4.6	5.0
Max Allow Headway (MAH), s	3.2	0.0	3.2	0.0	3.2	3.1	3.2	3.1
Queue Clearance Time (g_s), s	7.4		4.1		9.0	26.9	8.1	14.2
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.1	2.4	0.0	2.4
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		0.03	0.00	1.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	109	421		43	534	230	146	406	403	113	201	191
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1700		1681	1765	1486	1657	1739	1729	1640	1722	1604
Queue Service Time (g_s), s	5.4	24.9		2.1	35.7	15.9	7.0	24.9	24.9	6.1	11.9	12.2
Cycle Queue Clearance Time (g_c), s	5.4	24.9		2.1	35.7	15.9	7.0	24.9	24.9	6.1	11.9	12.2
Green Ratio (g/C)	0.41	0.37		0.41	0.37	0.37	0.46	0.39	0.39	0.38	0.33	0.33
Capacity (c), veh/h	200	634		287	658	554	475	675	671	267	565	527
Volume-to-Capacity Ratio (X)	0.545	0.664		0.151	0.811	0.416	0.306	0.601	0.601	0.425	0.355	0.363
Available Capacity (c_a), veh/h	200	634		287	658	554	475	675	671	267	565	527
Back of Queue (Q), veh/ln (50th percentile)	2.3	10.3		0.8	16.6	6.2	2.8	10.7	10.7	2.5	5.0	4.8
Queue Storage Ratio (RQ) (50th percentile)	0.72	0.00		0.22	0.00	1.59	0.45	0.00	0.00	0.58	0.00	0.00
Uniform Delay (d_1), s/veh	30.8	27.4		26.6	35.1	32.6	22.4	32.7	32.7	29.0	34.2	34.3
Incremental Delay (d_2), s/veh	1.7	5.4		0.1	9.0	2.0	0.1	1.1	1.1	0.4	0.1	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	0.0	0.0
Control Delay (d), s/veh	32.5	32.8		26.7	44.1	34.6	22.6	33.8	33.8	29.4	34.4	34.5
Level of Service (LOS)	C	C		C	D	C	C	C	C	C	C	C
Approach Delay, s/veh / LOS	32.7	C		40.5	D		32.1	C		33.3	C	
Intersection Delay, s/veh / LOS	34.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	3.1	C	2.8	C	2.6	B
Bicycle LOS Score / LOS	3.0	C	3.7	D	3.2	C	2.8	C

HCS 2010 Signalized Intersection Results Summary

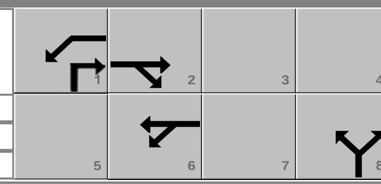
General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	YEAGER ROAD	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING AM phf.xus				
Project Description	AM PEAK				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		410	49	812	767		126		170			

Signal Information			
Cycle, s	134.0	Reference Phase	2
Offset, s	41	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	79.5	21.5	17.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.9	1.9	1.0	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		27.0	85.0	112.0		22.0		
Change Period, (Y+R_c), s		5.5	5.5	5.5		5.0		
Max Allow Headway (MAH), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (g_s), s			30.6			13.6		
Green Extension Time (g_e), s		0.0	1.8	0.0		0.2		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			0.88		

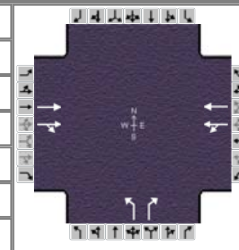
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		232	227	735	694		140		167			
Adjusted Saturation Flow Rate (s), veh/h/ln		1725	1671	1869	1852		1549		1549			
Queue Service Time (g_s), s		19.0	17.1	28.6	15.5		11.6		4.5			
Cycle Queue Clearance Time (g_c), s		19.0	17.1	28.6	15.5		11.6		4.5			
Green Ratio (g/C)		0.16	0.16	0.77	0.79		0.13		0.72			
Capacity (c), veh/h		277	268	1183	1472		196		1115			
Volume-to-Capacity Ratio (X)		0.839	0.846	0.621	0.472		0.713		0.149			
Available Capacity (c_a), veh/h		277	268	1183	1472		196		1115			
Back of Queue (Q), veh/ln (50th percentile)		7.9	7.9	14.4	4.7		5.1		1.4			
Queue Storage Ratio (RQ) (50th percentile)		0.00	0.00	0.00	0.00		1.29		0.00			
Uniform Delay (d_1), s/veh		44.7	45.6	13.8	4.1		56.2		5.9			
Incremental Delay (d_2), s/veh		20.2	21.5	0.1	0.1		9.9		0.0			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		64.9	67.1	13.8	4.2		66.1		5.9			
Level of Service (LOS)		E	E	B	A		E		A			

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	66.0	E	9.2	A	33.4	C	0.0	
Intersection Delay, s/veh / LOS	24.4				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	0.6	A	3.1	C	2.7	B
Bicycle LOS Score / LOS	2.6	B	5.6	F		F		

HCS 2010 Signalized Intersection Results Summary

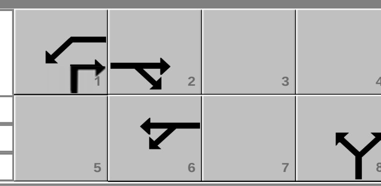
General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	I-229 NORTHBOUND	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING AM phf.xus				
Project Description	AM PEAK				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		472	108	373	1472		107		382			

Signal Information				
Cycle, s	134.0	Reference Phase	2	
Offset, s	19	Reference Point	Begin	
Uncoordinated	No	Simult. Gap E/W	On	
Force Mode	Fixed	Simult. Gap N/S	On	

Green	5.0	96.9	17.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.9	1.0	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	0.0	14.0		9.0		
Phase Duration, s		102.4	9.6	112.0		22.0		
Change Period, ($Y+R_c$), s		5.5	4.6	5.5		5.0		
Max Allow Headway (*MAH*), s		0.0	0.0	0.0		3.1		
Queue Clearance Time (g_s), s						19.0		
Green Extension Time (g_e), s		0.0	0.0	0.0		0.0		
Phase Call Probability						1.00		
Max Out Probability						1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		301	291	401	1582		119		380			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1747	1672	153	1649		1471		1511			
Queue Service Time (g_s), s		20.7	22.5	5.0	104.6		10.3		17.0			
Cycle Queue Clearance Time (g_c), s		20.7	22.5	5.0	104.6		10.3		17.0			
Green Ratio (*g/C*)		0.22	0.22	0.79	0.79		0.13		0.16			
Capacity (*c*), veh/h		389	1209	175	1310		187		248			
Volume-to-Capacity Ratio (*X*)		0.776	0.241	2.291	1.207		0.637		1.531			
Available Capacity (c_a), veh/h		389	1209	175	1310		187		248			
Back of Queue (*Q*), veh/ln (50th percentile)		11.4	10.0	32.4	65.4		4.0		26.0			
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.00	0.00	0.00		0.35		0.00			
Uniform Delay (d_1), s/veh		25.2	54.4	41.5	14.6		55.6		56.0			
Incremental Delay (d_2), s/veh		10.5	0.3	582.5	93.9		5.5		258.4			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		35.6	54.7	624.0	108.5		61.0		314.4			
Level of Service (LOS)		D	D	F	F		E		F			
Approach Delay, s/veh / LOS	45.0		D	212.7		F	254.0		F	0.0		
Intersection Delay, s/veh / LOS	187.1						F					

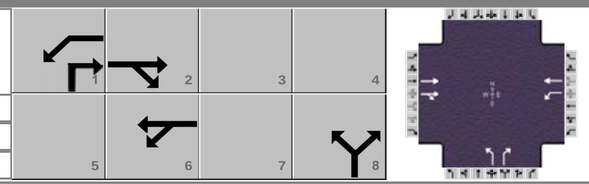
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	0.6	A	3.2	C	3.1	C
Bicycle LOS Score / LOS	3.2	C	3.3	C		F		

HCS 2010 Interchanges Results Summary

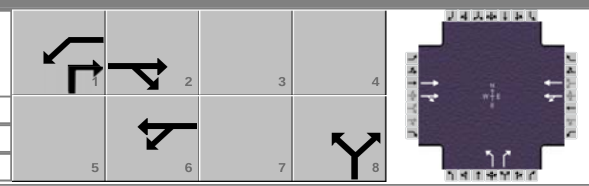
General Information				Interchange Information	
Agency	SDDOT/Sioux Falls			Interchange Type	Parclo A-2Q
Analyst	HDR	Analysis Date	Sep 18, 2012	Segment Distance, ft	1082
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-229 NORTHBOUND	PHF	0.90	Arterial Direction	East-West
File Name	26TH EXISTING AM phf.xus				
Project Description	AM PEAK				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		410	49	812	767		126		170			
Intersection Two Demand (*v*), veh/h		472	108	373	1472		107		382			

Signal One Information								
Cycle, s	134.0							
Offset, s	19	Green	79.5	21.5	17.0	0.0	0.0	0.0
Uncoordinated	No	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Force Mode	Fixed	Red	1.9	1.9	1.0	0.0	0.0	0.0



Signal Two Information								
Cycle, s	134.0							
Offset, s	19	Green	5.0	96.9	17.0	0.0	0.0	0.0
Uncoordinated	No	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Force Mode	Fixed	Red	1.0	1.9	1.0	0.0	0.0	0.0



Interchange Results

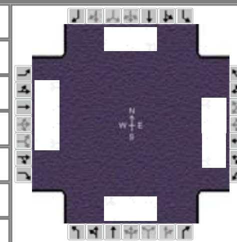
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	119	NBL(II) + NBT(II) + WBT(I)	65.2	D
B	NBR	380	NBT(II)	314.4	F
C	SBR	0	SBT(I)	0.0	A
D	SBL - SBU	0	SBL(I) + SBT(I) - EBT(II)	35.6	C
E	EBR(INT) - SBU	102	EBT(II) + EBT(I)	119.6	E
F	EBL(EXT)	0	EBL(I) + EBT(I)	0.0	A
G	WBL(EXT)	401	WBL(II) + WBT(II)	624.0	F
H	WBR(INT) - NBU	0	WBT(I) + WBT(II)	108.5	F
I	EBT(INT) - SBL + SBU	490	EBT(I) + EBT(II)	100.6	E
J	WBT(INT) - NBL + NBU	575	WBT(I) + WBT(II)	112.7	F
K		-		-	-
L		-		-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		64.9	67.1	13.8	4.2		66.1		5.9			
Level of Service (LOS)		E	E	B	A		E		A			
Approach Delay, s/veh / LOS	66.0	E		9.2	A		33.4	C		0.0		
Intersection Delay, s/veh / LOS	24.4						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		35.6	54.7	624.0	108.5		61.0		314.4			
Level of Service (LOS)		D	D	F	F		E		F			
Approach Delay, s/veh / LOS	45.0	D		212.7	F		254.0	F		0.0		
Intersection Delay, s/veh / LOS	187.1						F					

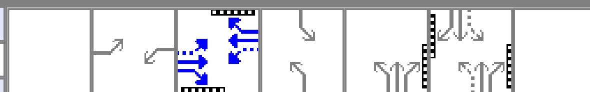
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	SOUTHEASTERN AVE.	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING AM phf.xus				
Project Description	AM PEAK				

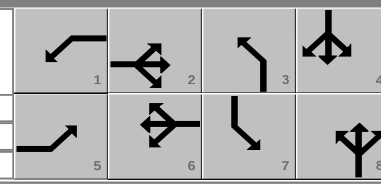


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	60	657	137	42	1213	251	590	514	88	59	68	42

Signal Information			
Cycle, s	134.0	Reference Phase	2
Offset, s	130	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.1	50.3	9.1	29.1	14.3	0.0
Yellow	3.9	3.9	3.9	3.9	3.9	0.0
Red	1.0	1.8	1.0	1.0	1.8	0.0



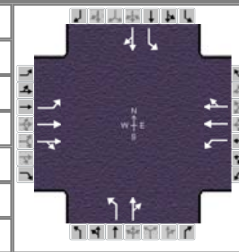
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	3.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	56.0	10.0	56.0	48.0	54.0	14.0	20.0
Change Period, ($Y+R_c$), s	4.9	5.7	4.9	5.7	4.9	5.7	4.9	5.7
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0	3.1	3.1	3.2	3.1
Queue Clearance Time (g_s), s	4.6		4.2		45.1	22.3	6.5	6.6
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	1.5	0.0	1.1
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	0.00	1.00	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	53	585	0	47	1348	246	656	336	322	66	59	57
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1672	1672	1482	1706	1705	1516	1681	1765	1683	1681	1765	1563
Queue Service Time (g_s), s	2.6	21.0	0.0	2.2	50.3	9.1	43.1	20.1	20.3	4.5	4.2	4.6
Cycle Queue Clearance Time (g_c), s	2.6	21.0	0.0	2.2	50.3	9.1	43.1	20.1	20.3	4.5	4.2	4.6
Green Ratio (*g/C*)	0.41	0.38	0.38	0.41	0.38	0.38	0.44	0.36	0.36	0.17	0.11	0.11
Capacity (*c*), veh/h	117	1255	556	290	1280	569	687	636	607	250	188	167
Volume-to-Capacity Ratio (*X*)	0.455	0.466	0.000	0.161	1.053	0.432	0.955	0.528	0.531	0.262	0.314	0.345
Available Capacity (c_a), veh/h	117	1255	556	290	1280	569	687	636	607	250	188	167
Back of Queue (*Q*), veh/ln (50th percentile)	1.9	9.3	0.0	0.9	22.0	2.6	23.4	8.7	8.3	1.9	1.9	1.8
Queue Storage Ratio (*RQ*) (50th percentile)	0.96	0.00	0.00	0.22	0.00	0.26	1.98	0.00	0.00	0.44	0.00	0.00
Uniform Delay (d_1), s/veh	34.3	42.9	0.0	26.8	25.2	13.5	35.1	33.8	33.9	47.5	55.3	55.5
Incremental Delay (d_2), s/veh	0.1	0.1	0.0	0.1	35.5	1.5	23.5	0.4	0.5	0.2	0.4	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	34.4	43.0	0.0	26.9	60.7	15.0	58.7	34.3	34.3	47.7	55.7	56.0
Level of Service (LOS)	C	D		C	F	B	E	C	C	D	E	E
Approach Delay, s/veh / LOS	42.3	D		52.9	D		46.5	D		52.9	D	
Intersection Delay, s/veh / LOS	48.9						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.0	C	3.3	C	3.6	D
Bicycle LOS Score / LOS	3.5	C	4.2	D	4.0	D	3.1	C

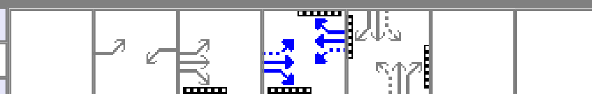
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	CLEVELAND AVE.	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING AM phf.xus				
Project Description	AM PEAK				

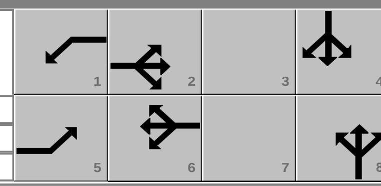


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	100	686	18	6	1308	91	57	51	16	46	15	141

Signal Information			
Cycle, s	134.0	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	5.4	3.4	78.0	27.5	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	1.0	1.0	1.4	1.9	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		6.0
Phase Duration, s	18.0	91.0	10.0	83.0		33.0		33.0
Change Period, ($Y+R_c$), s	4.6	5.0	4.6	5.0		5.5		5.5
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0		3.4		3.4
Queue Clearance Time (g_s), s	4.5		2.2			20.8		14.3
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0		0.5		0.6
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		0.97			0.10		0.00

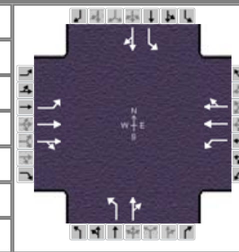
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	93	328	325	7	777	766	63	72		51	157	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1655	1738	1724	1689	1774	1736	1225	1682		1323	1514	
Queue Service Time (g_s), s	2.5	6.5	6.4	0.2	40.8	41.3	6.5	4.8		4.5	12.3	
Cycle Queue Clearance Time (g_c), s	2.5	6.5	6.4	0.2	40.8	41.3	18.8	4.8		9.3	12.3	
Green Ratio (*g/C*)	0.70	0.64	0.64	0.62	0.58	0.58	0.21	0.21		0.21	0.21	
Capacity (*c*), veh/h	309	1116	1106	573	1032	1011	193	345		278	311	
Volume-to-Capacity Ratio (*X*)	0.301	0.294	0.294	0.012	0.753	0.758	0.329	0.209		0.184	0.504	
Available Capacity (c_a), veh/h	309	1116	1106	573	1032	1011	193	345		278	311	
Back of Queue (*Q*), veh/ln (50th percentile)	1.3	2.3	2.2	0.1	16.6	16.5	2.0	2.0		1.5	4.7	
Queue Storage Ratio (*RQ*) (50th percentile)	0.23	0.00	0.00	0.02	0.00	0.00	0.64	0.00		0.32	0.00	
Uniform Delay (d_1), s/veh	18.0	5.4	5.2	9.5	17.5	17.5	55.5	44.2		48.1	47.2	
Incremental Delay (d_2), s/veh	0.2	0.6	0.6	0.0	4.3	4.6	0.4	0.1		0.1	0.5	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	18.1	6.0	5.8	9.5	21.8	22.1	55.9	44.3		48.2	47.7	
Level of Service (LOS)	B	A	A	A	C	C	E	D		D	D	
Approach Delay, s/veh / LOS	7.4		A	21.9		C	49.7		D	47.8		D
Intersection Delay, s/veh / LOS	21.3						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.5	B	3.2	C	3.3	C
Bicycle LOS Score / LOS	2.8	C	3.4	C	2.7	B	2.8	C

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 9:58:46 AM

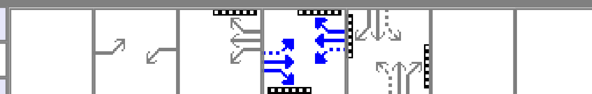
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	VILLAGE SQUARE PLACE	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING AM phf.xus				
Project Description	AM PEAK				

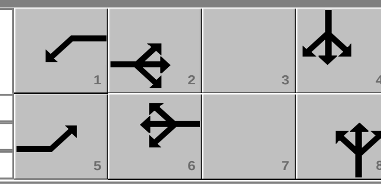


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	4	733	11	9	1311	3	72	1	42	9	0	22

Signal Information			
Cycle, s	134.0	Reference Phase	2
Offset, s	69	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	0.7	0.9	106.0	11.6	0.0	0.0
Yellow	3.6	0.0	3.6	3.2	0.0	0.0
Red	1.0	0.0	1.4	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		6.0
Phase Duration, s	5.3	111.0	6.2	111.9		16.8		16.8
Change Period, (*Y+Rc*), s	4.6	5.0	4.6	5.0		5.2		5.2
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0		3.4		3.4
Queue Clearance Time (g_s), s	2.1		2.2			11.4		6.4
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.3		0.3
Phase Call Probability	0.13		0.31			1.00		1.00
Max Out Probability	0.00		0.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	4	351	350	10	730	729	80	42		10	22	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1672	1756	1748	1689	1774	1773	1397	1516		1372	1510	
Queue Service Time (g_s), s	0.1	7.9	7.9	0.2	0.0	0.0	7.5	3.5		0.9	1.8	
Cycle Queue Clearance Time (g_c), s	0.1	7.9	7.9	0.2	0.0	0.0	9.4	3.5		4.4	1.8	
Green Ratio (*g/C*)	0.80	0.79	0.79	0.80	0.80	0.80	0.09	0.09		0.09	0.09	
Capacity (*c*), veh/h	344	1389	1383	619	1415	1414	157	132		138	132	
Volume-to-Capacity Ratio (*X*)	0.011	0.253	0.253	0.016	0.516	0.516	0.511	0.320		0.073	0.169	
Available Capacity (c_a), veh/h	604	1389	1383	870	1415	1414	325	315		303	313	
Back of Queue (*Q*), veh/ln (50th percentile)	0.0	2.7	2.7	0.0	0.5	0.5	2.7	1.4		0.3	0.7	
Queue Storage Ratio (*RQ*) (50th percentile)	0.01	0.00	0.00	0.02	0.00	0.00	1.38	0.00		0.17	0.00	
Uniform Delay (d_1), s/veh	2.8	4.2	4.3	2.9	0.0	0.0	61.0	57.4		59.5	56.7	
Incremental Delay (d_2), s/veh	0.0	0.4	0.4	0.0	1.3	1.3	1.0	0.5		0.1	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	0.0	
Control Delay (*d*), s/veh	2.8	4.7	4.7	2.9	1.3	1.3	62.0	58.0		59.6	56.9	
Level of Service (LOS)	A	A	A	A	A	A	E	E		E	E	
Approach Delay, s/veh / LOS	4.7		A	1.4		A	60.6		E	57.7		E
Intersection Delay, s/veh / LOS	6.2						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	3.2	C	3.3	C
Bicycle LOS Score / LOS	2.8	C	3.3	C	2.7	B	2.5	B

This Urban Streets text report was created on August 21, 2014 at 02:34:33

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	6
Number of Segments	5
Analysis period duration, h	0.25
System cycle length, s	134
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	50
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

Saturation Flowrate of 1800 was used, program printout indicates 1900 but that is incorrect.

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	30	30	2	1	2143	2143	36	36	0	0	100	100	0	0
2	30	30	2	1	1082	1082	36	48	0	0	0	100	0	0
3	30	30	2	2	1280	1280	48	60	0	0	0	0	0	0
4	30	30	2	2	771	771	48	60	0	0	100	100	0	0
5	30	30	2	2	1214	1214	36	36	0	0	100	100	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

SEGMENT 5

Number of access points: 0

Global Output

SEGMENT DATA

		EB	EB	EB	WB	WB	WB
		LT	TH	RT	LT	TH	RT
Seg.No.	Movement	5	2	12	1	6	16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h			1001.3	999		999.57
1	Base Free-Flow Speed, mph		38.06			36.88	
1	Running Time, s		40.47			43.54	
1	Running Speed, mph		36.11			33.56	
1	Through Delay, s/veh		65.99			44.11	
1	Travel Speed, mph		13.72			16.67	
1	Stop Rate, stops/veh		0.92			0.83	
1	Spatial Stop Rate, stops/mi		2.28			2.06	
1	Through vol/cap ratio		0.84			0.81	
1	Percent of Base FFS		36.06			45.19	
1	Level of Service		E			D	
1	Automobile Perception Score		2.72			2.46	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h						
2	Base Free-Flow Speed, mph		39.7			39.23	
2	Running Time, s		21.75			24.6	
2	Running Speed, mph		33.92			29.98	
2	Through Delay, s/veh		42.85			4.33	
2	Travel Speed, mph		11.42			25.5	
2	Stop Rate, stops/veh		0.98			0.19	
2	Spatial Stop Rate, stops/mi		4.79			0.92	
2	Through vol/cap ratio		0.56			0.48	
2	Percent of Base FFS		28.77			65	
2	Level of Service		F			C	
2	Automobile Perception Score		3.18			2.49	
3	Bay/Lane Spillback Time, h	999	999	999	0	0.91	999
3	ShrdLane Spillback Time, h	999		999			
3	Base Free-Flow Speed, mph		38.7			38.69	
3	Running Time, s		24.3			26.61	
3	Running Speed, mph		35.91			32.79	
3	Through Delay, s/veh		42.58			74.65	
3	Travel Speed, mph		13.05			8.62	
3	Stop Rate, stops/veh		0.85			0.89	
3	Spatial Stop Rate, stops/mi		3.51			3.69	
3	Through vol/cap ratio		0.46			1.11	
3	Percent of Base FFS		33.72			22.28	
3	Level of Service		E			F	
3	Automobile Perception Score		2.7			2.73	
4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999			1001.2		999.21
4	Base Free-Flow Speed, mph		39.23			39.23	
4	Running Time, s		17.31			17.78	
4	Running Speed, mph		30.37			29.57	
4	Through Delay, s/veh		5.81			36.15	
4	Travel Speed, mph		22.74			9.75	
4	Stop Rate, stops/veh		0.18			0.7	
4	Spatial Stop Rate, stops/mi		1.25			4.81	
4	Through vol/cap ratio		0.29			0.95	
4	Percent of Base FFS		57.97			24.85	
4	Level of Service		C			F	
4	Automobile Perception Score		2.33			2.93	
5	Bay/Lane Spillback Time, h	999	999	999	999	999	999
5	ShrdLane Spillback Time, h	999			999		
5	Base Free-Flow Speed, mph		37.48			37.48	
5	Running Time, s		25.04			25.69	
5	Running Speed, mph		33.05			32.21	
5	Through Delay, s/veh		4.41			19.6	
5	Travel Speed, mph		28.1			18.27	
5	Stop Rate, stops/veh		0.2			0.53	

5	Spatial Stop Rate, stops/mi	0.86	2.29
5	Through vol/cap ratio	0.24	0.68
5	Percent of Base FFS	74.98	48.75
5	Level of Service	B	D
5	Automobile Perception Score	2.27	2.49

Facility Travel Time, s	290.51	317.07
Facility Travel Speed, mph	15.23	13.96
Facility Spatial Stop Rate, veh/mi	2.55	2.56
Facility Base Free Flow Speed, mph	38.47	38
Facility Percent Base Free Flow Speed	39.59	36.73
Facility Level of Service	E	E
Facility Automobile Perception Score	2.63	2.57
Facility Pedestrian Space	0	0
Facility Pedestrian Travel Speed	2.6	3.31
Facility Pedestrian LOS Score	4.13	4.31
Facility Pedestrian LOS	F	F
Facility Bicycle Travel Speed	10.83	12.98
Facility Bicycle LOS Score	4.41	4.97
Facility Bicycle LOS	E	E
Facility Transit Travel Speed	13.85	16.67
Facility Transit LOS Score	5.78	5.94
Facility Transit LOS	F	F
SPILLBACK TIME, h	0.91	

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	4.74	6.06
1	Ped LOS Score for Intersection	2.87	3.09
1	Ped LOS Score for Segment	4.5	5.05
1	Ped Segment LOS	F	
1	Bicycle LOS Score for Link	3.81	4.41
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	2.61	3.72
1	Number of access point approaches	18	20
1	Segment Length, ft	2143	2143
1	Bicycle LOS Score for Segment	5.16	5.73
1	Bicycle Segment LOS	F	F
1	Transit Wait-Ride Score	0.92	1
1	Ped LOS Score for Link	4.74	6.06
1	Transit LOS Score for Segment	5.32	5.41
1	Transit Segment LOS	F	F
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	3.85	5.31
2	Ped LOS Score for Intersection	2.59	0.64
2	Ped LOS Score for Segment	4.08	4.12
2	Ped Segment LOS	D	D
2	Bicycle LOS Score for Link	3.62	4.6
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	3.13	5.27
2	Number of access point approaches	0	0
2	Segment Length, ft	1082	1082
2	Bicycle LOS Score for Segment	3.68	5.72
2	Bicycle Segment LOS	D	F
2	Transit Wait-Ride Score	0	0
2	Ped LOS Score for Link	3.85	5.31
2	Transit LOS Score for Segment	6.58	6.8
2	Transit Segment LOS	F	F
3	Roadway crossing difficulty factor	1.2	1.2
3	Ped LOS Score for Link	4.12	4.14
3	Ped LOS Score for Intersection	3.18	0.64
3	Ped LOS Score for Segment	4.34	3.67
3	Ped Segment LOS	E	D
3	Bicycle LOS Score for Link	3.81	4.44
3	Indicator Variable	1	1

3	Bicycle LOS Score for Intersection	3.41	3.08
3	Number of access point approaches	4	1
3	Segment Length, ft	1280	1280
3	Bicycle LOS Score for Segment	4.37	3.94
3	Bicycle Segment LOS	E	D
3	Transit Wait-Ride Score	0	0
3	Ped LOS Score for Link	4.12	4.14
3	Transit LOS Score for Segment	6.62	6.62
3	Transit Segment LOS	F	F
4	Roadway crossing difficulty factor	1.2	1.2
4	Ped LOS Score for Link	2.81	3.67
4	Ped LOS Score for Intersection	2.35	3.01
4	Ped LOS Score for Segment	3.62	4.12
4	Ped Segment LOS	D	D
4	Bicycle LOS Score for Link	3.9	4.24
4	Indicator Variable	1	1
4	Bicycle LOS Score for Intersection	2.77	4.03
4	Number of access point approaches	0	0
4	Segment Length, ft	771	771
4	Bicycle LOS Score for Segment	3.65	4.15
4	Bicycle Segment LOS	D	D
4	Transit Wait-Ride Score	0	0
4	Ped LOS Score for Link	2.81	3.67
4	Transit LOS Score for Segment	6.42	6.55
4	Transit Segment LOS	F	F
5	Roadway crossing difficulty factor	1.2	1.2
5	Ped LOS Score for Link	2.82	3.62
5	Ped LOS Score for Intersection	2.35	2.47
5	Ped LOS Score for Segment	3.62	3.96
5	Ped Segment LOS	D	D
5	Bicycle LOS Score for Link	3.94	4.29
5	Indicator Variable	1	1
5	Bicycle LOS Score for Intersection	2.73	3.26
5	Number of access point approaches	4	5
5	Segment Length, ft	1214	1214
5	Bicycle LOS Score for Segment	4.26	4.58
5	Bicycle Segment LOS	E	E
5	Transit Wait-Ride Score	1.22	1.03
5	Ped LOS Score for Link	2.82	3.62
5	Transit LOS Score for Segment	4.59	4.99
5	Transit Segment LOS	E	E

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

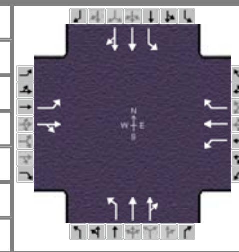
SEGMENT 3

SEGMENT 4

SEGMENT 5

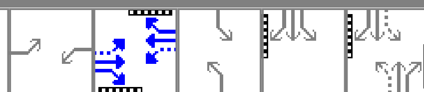
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	CLIFF AVENUE	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING PM phf.xus				
Project Description	PM PEAK				

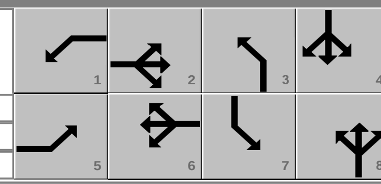


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	58	393	38	69	375	66	79	367	47	299	858	110

Signal Information			
Cycle, s	146.0	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	8.4	35.0	5.4	23.4	50.0	0.0
Yellow	3.6	3.6	3.6	3.6	3.6	0.0
Red	1.0	1.4	1.0	1.0	1.4	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	13.0	40.0	13.0	40.0	10.0	55.0	38.0	83.0
Change Period, ($Y+R_c$), s	4.6	5.0	4.6	5.0	4.6	5.0	4.6	5.0
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0	3.2	3.1	3.2	3.1
Queue Clearance Time (g_s), s	6.1		6.4		7.1	16.8	17.4	33.4
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	3.4	0.6	3.4
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	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	64	474		69	377	59	88	230	224	332	543	521
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1739		1681	1765	1484	1657	1739	1675	1640	1722	1651
Queue Service Time (g_s), s	4.1	35.0		4.4	30.3	4.6	5.1	14.6	14.8	15.4	31.3	31.4
Cycle Queue Clearance Time (g_c), s	4.1	35.0		4.4	30.3	4.6	5.1	14.6	14.8	15.4	31.3	31.4
Green Ratio (*g/C*)	0.30	0.24		0.30	0.24	0.24	0.38	0.34	0.34	0.58	0.53	0.53
Capacity (*c*), veh/h	165	417		146	423	356	270	596	574	644	920	882
Volume-to-Capacity Ratio (*X*)	0.391	1.138		0.475	0.890	0.167	0.325	0.387	0.391	0.516	0.591	0.591
Available Capacity (c_a), veh/h	165	417		146	423	356	270	596	574	644	920	882
Back of Queue (*Q*), veh/ln (50th percentile)	1.7	24.7		1.9	16.3	2.0	2.1	6.3	6.2	5.9	12.9	12.4
Queue Storage Ratio (*RQ*) (50th percentile)	0.54	0.00		0.48	0.00	0.52	0.33	0.00	0.00	1.37	0.00	0.00
Uniform Delay (d_1), s/veh	40.4	49.7		41.8	55.7	44.2	29.8	36.4	36.4	17.3	23.1	23.1
Incremental Delay (d_2), s/veh	0.6	87.3		0.9	22.7	1.0	0.3	0.2	0.2	0.3	0.7	0.7
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	41.0	137.0		42.7	78.4	45.1	30.1	36.5	36.6	17.6	23.8	23.9
Level of Service (LOS)	D	F		D	E	D	C	D	D	B	C	C
Approach Delay, s/veh / LOS	125.5	F		69.6	E		35.5	D		22.4	C	
Intersection Delay, s/veh / LOS	51.4						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	2.7	B	2.6	B
Bicycle LOS Score / LOS	3.0	C	3.0	C	2.8	C	3.5	D

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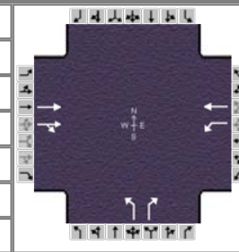
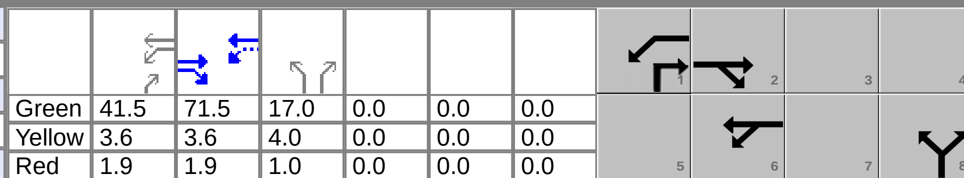
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	YEAGER ROAD	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING PM phf.xus				
Project Description	PM PEAK				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		665	74	513	438		75		484			

Signal Information										
Cycle, s	146.0	Reference Phase	2							
Offset, s	111	Reference Point	Begin	Green	41.5	71.5	17.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.9	1.9	1.0	0.0	0.0	0.0



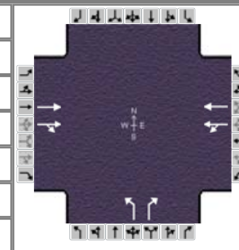
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		8.3	1.0	4.0		9.0		
Phase Duration, s		77.0	47.0	124.0		22.0		
Change Period, ($Y+R_c$), s		5.5	5.5	5.5		5.0		
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (g_s), s			16.6			19.0		
Green Extension Time (g_e), s		0.0	1.3	0.0		0.0		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		387	376	570	487		83		516			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1785	1728	1811	1795		1530		1530			
Queue Service Time (g_s), s		22.6	18.4	14.6	6.9		7.4		17.0			
Cycle Queue Clearance Time (g_c), s		22.6	18.4	14.6	6.9		7.4		17.0			
Green Ratio (*g/C*)		0.49	0.49	0.79	0.81		0.12		0.40			
Capacity (*c*), veh/h		874	846	819	1457		178		613			
Volume-to-Capacity Ratio (*X*)		0.443	0.444	0.696	0.334		0.468		0.841			
Available Capacity (c_a), veh/h		874	846	819	1457		178		613			
Back of Queue (*Q*), veh/ln (50th percentile)		6.9	7.3	6.2	2.0		2.9		18.1			
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.00	0.00	0.00		0.74		0.00			
Uniform Delay (d_1), s/veh		18.5	20.2	9.6	2.1		60.3		39.5			
Incremental Delay (d_2), s/veh		0.7	0.7	1.6	0.5		0.7		9.7			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		19.2	20.9	11.2	2.6		61.0		49.2			
Level of Service (LOS)		B	C	B	A		E		D			
Approach Delay, s/veh / LOS	20.1	C		7.2	A		50.8	D		0.0		
Intersection Delay, s/veh / LOS	22.1						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	0.6	A	3.1	C	2.6	B
Bicycle LOS Score / LOS	2.9	C	4.4	E		F		

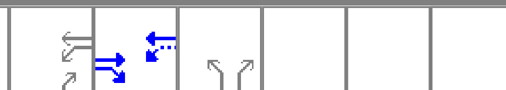
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	I-229 NORTHBOUND	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING PM phf.xus				
Project Description	PM PEAK				

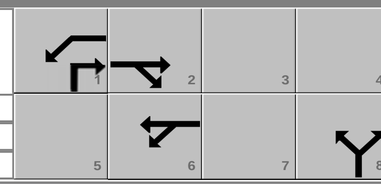


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1081	68	68	902		49		682			

Signal Information			
Cycle, s	146.0	Reference Phase	2
Offset, s	79	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.0	106.9	19.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.9	1.0	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	0.0	14.0		9.0		
Phase Duration, s		112.4	9.6	122.0		24.0		
Change Period, ($Y+R_c$), s		5.5	4.6	5.5		5.0		
Max Allow Headway (*MAH*), s		0.0	0.0	0.0		3.1		
Queue Clearance Time (g_s), s						21.0		
Green Extension Time (g_e), s		0.0	0.0	0.0		0.0		
Phase Call Probability						1.00		
Max Out Probability						1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		613	604	479	598		54		713			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1869	1837	308	1701		1450		1490			
Queue Service Time (g_s), s		41.2	47.3	5.0	13.6		5.0		19.0			
Cycle Queue Clearance Time (g_c), s		41.2	47.3	5.0	13.6		5.0		19.0			
Green Ratio (*g/C*)		0.32	0.32	0.80	0.80		0.13		0.16			
Capacity (*c*), veh/h		605	1345	282	1358		189		245			
Volume-to-Capacity Ratio (*X*)		1.014	0.449	1.698	0.441		0.289		2.912			
Available Capacity (c_a), veh/h		605	1345	282	1358		189		245			
Back of Queue (*Q*), veh/ln (50th percentile)		28.8	22.5	35.3	4.0		1.8		68.2			
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.00	0.00	0.00		0.16		0.00			
Uniform Delay (d_1), s/veh		30.7	53.6	39.1	3.7		57.4		61.0			
Incremental Delay (d_2), s/veh		35.4	0.8	325.9	0.8		0.3		871.5			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		66.1	54.4	365.0	4.6		57.7		932.5			
Level of Service (LOS)		F	D	F	A		E		F			
Approach Delay, s/veh / LOS	60.3	E		164.9	F		870.5	F		0.0		
Intersection Delay, s/veh / LOS	300.2						F					

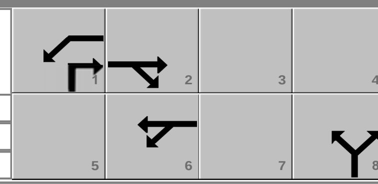
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	0.6	A	3.2	C	3.1	C
Bicycle LOS Score / LOS	3.7	D	2.4	B		F		

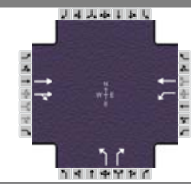
HCS 2010 Interchanges Results Summary

General Information				Interchange Information	
Agency	SDDOT/Sioux Falls			Interchange Type	Parclo A-2Q
Analyst	HDR	Analysis Date	Sep 18, 2012	Segment Distance, ft	1082
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-229 NORTHBOUND	PHF	0.90	Arterial Direction	East-West
File Name	26TH EXISTING PM phf.xus				
Project Description	PM PEAK				

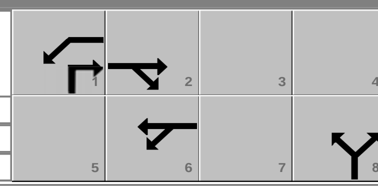
Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		665	74	513	438		75		484			
Intersection Two Demand (*v*), veh/h		1081	68	68	902		49		682			

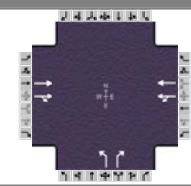
Signal One Information								
Cycle, s	146.0							
Offset, s	79	Green	41.5	71.5	17.0	0.0	0.0	0.0
Uncoordinated	No	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Force Mode	Fixed	Red	1.9	1.9	1.0	0.0	0.0	0.0





Signal Two Information								
Cycle, s	146.0							
Offset, s	79	Green	5.0	106.9	19.0	0.0	0.0	0.0
Uncoordinated	No	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Force Mode	Fixed	Red	1.0	1.9	1.0	0.0	0.0	0.0





Interchange Results

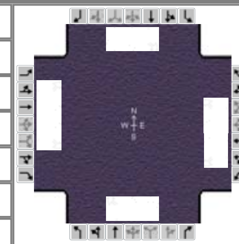
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	54	NBL(II) + NBT(II) + WBT(I)	60.3	D
B	NBR	713	NBT(II)	932.5	F
C	SBR	0	SBT(I)	0.0	A
D	SBL - SBU	0	SBL(I) + SBT(I) - EBT(II)	66.1	F
E	EBR(INT) - SBU	62	EBT(II) + EBT(I)	73.7	D
F	EBL(EXT)	0	EBL(I) + EBT(I)	0.0	A
G	WBL(EXT)	76	WBL(II) + WBT(II)	365.0	F
H	WBR(INT) - NBU	0	WBT(I) + WBT(II)	4.6	A
I	EBT(INT) - SBL + SBU	1156	EBT(I) + EBT(II)	85.4	F
J	WBT(INT) - NBL + NBU	432	WBT(I) + WBT(II)	7.2	A
K		-		-	-
L		-		-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		19.2	20.9	11.2	2.6		61.0		49.2			
Level of Service (LOS)		B	C	B	A		E		D			
Approach Delay, s/veh / LOS	20.1		C	7.2		A	50.8		D	0.0		
Intersection Delay, s/veh / LOS	22.1						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		66.1	54.4	365.0	4.6		57.7		932.5			
Level of Service (LOS)		F	D	F	A		E		F			
Approach Delay, s/veh / LOS	60.3		E	164.9		F	870.5		F	0.0		
Intersection Delay, s/veh / LOS	300.2						F					

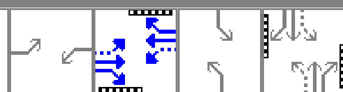
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	SOUTHEASTERN AVE.	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING PM phf.xus				
Project Description	PM PEAK				

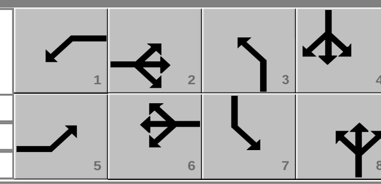


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	63	1210	490	80	707	89	197	110	79	248	420	66

Signal Information			
Cycle, s	146.0	Reference Phase	2
Offset, s	3	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.1	78.3	14.1	27.3	0.0	0.0
Yellow	3.9	3.9	3.9	3.9	0.0	0.0
Red	1.0	1.8	1.0	1.8	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	3.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	84.0	10.0	84.0	19.0	33.0	19.0	33.0
Change Period, ($Y+R_c$), s	4.9	5.7	4.9	5.7	4.9	5.7	4.9	5.7
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0	3.1	3.1	3.2	3.1
Queue Clearance Time (g_s), s	3.7		5.4		16.1	9.9	16.1	23.9
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.7
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	0.00	1.00	0.88

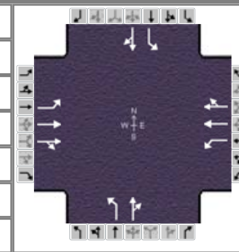
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	44	850	0	89	786	77	219	102	97	276	272	262
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1672	1672	1482	1706	1705	1516	1681	1765	1545	1681	1765	1686
Queue Service Time (g_s), s	1.7	16.4	0.0	3.4	27.5	5.4	14.1	7.3	7.9	14.1	21.6	21.9
Cycle Queue Clearance Time (g_c), s	1.7	16.4	0.0	3.4	27.5	5.4	14.1	7.3	7.9	14.1	21.6	21.9
Green Ratio (*g/C*)	0.57	0.54	0.54	0.57	0.54	0.54	0.28	0.19	0.19	0.28	0.19	0.19
Capacity (*c*), veh/h	336	1793	795	377	1829	813	232	330	289	352	330	315
Volume-to-Capacity Ratio (*X*)	0.132	0.474	0.000	0.236	0.429	0.094	0.944	0.309	0.336	0.783	0.825	0.832
Available Capacity (c_a), veh/h	336	1793	795	377	1829	813	232	330	289	352	330	315
Back of Queue (*Q*), veh/ln (50th percentile)	0.6	5.2	0.0	1.4	12.5	3.6	9.3	3.3	3.1	4.2	11.0	10.8
Queue Storage Ratio (*RQ*) (50th percentile)	0.32	0.00	0.00	0.33	0.00	0.36	0.79	0.00	0.00	0.97	0.00	0.00
Uniform Delay (d_1), s/veh	16.3	12.4	0.0	16.0	34.2	26.1	47.4	51.2	51.5	48.6	57.0	57.1
Incremental Delay (d_2), s/veh	0.0	0.1	0.0	0.1	0.5	0.2	43.1	0.2	0.3	10.1	14.6	16.1
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	16.3	12.5	0.0	16.1	34.8	26.2	90.5	51.4	51.7	58.7	71.7	73.3
Level of Service (LOS)	B	B		B	C	C	F	D	D	E	E	E
Approach Delay, s/veh / LOS	12.7	B		32.3	C		72.0	E		67.8	E	
Intersection Delay, s/veh / LOS	41.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.2	C	3.0	C	3.3	C	4.0	D
Bicycle LOS Score / LOS	4.0	D	3.6	D	3.3	C	3.6	D

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:18:39 AM

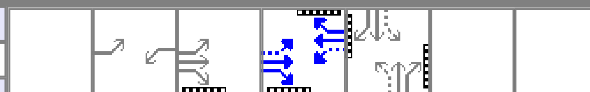
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	CLEVELAND AVE.	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING PM phf.xus				
Project Description	PM PEAK				

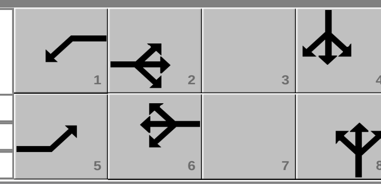


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	180	1319	38	33	711	79	27	25	30	125	52	138

Signal Information			
Cycle, s	146.0	Reference Phase	2
Offset, s	34	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.4	14.4	51.0	55.5	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	1.0	1.0	1.4	1.9	0.0	0.0



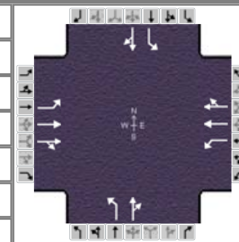
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		6.0		6.0
Phase Duration, s	29.0	75.0	10.0	56.0		61.0		61.0
Change Period, (Y+R_c), s	4.6	5.0	4.6	5.0		5.5		5.5
Max Allow Headway (MAH), s	3.2	0.0	3.2	0.0		3.3		3.3
Queue Clearance Time (g_s), s	7.4		4.0			15.3		15.6
Green Extension Time (g_e), s	0.2	0.0	0.0	0.0		0.8		0.8
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	142	532	528	37	434	422	30	50		139	167	
Adjusted Saturation Flow Rate (s), veh/h/ln	1655	1738	1725	1689	1774	1724	1214	1618		1349	1573	
Queue Service Time (g_s), s	5.4	34.5	34.3	2.0	31.9	31.9	2.6	2.9		10.7	10.7	
Cycle Queue Clearance Time (g_c), s	5.4	34.5	34.3	2.0	31.9	31.9	13.3	2.9		13.6	10.7	
Green Ratio (g/C)	0.53	0.48	0.48	0.39	0.35	0.35	0.38	0.38		0.38	0.38	
Capacity (c), veh/h	409	833	827	234	620	602	422	615		536	598	
Volume-to-Capacity Ratio (X)	0.347	0.639	0.639	0.157	0.700	0.700	0.071	0.081		0.259	0.279	
Available Capacity (c_a), veh/h	409	833	827	234	620	602	422	615		536	598	
Back of Queue (Q), veh/ln (50th percentile)	1.8	15.3	15.1	0.8	15.5	15.1	0.8	1.2		3.6	4.2	
Queue Storage Ratio (RQ) (50th percentile)	0.30	0.00	0.00	0.26	0.00	0.00	0.25	0.00		0.76	0.00	
Uniform Delay (d_1), s/veh	16.1	30.3	30.0	29.0	45.4	45.3	36.0	28.9		33.3	31.4	
Incremental Delay (d_2), s/veh	0.2	3.1	3.1	0.1	6.2	6.3	0.0	0.0		0.1	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	0.0	
Control Delay (d), s/veh	16.3	33.4	33.2	29.1	51.6	51.7	36.0	29.0		33.4	31.5	
Level of Service (LOS)	B	C	C	C	D	D	D	C		C	C	
Approach Delay, s/veh / LOS	31.3	C		50.7	D		31.6	C		32.3	C	
Intersection Delay, s/veh / LOS	38.4						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.5	B	3.4	C	3.2	C
Bicycle LOS Score / LOS	3.5	D	2.8	C	2.6	B	3.0	C

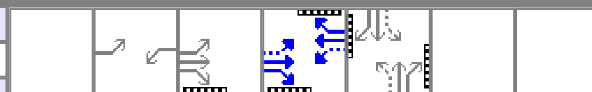
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	VILLAGE SQUARE PLACE	Analysis Year	2012	Analysis Period	1> 7:00
File Name	26TH EXISTING PM phf.xus				
Project Description	PM PEAK				

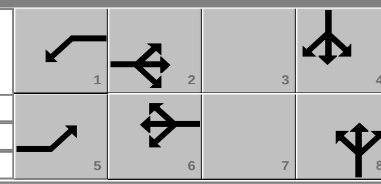


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	26	1402	46	17	759	8	51	0	50	3	0	13

Signal Information			
Cycle, s	146.0	Reference Phase	2
Offset, s	53	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.4	1.0	100.0	24.8	0.0	0.0
Yellow	3.6	0.0	3.6	3.2	0.0	0.0
Red	1.0	0.0	1.4	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		6.0
Phase Duration, s	11.0	106.0	10.0	105.0		30.0		30.0
Change Period, ($Y+R_c$), s	4.6	5.0	4.6	5.0		5.2		5.2
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0		3.4		3.4
Queue Clearance Time (g_s), s	2.5		2.5			8.1		6.5
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.2		0.2
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.25		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	21	597	591	19	426	425	57	50		3	12	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1672	1756	1737	1689	1774	1768	1410	1510		1363	1510	
Queue Service Time (g_s), s	0.5	3.8	3.6	0.5	4.5	4.5	5.1	4.1		0.3	1.0	
Cycle Queue Clearance Time (g_c), s	0.5	3.8	3.6	0.5	4.5	4.5	6.1	4.1		4.5	1.0	
Green Ratio (*g/C*)	0.73	0.69	0.69	0.72	0.68	0.68	0.17	0.17		0.17	0.17	
Capacity (*c*), veh/h	543	1215	1201	420	1215	1211	279	257		242	257	
Volume-to-Capacity Ratio (*X*)	0.039	0.491	0.492	0.045	0.351	0.351	0.203	0.195		0.014	0.048	
Available Capacity (c_a), veh/h	543	1215	1201	420	1215	1211	279	257		242	257	
Back of Queue (*Q*), veh/ln (50th percentile)	0.2	1.2	1.1	0.2	1.5	1.5	1.9	1.6		0.1	0.4	
Queue Storage Ratio (*RQ*) (50th percentile)	0.06	0.00	0.00	0.05	0.00	0.00	0.94	0.00		0.05	0.00	
Uniform Delay (d_1), s/veh	5.8	1.0	0.9	5.7	2.2	2.2	53.3	52.0		53.9	50.7	
Incremental Delay (d_2), s/veh	0.0	1.1	1.1	0.0	0.8	0.8	0.1	0.1		0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	5.8	2.1	2.1	5.7	3.0	3.0	53.4	52.2		54.0	50.7	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	2.1	A		3.0	A		52.8	D		51.4	D	
Intersection Delay, s/veh / LOS	5.3						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	3.2	C	3.3	C
Bicycle LOS Score / LOS	3.5	C	2.8	C	2.7	B	2.5	B

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:18:39 AM

This Urban Streets text report was created on August 22, 2014 at 10:21:35

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	6
Number of Segments	5
Analysis period duration, h	0.25
System cycle length, s	146
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	50
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

Saturation Flowrate of 1800 was used, program printout indicating 1900 is incorrect.

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	30	30	2	1	2143	2143	36	36	0	0	100	100	0	0
2	30	30	2	1	1082	1082	36	48	0	0	0	100	0	0
3	30	30	2	2	1280	1280	48	60	0	0	0	0	0	0
4	30	30	2	2	771	771	48	60	0	0	100	100	0	0
5	30	30	2	2	1219	1219	36	36	0	0	100	100	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

SEGMENT 5

Number of access points: 0

Global Output

SEGMENT DATA

		EB	EB	EB	WB	WB	WB
		LT	TH	RT	LT	TH	RT
Seg.No.	Movement	5	2	12	1	6	16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h			999	999.47		1000.1
1	Base Free-Flow Speed, mph		38.06			36.88	
1	Running Time, s		40.85			42.59	
1	Running Speed, mph		35.77			34.31	
1	Through Delay, s/veh		19.96			97.43	
1	Travel Speed, mph		24.03			10.43	
1	Stop Rate, stops/veh		0.46			1.19	
1	Spatial Stop Rate, stops/mi		1.13			2.94	
1	Through vol/cap ratio		0.44			0.99	
1	Percent of Base FFS		63.14			28.29	
1	Level of Service		C			F	
1	Automobile Perception Score		2.53			2.6	
2	Bay/Lane Spillback Time, h	999	4.88	0	999	999	999
2	ShrdLane Spillback Time, h						
2	Base Free-Flow Speed, mph		39.7			39.23	
2	Running Time, s		22.2			23.27	
2	Running Speed, mph		33.23			31.7	
2	Through Delay, s/veh		60.63			2.58	
2	Travel Speed, mph		8.91			28.54	
2	Stop Rate, stops/veh		1.06			0.1	
2	Spatial Stop Rate, stops/mi		5.17			0.5	
2	Through vol/cap ratio		0.75			0.33	
2	Percent of Base FFS		22.43			72.75	
2	Level of Service		F			B	
2	Automobile Perception Score		3.26			2.42	
3	Bay/Lane Spillback Time, h	999	999	999	0	999	999
3	ShrdLane Spillback Time, h	999		999			
3	Base Free-Flow Speed, mph		38.7			38.69	
3	Running Time, s		24.91			25.82	
3	Running Speed, mph		35.04			33.8	
3	Through Delay, s/veh		12.49			149.83	
3	Travel Speed, mph		23.34			4.97	
3	Stop Rate, stops/veh		0.3			0.97	
3	Spatial Stop Rate, stops/mi		1.25			4.02	
3	Through vol/cap ratio		0.47			0.95	
3	Percent of Base FFS		60.32			12.84	
3	Level of Service		C			F	
3	Automobile Perception Score		2.33			2.79	
4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999			999		999
4	Base Free-Flow Speed, mph		39.23			39.23	
4	Running Time, s		17.58			17.44	
4	Running Speed, mph		29.89			30.14	
4	Through Delay, s/veh		33.28			34.76	
4	Travel Speed, mph		10.33			10.07	
4	Stop Rate, stops/veh		0.71			0.78	
4	Spatial Stop Rate, stops/mi		4.85			5.37	
4	Through vol/cap ratio		0.64			0.43	
4	Percent of Base FFS		26.34			25.67	
4	Level of Service		F			F	
4	Automobile Perception Score		2.94			3.04	
5	Bay/Lane Spillback Time, h	999	999	999	999	999	999
5	ShrdLane Spillback Time, h	999			999		
5	Base Free-Flow Speed, mph		37.49			37.49	
5	Running Time, s		25.58			25.32	
5	Running Speed, mph		32.49			32.83	
5	Through Delay, s/veh		2.08			51.63	
5	Travel Speed, mph		30.04			10.8	
5	Stop Rate, stops/veh		0.05			0.88	

5	Spatial Stop Rate, stops/mi	0.2	3.82
5	Through vol/cap ratio	0.49	0.7
5	Percent of Base FFS	80.13	28.81
5	Level of Service	B	F
5	Automobile Perception Score	2.17	2.75

Facility Travel Time, s	259.57	470.66
Facility Travel Speed, mph	17.06	9.41
Facility Spatial Stop Rate, veh/mi	2.1	3.2
Facility Base Free Flow Speed, mph	38.47	38
Facility Percent Base Free Flow Speed	44.34	24.76
Facility Level of Service	D	F
Facility Automobile Perception Score	2.54	2.68
Facility Pedestrian Space	0	0
Facility Pedestrian Travel Speed	2.6	3.31
Facility Pedestrian LOS Score	4.32	4.06
Facility Pedestrian LOS	F	F
Facility Bicycle Travel Speed	11.15	12.49
Facility Bicycle LOS Score	4.47	4.6
Facility Bicycle LOS	E	E
Facility Transit Travel Speed	24.32	10.43
Facility Transit LOS Score	5.74	5.97
Facility Transit LOS	F	F
SPILLBACK TIME, h	4.88	

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	5.08	5.46
1	Ped LOS Score for Intersection	2.72	3.12
1	Ped LOS Score for Segment	4.58	4.83
1	Ped Segment LOS	F	F
1	Bicycle LOS Score for Link	4.06	4.23
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	2.91	3.03
1	Number of access point approaches	13	20
1	Segment Length, ft	2143	2143
1	Bicycle LOS Score for Segment	4.82	5.48
1	Bicycle Segment LOS	E	F
1	Transit Wait-Ride Score	1.15	0.83
1	Ped LOS Score for Link	5.08	5.46
1	Transit LOS Score for Segment	5.03	5.58
1	Transit Segment LOS	F	F
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	4.56	4.41
2	Ped LOS Score for Intersection	2.47	0.64
2	Ped LOS Score for Segment	4.32	3.78
2	Ped Segment LOS	E	D
2	Bicycle LOS Score for Link	3.98	4.48
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	3.7	4.4
2	Number of access point approaches	0	0
2	Segment Length, ft	1082	1082
2	Bicycle LOS Score for Segment	3.93	4.47
2	Bicycle Segment LOS	D	E
2	Transit Wait-Ride Score	0	0
2	Ped LOS Score for Link	4.56	4.41
2	Transit LOS Score for Segment	6.68	6.66
2	Transit Segment LOS	F	F
3	Roadway crossing difficulty factor	1.2	1.2
3	Ped LOS Score for Link	4.85	3.29
3	Ped LOS Score for Intersection	3.19	0.64
3	Ped LOS Score for Segment	4.62	3.35
3	Ped Segment LOS	E	C
3	Bicycle LOS Score for Link	4.11	4.19
3	Indicator Variable	1	1

3	Bicycle LOS Score for Intersection	3.98	2.45
3	Number of access point approaches	4	1
3	Segment Length, ft	1280	1280
3	Bicycle LOS Score for Segment	4.67	3.79
3	Bicycle Segment LOS	E	D
3	Transit Wait-Ride Score	0	0
3	Ped LOS Score for Link	4.85	3.29
3	Transit LOS Score for Segment	6.73	6.49
3	Transit Segment LOS	F	F
4	Roadway crossing difficulty factor	1.2	1.2
4	Ped LOS Score for Link	3.35	3.08
4	Ped LOS Score for Intersection	2.38	3.03
4	Ped LOS Score for Segment	3.83	3.9
4	Ped Segment LOS	D	D
4	Bicycle LOS Score for Link	4.14	4.04
4	Indicator Variable	1	1
4	Bicycle LOS Score for Intersection	3.51	3.6
4	Number of access point approaches	0	0
4	Segment Length, ft	771	771
4	Bicycle LOS Score for Segment	3.88	3.9
4	Bicycle Segment LOS	D	D
4	Transit Wait-Ride Score	0	0
4	Ped LOS Score for Link	3.35	3.08
4	Transit LOS Score for Segment	6.5	6.46
4	Transit Segment LOS	F	F
5	Roadway crossing difficulty factor	1.2	1.2
5	Ped LOS Score for Link	3.41	3.08
5	Ped LOS Score for Intersection	2.36	2.54
5	Ped LOS Score for Segment	3.85	3.77
5	Ped Segment LOS	D	D
5	Bicycle LOS Score for Link	4.22	4.08
5	Indicator Variable	1	1
5	Bicycle LOS Score for Intersection	3.46	2.85
5	Number of access point approaches	4	5
5	Segment Length, ft	1219	1219
5	Bicycle LOS Score for Segment	4.48	4.45
5	Bicycle Segment LOS	E	E
5	Transit Wait-Ride Score	1.25	0.84
5	Ped LOS Score for Link	3.41	3.08
5	Transit LOS Score for Segment	4.64	5.2
5	Transit Segment LOS	E	F

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

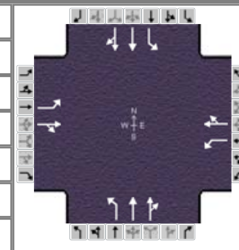
SEGMENT 3

SEGMENT 4

SEGMENT 5

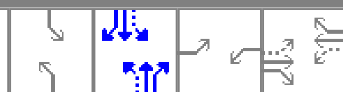
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM existing	PHF	0.90
Intersection	33rd Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	am existing.xus				
Project Description	I-229/Cliff interchange				

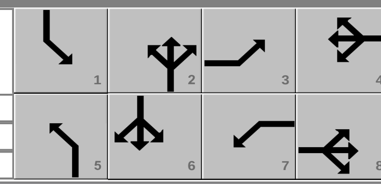


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	61	123	35	66	236	39	110	763	19	45	327	50

Signal Information			
Cycle, s	100.0	Reference Phase	2
Offset, s	26	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	8.4	39.9	8.4	23.5	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	1.0	1.5	1.0	1.9	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	3	8	7	4	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	13.0	29.0	13.0	29.0	13.0	45.0	13.0	45.0
Change Period, ($Y+R_c$), s	4.6	5.5	4.6	5.5	4.6	5.1	4.6	5.1
Max Allow Headway (*MAH*), s	3.2	3.1	3.2	3.1	3.2	0.0	3.2	0.0
Queue Clearance Time (g_s), s	4.9	10.7	5.1	18.4	9.4		3.5	
Green Extension Time (g_e), s	0.0	0.8	0.0	0.5	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	0.62	0.00	0.90	0.30	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	3	8	18	7	4	14	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	68	171		73	301		201	713	709	50	210	204
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664	1683		1664	1706		1655	1689	1675	1689	1723	1647
Queue Service Time (g_s), s	2.9	8.7		3.1	16.4		7.4	39.9	39.9	1.5	6.8	6.9
Cycle Queue Clearance Time (g_c), s	2.9	8.7		3.1	16.4		7.4	39.9	39.9	1.5	6.8	6.9
Green Ratio (g/C)	0.32	0.24		0.32	0.24		0.48	0.40	0.40	0.48	0.40	0.40
Capacity (*c*), veh/h	266	396		366	401		507	674	668	214	687	657
Volume-to-Capacity Ratio (*X*)	0.255	0.433		0.201	0.751		0.396	1.059	1.060	0.234	0.305	0.310
Available Capacity (c_a), veh/h	266	396		366	401		507	674	668	214	687	657
Back of Queue (*Q*), veh/ln (50th percentile)	1.1	3.5		1.2	7.5		2.4	22.5	22.4	0.6	2.7	2.6
Queue Storage Ratio (*RQ*) (50th percentile)	0.14	0.00		0.42	0.00		0.62	0.00	0.00	0.15	0.00	0.00
Uniform Delay (d_1), s/veh	26.0	32.6		24.9	35.5		14.6	25.1	25.1	21.1	15.7	15.7
Incremental Delay (d_2), s/veh	0.2	0.3		0.1	6.9		0.1	45.9	46.6	0.2	1.1	1.2
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (*d*), s/veh	26.2	32.8		25.0	42.5		14.8	71.1	71.7	21.3	16.8	16.9
Level of Service (LOS)	C	C		C	D		B	F	F	C	B	B
Approach Delay, s/veh / LOS	31.0	C		39.0	D		64.4	E		17.3	B	
Intersection Delay, s/veh / LOS	49.8						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.1	A	1.3	A	0.9	A

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*RL*	Intersection	*33RD/SHERMAN*
Agency/Co.	*HDR*	Jurisdiction	*SIOUX FALLS*
Date Performed	*1/9/2014*	Analysis Year	*EXISTING*
Analysis Time Period	*AM PEAK*		
Project Description *I-229/26TH ST. IMJR*			
East/West Street: *33RD STREET*		North/South Street: *SHERMAN AVE.*	
Intersection Orientation: *East-West*		Study Period (hrs): *1.00*	

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*11*	*62*	*114*	*55*	*239*	*5*
Peak-Hour Factor, PHF	*0.84*	*0.84*	*0.84*	*0.75*	*0.75*	*0.75*
Hourly Flow Rate, HFR (veh/h)	*13*	*73*	*135*	*73*	*318*	*6*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*87*	*14*	*22*	*1*	*14*	*15*
Peak-Hour Factor, PHF	*0.72*	*0.72*	*0.72*	*0.62*	*0.62*	*0.62*
Hourly Flow Rate, HFR (veh/h)	*120*	*19*	*30*	*1*	*22*	*24*
Percent Heavy Vehicles	*1*	*1*	*1*	*1*	*1*	*1*
Percent Grade (%)	*1*			*-1*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*13*	*73*		*169*			*47*	
C (m) (veh/h)	*1236*	*1363*		*364*			*476*	
v/c	*0.01*	*0.05*		*0.46*			*0.10*	
95% queue length	*0.03*	*0.17*		*2.53*			*0.33*	
Control Delay (s/veh)	*7.9*	*7.8*		*23.4*			*13.4*	
LOS	*A*	*A*		*C*			*B*	
Approach Delay (s/veh)	--	--	*23.4*			*13.4*		
Approach LOS	--	--	*C*			*B*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RL	Intersection	33RD/VAN EPS
Agency/Co.	HDR	Jurisdiction	SIOUX FALLS
Date Performed	1/10/2014	Analysis Year	EXISTING
Analysis Time Period	AM PEAK		

Project Description *I-229/26TH ST. IMJR*

East/West Street: *33RD STREET* | North/South Street: *VAN EPS AVE.*

Intersection Orientation: *East-West* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	4	77	4	5	272	2
Peak-Hour Factor, PHF	0.85	0.85	0.85	0.82	0.82	0.82
Hourly Flow Rate, HFR (veh/h)	4	90	4	6	331	2
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		1			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	14	0	2	1	2	13
Peak-Hour Factor, PHF	0.57	0.57	0.57	0.80	0.80	0.80
Hourly Flow Rate, HFR (veh/h)	24	0	3	1	2	16
Percent Heavy Vehicles	1	1	1	1	1	1
Percent Grade (%)		2			-2	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR			LTR	
v (veh/h)	4	6		27			19	
C (m) (veh/h)	1226	1500		506			687	
v/c	0.00	0.00		0.05			0.03	
95% queue length	0.01	0.01		0.17			0.09	
Control Delay (s/veh)	7.9	7.4		12.5			10.4	
LOS	A	A		B			B	
Approach Delay (s/veh)	--	--	12.5			10.4		
Approach LOS	--	--	B			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*RL*	Intersection	*33RD/BLAUVELT*
Agency/Co.	*HDR*	Jurisdiction	*SIOUX FALLS*
Date Performed	*1/10/2014*	Analysis Year	*EXISTING*
Analysis Time Period	*AM PEAK*		

Project Description *I-229/26TH ST. IMJR*	
East/West Street: *33RD STREET*	North/South Street: *BLAUVELT AVE.*
Intersection Orientation: *East-West*	Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*7*	*65*	*8*	*41*	*225*	*3*
Peak-Hour Factor, PHF	*0.79*	*0.79*	*0.79*	*0.77*	*0.77*	*0.77*
Hourly Flow Rate, HFR (veh/h)	*8*	*82*	*10*	*53*	*292*	*3*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*7*	*5*	*25*	*9*	*19*	*47*
Peak-Hour Factor, PHF	*0.79*	*0.79*	*0.79*	*0.64*	*0.64*	*0.64*
Hourly Flow Rate, HFR (veh/h)	*8*	*6*	*31*	*14*	*29*	*73*
Percent Heavy Vehicles	*1*	*1*	*1*	*1*	*1*	*1*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*8*	*53*		*45*			*116*	
C (m) (veh/h)	*1266*	*1503*		*672*			*595*	
v/c	*0.01*	*0.04*		*0.07*			*0.19*	
95% queue length	*0.02*	*0.11*		*0.22*			*0.72*	
Control Delay (s/veh)	*7.9*	*7.5*		*10.7*			*12.5*	
LOS	*A*	*A*		*B*			*B*	
Approach Delay (s/veh)	--	--	*10.7*			*12.5*		
Approach LOS	--	--	*B*			*B*		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*RL*
Agency/Co.	*HDR*
Date Performed	*1/10/2014*
Analysis Time Period	*AM PEAK*

Site Information

Intersection	*I-229/YEAGER*
Jurisdiction	*SIOUX FALLS*
Analysis Year	*EXISTING*

Project Description *I-229/26TH ST. IMJR*

East/West Street: *I-229 RAMPS* North/South Street: *YEAGER ROAD*

Intersection Orientation: *North-South* Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*94*	*5*	*668*	*193*	
Peak-Hour Factor, PHF	*0.79*	*0.87*	*0.87*	*0.87*	*0.87*	*0.64*
Hourly Flow Rate, HFR (veh/h)	*0*	*108*	*5*	*767*	*221*	*0*
Percent Heavy Vehicles	*1*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration			*TR*	*L*	*T*	
Upstream Signal		*0*			*1*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*76*		*202*
Peak-Hour Factor, PHF	*0.79*	*0.79*	*0.79*	*0.70*	*0.77*	*0.70*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*108*	*0*	*288*
Percent Heavy Vehicles	*2*	*0*	*0*	*2*	*0*	*2*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*	*L*		*R*			
v (veh/h)		*767*	*108*		*288*			
C (m) (veh/h)		*1476*	*38*		*943*			
v/c		*0.52*	*2.84*		*0.31*			
95% queue length		*3.22*	*39.14*		*1.31*			
Control Delay (s/veh)		*10.1*	*3556*		*10.5*			
LOS		*B*	*F*		*B*			
Approach Delay (s/veh)	--	--	*977.4*					
Approach LOS	--	--	*F*					

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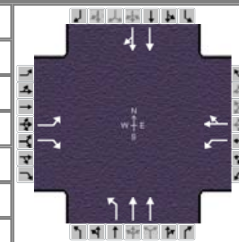
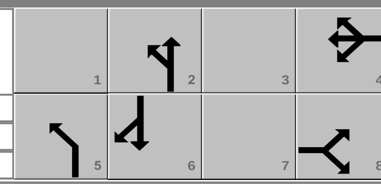
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM existing	PHF	0.90
Intersection	41st Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	am existing.xus				
Project Description	I-229/Cliff interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	97		80	123	105	56	177	1172			455	71

Signal Information										
Cycle, s	100.0	Reference Phase	2							
Offset, s	71	Reference Point	Begin	Green	6.4	52.9	24.9	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	2.5	1.5	0.0	0.0	0.0



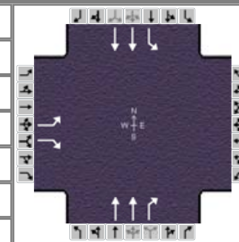
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		8		4	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		30.0		30.0	11.0	70.0		59.0
Change Period, ($Y+R_c$), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (MAH), s		3.2		3.2	3.4	0.0		0.0
Queue Clearance Time (g_s), s		20.0		11.0	8.4			
Green Extension Time (g_e), s		0.4		0.7	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		0.31		0.00	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	3		18	7	4	14	5	2			6	16
Adjusted Flow Rate (v), veh/h	108		0	137	168		244	1614			237	228
Adjusted Saturation Flow Rate (s), veh/h/ln	1118		1432	1497	1571		1442	1698			1651	1564
Queue Service Time (g_s), s	9.0		0.0	7.5	9.0		6.4	27.5			9.7	9.5
Cycle Queue Clearance Time (g_c), s	18.0		0.0	7.5	9.0		6.4	27.5			9.7	9.5
Green Ratio (g/C)	0.25		0.25	0.25	0.25		0.61	0.64			0.53	0.53
Capacity (c), veh/h	250		357	445	391		543	2170			874	828
Volume-to-Capacity Ratio (X)	0.431		0.000	0.307	0.429		0.449	0.744			0.271	0.275
Available Capacity (c_a), veh/h	250		357	445	391		543	2170			874	828
Back of Queue (Q), veh/ln (50th percentile)	2.5		0.0	2.6	3.3		2.4	7.3			3.6	3.6
Queue Storage Ratio (RQ) (50th percentile)	0.46		0.00	0.76	0.00		0.61	0.00			0.00	0.00
Uniform Delay (d_1), s/veh	39.1		0.0	31.0	31.6		11.2	8.3			15.6	16.2
Incremental Delay (d_2), s/veh	0.4		0.0	0.1	0.3		0.1	0.9			0.7	0.8
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (d), s/veh	39.6		0.0	31.2	31.8		11.2	9.2			16.3	17.0
Level of Service (LOS)	D			C	C		B	A			B	B
Approach Delay, s/veh / LOS	39.6		D	31.5		C	9.5		A	16.7		B
Intersection Delay, s/veh / LOS	14.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	2.4	B
Bicycle LOS Score / LOS		F	1.0	A	1.7	A	1.0	A

HCS 2010 Signalized Intersection Results Summary

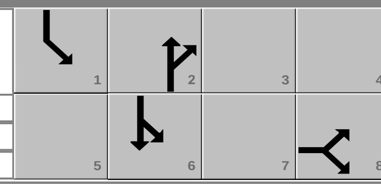
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM existing	PHF	0.90
Intersection	I-229 NB	Analysis Year	2013	Analysis Period	1> 7:00
File Name	am existing.xus				
Project Description	I-229/Cliff interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	322		137					1372	382	101	374	

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	6.4	50.9	28.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.5	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		8				2	1	6
Case Number		9.0				7.3	1.0	4.0
Phase Duration, s		33.0				56.0	11.0	67.0
Change Period, (Y+R_c), s		5.0				5.1	4.6	5.1
Max Allow Headway (MAH), s		3.1				0.0	3.3	0.0
Queue Clearance Time (g_s), s		23.3					6.1	
Green Extension Time (g_e), s		0.5				0.0	0.0	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.38					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	3		18					2	12	1	6	
Adjusted Flow Rate (v), veh/h	358		119					1500	363	135	500	
Adjusted Saturation Flow Rate (s), veh/h/ln	1568		1499					1685	1533	1505	1575	
Queue Service Time (g_s), s	21.3		6.2					38.2	9.8	4.1	14.7	
Cycle Queue Clearance Time (g_c), s	21.3		6.2					38.2	9.8	4.1	14.7	
Green Ratio (g/C)	0.28		0.28					0.51	0.51	0.59	0.29	
Capacity (c), veh/h	439		420					1715	780	209	929	
Volume-to-Capacity Ratio (X)	0.815		0.283					0.875	0.465	0.645	0.538	
Available Capacity (c_a), veh/h	439		420					1715	780	209	929	
Back of Queue (Q), veh/ln (50th percentile)	8.9		2.1					13.3	2.6	1.9	6.3	
Queue Storage Ratio (RQ) (50th percentile)	1.71		0.00					0.00	0.00	0.48	0.00	
Uniform Delay (d_1), s/veh	33.6		28.2					18.9	8.0	20.6	22.2	
Incremental Delay (d_2), s/veh	10.6		0.1					0.8	0.2	5.1	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	44.2		28.3					19.8	8.3	25.7	24.4	
Level of Service (LOS)	D		C					B	A	C	C	
Approach Delay, s/veh / LOS	40.2	D		0.0			17.5	B		24.7	C	
Intersection Delay, s/veh / LOS	22.7						C					

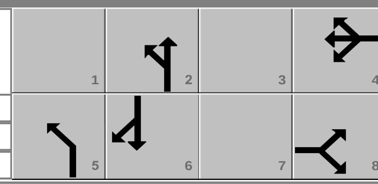
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS		F			2.0	B	0.9	A

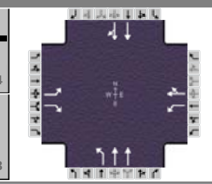
HCS 2010 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Oct 8, 2013	Segment Distance, ft	820
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	East-West
Intersection	I-229 NB	PHF	0.90	Arterial Direction	North-South
File Name	am existing.xus				
Project Description	I-229/Cliff interchange				

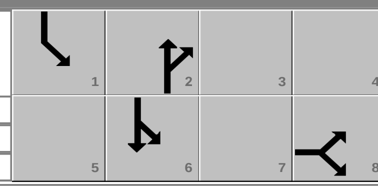
Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	97		80	123	105	56	177	1172			455	71
Intersection Two Demand (*v*), veh/h	322		137					1372	382	101	374	

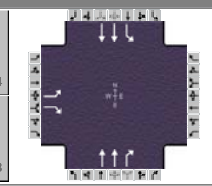
Signal One Information								
Cycle, s	100.0							
Offset, s	56							
Uncoordinated	No	Green	6.4	52.9	24.9	0.0	0.0	0.0
Force Mode	Fixed	Yellow	3.6	3.6	3.6	0.0	0.0	0.0
		Red	1.0	2.5	1.5	0.0	0.0	0.0





Signal Two Information								
Cycle, s	100.0							
Offset, s	56							
Uncoordinated	No	Green	6.4	50.9	28.0	0.0	0.0	0.0
Force Mode	Fixed	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
		Red	1.0	1.5	1.0	0.0	0.0	0.0





Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	EBL - EBU	358	EBL(II) + EBT(II) + NBT(I)	53.4	F
B	EBR	119	EBT(II)	28.3	B
C	WBR	51	WBT(I)	31.8	C
D	WBL - WBU	137	WBL(I) + WBT(I) - SBT(II)	55.6	D
E	SBL(INT) - WBU	135	SBL(II) + SBT(II) + SBT(I)	42.0	C
F	SBR(EXT)	55	SBT(I)	16.3	B
G	NBR(EXT)	363	NBT(II)	8.3	A
H	NBL(INT) - EBU	244	NBL(I) + NBT(I) + NBT(II)	31.0	C
I	SBT(INT) - WBL + WBU	363	SBT(I) + SBT(II)	40.7	C
J	NBT(INT) - EBL + EBU	1256	NBT(I) + NBT(II)	29.0	B
K	EBT	0	EBT	-	-
L	WBT	117	WBT	-	-
M	EBU	0	EBU	-	-
N	WBU	0	WBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	39.6		0.0	31.2	31.8		11.2	9.2			16.3	17.0
Level of Service (LOS)	D			C	C		B	A			B	B
Approach Delay, s/veh / LOS	39.6	D		31.5	C		9.5	A		16.7	B	
Intersection Delay, s/veh / LOS	14.3						B					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	44.2		28.3					19.8	8.3	25.7	24.4	
Level of Service (LOS)	D		C					B	A	C	C	
Approach Delay, s/veh / LOS	40.2	D		0.0			17.5	B		24.7	C	
Intersection Delay, s/veh / LOS	22.7						C					

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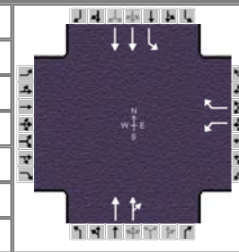
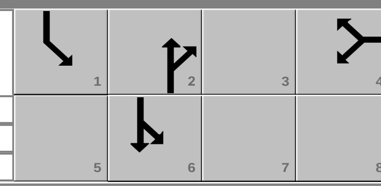
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM existing	PHF	0.90
Intersection	49th Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	am existing.xus				
Project Description	I-229/Cliff interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h				35		646		1108	11	146	365	

Signal Information									
Cycle, s	100.0	Reference Phase	2						
Offset, s	3	Reference Point	Begin	Green	7.4	37.9	40.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.5	1.0	0.0	0.0	0.0

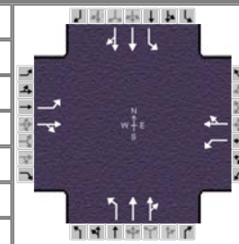


Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				4		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				45.0		43.0	12.0	55.0
Change Period, ($Y+R_c$), s				5.0		5.1	4.6	5.1
Max Allow Headway (*MAH*), s				3.4		0.0	3.2	0.0
Queue Clearance Time (g_s), s				42.0			8.3	
Green Extension Time (g_e), s				0.0		0.0	0.0	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				7		14		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				39		629		621	620	186	466	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1714	1709	1672	1624	
Queue Service Time (g_s), s				1.4		40.0		35.3	34.7	6.3	5.3	
Cycle Queue Clearance Time (g_c), s				1.4		40.0		35.3	34.7	6.3	5.3	
Green Ratio (g/C)				0.40		0.40		0.38	0.38	0.47	0.50	
Capacity (*c*), veh/h				672		598		650	648	207	1621	
Volume-to-Capacity Ratio (*X*)				0.058		1.051		0.956	0.957	0.899	0.287	
Available Capacity (c_a), veh/h				672		598		650	648	207	1621	
Back of Queue (*Q*), veh/ln (50th percentile)				0.6		22.2		16.6	16.6	4.5	1.7	
Queue Storage Ratio (*RQ*) (50th percentile)				0.17		0.00		0.00	0.00	0.46	0.00	
Uniform Delay (d_1), s/veh				18.4		30.0		23.9	23.9	25.3	8.2	
Incremental Delay (d_2), s/veh				0.0		51.0		26.1	26.2	32.1	0.4	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				18.4		81.0		50.0	50.1	57.3	8.6	
Level of Service (LOS)				B		F		D	D	E	A	
Approach Delay, s/veh / LOS	0.0			77.4	E		50.1	D		22.5	C	
Intersection Delay, s/veh / LOS	50.2						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	2.4	B	0.7	A
Bicycle LOS Score / LOS				F	1.5	A	1.0	A

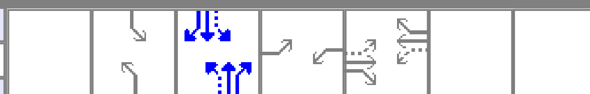
HCS 2010 Signalized Intersection Results Summary



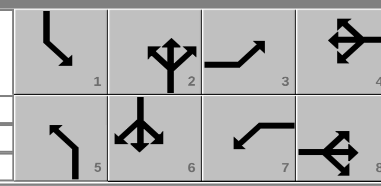
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM existing	PHF	0.90
Intersection	33rd Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	pm existing.xus				
Project Description	I-229/Cliff interchange				

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	137	129	71	84	196	12	69	344	31	11	846	108

Signal Information			
Cycle, s	75.0	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	8.4	14.9	8.4	23.5	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	1.0	1.5	1.0	1.9	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	3	8	7	4	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	13.0	29.0	13.0	29.0	13.0	20.0	13.0	20.0
Change Period, ($Y+R_c$), s	4.6	5.5	4.6	5.5	4.6	5.1	4.6	5.1
Max Allow Headway (MAH), s	3.2	3.2	3.2	3.2	3.2	0.0	3.2	0.0
Queue Clearance Time (g_s), s	6.3	9.6	4.6	9.8	2.5		2.4	
Green Extension Time (g_e), s	0.1	0.8	0.0	0.8	0.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	0.00	0.42	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	3	8	18	7	4	14	5	2	12	1	6	16
Adjusted Flow Rate (v), veh/h	152	211		93	229		16	44	44	12	532	512
Adjusted Saturation Flow Rate (s), veh/h/ln	1664	1649		1664	1731		1655	1689	1643	1689	1723	1658
Queue Service Time (g_s), s	4.3	7.6		2.6	7.8		0.5	1.6	1.6	0.4	14.9	14.9
Cycle Queue Clearance Time (g_c), s	4.3	7.6		2.6	7.8		0.5	1.6	1.6	0.4	14.9	14.9
Green Ratio (g/C)	0.43	0.31		0.43	0.31		0.31	0.20	0.20	0.31	0.20	0.20
Capacity (c), veh/h	489	517		497	543		281	335	327	482	342	329
Volume-to-Capacity Ratio (X)	0.311	0.409		0.188	0.422		0.058	0.130	0.133	0.025	1.553	1.554
Available Capacity (c_a), veh/h	489	517		497	543		281	335	327	482	342	329
Back of Queue (Q), veh/ln (50th percentile)	1.5	2.8		0.9	3.0		0.2	0.6	0.6	0.1	30.3	29.3
Queue Storage Ratio (RQ) (50th percentile)	0.19	0.00		0.31	0.00		0.05	0.00	0.00	0.03	0.00	0.00
Uniform Delay (d_1), s/veh	14.4	20.3		13.8	20.4		19.8	24.7	24.7	17.3	27.6	27.6
Incremental Delay (d_2), s/veh	0.1	0.2		0.1	0.2		0.0	0.1	0.1	0.0	263.0	263.6
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	14.5	20.5		13.9	20.6		19.8	24.8	24.8	17.3	290.6	291.2
Level of Service (LOS)	B	C		B	C		B	C	C	B	F	F
Approach Delay, s/veh / LOS	18.0	B		18.6	B		24.0	C		287.7	F	
Intersection Delay, s/veh / LOS	172.8						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.1	A	1.0	A	0.9	A	1.4	A

 HCS 2010™ Streets Version 6.60 Generated: 8/21/2014 3:33:32 PM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*RL*
Agency/Co.	*HDR*
Date Performed	*1/10/2014*
Analysis Time Period	*PM PEAK*

Site Information

Intersection	*33RD/SHERMAN*
Jurisdiction	*SIOUX FALLS*
Analysis Year	*EXISTING*

Project Description *I-229/26TH ST. IMJR*

East/West Street: *33RD STREET* | North/South Street: *SHERMAN AVE.*

Intersection Orientation: *East-West* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*14*	*122*	*35*	*17*	*167*	*6*
Peak-Hour Factor, PHF	*0.77*	*0.77*	*0.77*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*18*	*158*	*45*	*18*	*185*	*6*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*111*	*20*	*23*	*4*	*5*	*14*
Peak-Hour Factor, PHF	*0.86*	*0.86*	*0.86*	*0.80*	*0.80*	*0.80*
Hourly Flow Rate, HFR (veh/h)	*129*	*23*	*26*	*4*	*6*	*17*
Percent Heavy Vehicles	*1*	*1*	*1*	*1*	*1*	*1*
Percent Grade (%)		*1*			*-1*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*18*	*18*		*178*			*27*	
C (m) (veh/h)	*1383*	*1369*		*514*			*671*	
v/c	*0.01*	*0.01*		*0.35*			*0.04*	
95% queue length	*0.04*	*0.04*		*1.57*			*0.13*	
Control Delay (s/veh)	*7.6*	*7.7*		*15.7*			*10.6*	
LOS	*A*	*A*		*C*			*B*	
Approach Delay (s/veh)	--	--		*15.7*			*10.6*	
Approach LOS	--	--		*C*			*B*	

 *HCS+*TM Version 5.6 Generated: 1/10/2014 9:12 AM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*RL*
Agency/Co.	*HDR*
Date Performed	*1/10/2014*
Analysis Time Period	*PM PEAK*

Site Information

Intersection	*33RD/VAN EPS*
Jurisdiction	*SIOUX FALLS*
Analysis Year	*EXISTING*

Project Description *I-229/26TH ST. IMJR*

East/West Street: *33RD STREET* | North/South Street: *VAN EPS AVE.*

Intersection Orientation: *East-West* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*14*	*128*	*7*	*4*	*144*	*2*
Peak-Hour Factor, PHF	*0.88*	*0.88*	*0.88*	*0.72*	*0.72*	*0.72*
Hourly Flow Rate, HFR (veh/h)	*15*	*145*	*7*	*5*	*199*	*2*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*35*	*0*	*0*	*1*	*3*	*11*
Peak-Hour Factor, PHF	*0.44*	*0.44*	*0.44*	*0.62*	*0.62*	*0.62*
Hourly Flow Rate, HFR (veh/h)	*79*	*0*	*0*	*1*	*4*	*17*
Percent Heavy Vehicles	*1*	*1*	*1*	*1*	*1*	*1*
Percent Grade (%)		*2*			*-2*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*15*	*5*		*79*			*22*	
C (m) (veh/h)	*1371*	*1429*		*520*			*765*	
v/c	*0.01*	*0.00*		*0.15*			*0.03*	
95% queue length	*0.03*	*0.01*		*0.54*			*0.09*	
Control Delay (s/veh)	*7.7*	*7.5*		*13.2*			*9.8*	
LOS	*A*	*A*		*B*			*A*	
Approach Delay (s/veh)	--	--		*13.2*			*9.8*	
Approach LOS	--	--		*B*			*A*	

 HCS+^{TM} Version 5.6 Generated: 1/10/2014 9:14 AM

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/10/2014
Analysis Time Period	PM PEAK

Site Information

Intersection	33RD/BLAUVELT
Jurisdiction	SIOUX FALLS
Analysis Year	EXISTING

Project Description *I-229/26TH ST. IMJR*

East/West Street: *33RD STREET* | North/South Street: *BLAUVELT AVE.*

Intersection Orientation: *East-West* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	18	108	3	11	114	4
Peak-Hour Factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Hourly Flow Rate, HFR (veh/h)	19	118	3	12	125	4
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		1			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	18	18	68	3	4	18
Peak-Hour Factor, PHF	0.35	0.35	0.35	0.75	0.75	0.75
Hourly Flow Rate, HFR (veh/h)	51	51	194	4	5	24
Percent Heavy Vehicles	1	1	1	1	1	1
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR			LTR	
v (veh/h)	19	12		296			33	
C (m) (veh/h)	1457	1467		781			740	
v/c	0.01	0.01		0.38			0.04	
95% queue length	0.04	0.02		1.82			0.14	
Control Delay (s/veh)	7.5	7.5		12.4			10.1	
LOS	A	A		B			B	
Approach Delay (s/veh)	--	--	12.4			10.1		
Approach LOS	--	--	B			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	RL
Agency/Co.	HDR
Date Performed	1/10/2014
Analysis Time Period	PM PEAK

Site Information

Intersection	I-229/YEAGER
Jurisdiction	SIOUX FALLS
Analysis Year	EXISTING

Project Description *I-229/26TH ST. IMJR*

East/West Street: *I-229 RAMPS*

North/South Street: *YEAGER ROAD*

Intersection Orientation: *North-South*

Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		178	1	514	73	
Peak-Hour Factor, PHF	0.79	0.88	0.88	0.94	0.94	0.64
Hourly Flow Rate, HFR (veh/h)	0	202	1	546	77	0
Percent Heavy Vehicles	1	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	1	1	0
Configuration			TR	L	T	
Upstream Signal		0			1	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				56		381
Peak-Hour Factor, PHF	0.79	0.79	0.79	0.77	0.77	0.77
Hourly Flow Rate, HFR (veh/h)	0	0	0	72	0	494
Percent Heavy Vehicles	2	0	0	2	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

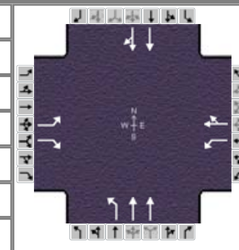
Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		L	L		R			
v (veh/h)		546	72		494			
C (m) (veh/h)		1369	97		839			
v/c		0.40	0.74		0.59			
95% queue length		1.98	5.88		4.19			
Control Delay (s/veh)		9.4	131.7		15.4			
LOS		A	F		C			
Approach Delay (s/veh)	--	--	30.2					
Approach LOS	--	--	D					

 *HCS+*TM Version 5.6 Generated: 1/10/2014 9:18 AM

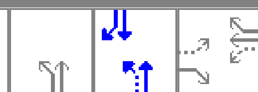
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM existing	PHF	0.90
Intersection	41st Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	pm existing.xus				
Project Description	I-229/Cliff interchange				

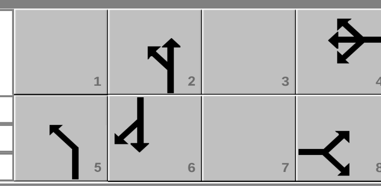


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	80		80	342	81	25	109	389			953	98

Signal Information			
Cycle, s	75.0	Reference Phase	2
Offset, s	62	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	6.4	27.9	24.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		8		4	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		30.0		30.0	11.0	45.0		34.0
Change Period, (*Y*+*Rc*), s		5.1		5.1	4.6	6.1		6.1
Max Allow Headway (*MAH*), s		3.0		3.0	3.4	0.0		0.0
Queue Clearance Time (*gs*), s		10.1		18.4	8.0			
Green Extension Time (*ge*), s		1.0		0.7	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		0.00		0.14	1.00			

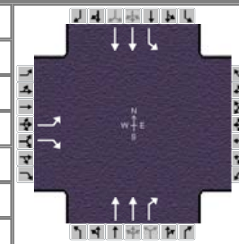
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	3		18	7	4	14	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	89		0	380	112		184	658			390	376
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1167		1422	1540	1639		1415	1574			1664	1598
Queue Service Time (*gs*), s	4.4		0.0	16.4	3.7		6.0	3.1			24.6	16.2
Cycle Queue Clearance Time (*gc*), s	8.1		0.0	16.4	3.7		6.0	3.1			24.6	16.2
Green Ratio (*g/C*)	0.33		0.33	0.33	0.33		0.48	0.52			0.37	0.37
Capacity (*c*), veh/h	426		472	607	544		246	1633			619	595
Volume-to-Capacity Ratio (*X*)	0.209		0.000	0.626	0.206		0.751	0.403			0.630	0.632
Available Capacity (*ca*), veh/h	426		472	607	544		246	1633			619	595
Back of Queue (*Q*), veh/ln (50th percentile)	1.2		0.0	5.5	1.3		3.7	0.8			6.7	6.6
Queue Storage Ratio (*RQ*) (50th percentile)	0.22		0.00	1.58	0.00		0.95	0.00			0.00	0.00
Uniform Delay (*d1*), s/veh	20.9		0.0	22.2	18.0		16.4	2.5			24.8	25.4
Incremental Delay (*d2*), s/veh	0.1		0.0	1.5	0.1		7.3	0.5			0.4	0.5
Initial Queue Delay (*d3*), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	21.0		0.0	23.7	18.0		23.8	3.0			25.3	25.8
Level of Service (LOS)	C			C	B		C	A			C	C
Approach Delay, s/veh / LOS	21.0	C		22.4	C		7.6	A		25.5	C	
Intersection Delay, s/veh / LOS	17.7						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	2.4	B
Bicycle LOS Score / LOS		F	1.3	A	0.9	A	1.4	A

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:32:22 AM

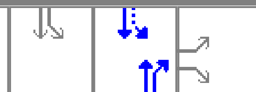
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM existing	PHF	0.90
Intersection	I-229 NB	Analysis Year	2013	Analysis Period	1> 7:00
File Name	pm existing.xus				
Project Description	I-229/Cliff interchange				

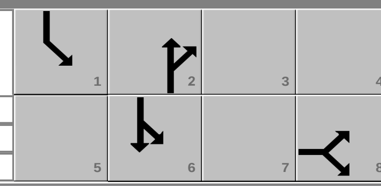


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	149		338					609	117	107	1037	

Signal Information			
Cycle, s	75.0	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	6.4	19.9	34.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.5	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		8				2	1	6
Case Number		9.0				7.3	1.0	4.0
Phase Duration, s		39.0				25.0	11.0	36.0
Change Period, (*Y*+*R*c), s		5.0				5.1	4.6	5.1
Max Allow Headway (*MAH*), s		3.2				0.0	3.3	0.0
Queue Clearance Time (*g*s), s		14.8					5.7	
Green Extension Time (*g*e), s		1.0				0.0	0.0	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	3		18					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	166		342					677	108	109	1061	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1502		1436					1576	1471	1491	1606	
Queue Service Time (*g*s), s	5.1		12.8					13.5	2.6	3.7	17.8	
Cycle Queue Clearance Time (*g*c), s	5.1		12.8					13.5	2.6	3.7	17.8	
Green Ratio (*g/C*)	0.45		0.45					0.27	0.27	0.38	0.41	
Capacity (*c*), veh/h	681		651					836	390	283	1323	
Volume-to-Capacity Ratio (*X*)	0.243		0.526					0.809	0.276	0.387	0.802	
Available Capacity (*c*a), veh/h	681		651					836	390	283	1323	
Back of Queue (*Q*), veh/ln (50th percentile)	1.5		3.6					4.0	0.9	1.1	4.2	
Queue Storage Ratio (*RQ*) (50th percentile)	0.28		0.00					0.00	0.00	0.30	0.00	
Uniform Delay (*d*1), s/veh	12.6		14.7					17.2	11.6	16.7	10.4	
Incremental Delay (*d*2), s/veh	0.1		0.4					5.5	1.1	0.2	3.9	
Initial Queue Delay (*d*3), s/veh	0.0		0.0					0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	12.7		15.1					22.7	12.7	17.0	14.3	
Level of Service (LOS)	B		B					C	B	B	B	
Approach Delay, s/veh / LOS	14.3		B	0.0			21.3		C	14.5		B
Intersection Delay, s/veh / LOS	16.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS		F			1.1	A	1.5	A

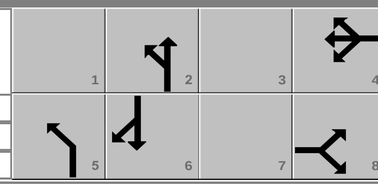
HCS 2010 Interchanges Results Summary

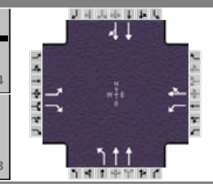
General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Oct 8, 2013	Segment Distance, ft	820
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	East-West
Intersection	I-229 NB	PHF	0.90	Arterial Direction	North-South
File Name	pm existing.xus				
Project Description	I-229/Cliff interchange				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	80		80	342	81	25	109	389			953	98
Intersection Two Demand (*v*), veh/h	149		338					609	117	107	1037	

Signal One Information	
Cycle, s	75.0
Offset, s	48
Uncoordinated	No
Force Mode	Fixed

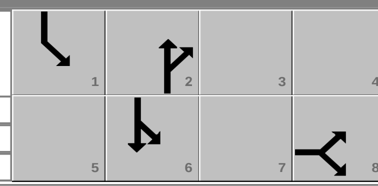
Green	6.4	27.9	24.9	0.0	0.0	0.0
Yellow	3.6	3.6	3.6	0.0	0.0	0.0
Red	1.0	2.5	1.5	0.0	0.0	0.0

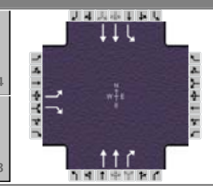




Signal Two Information	
Cycle, s	75.0
Offset, s	48
Uncoordinated	No
Force Mode	Fixed

Green	6.4	19.9	34.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.5	1.0	0.0	0.0	0.0





Interchange Results

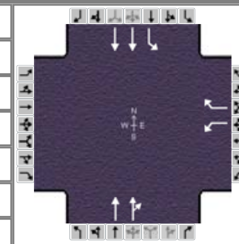
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	EBL - EBU	166	EBL(II) + EBT(II) + NBT(I)	15.7	B
B	EBR	342	EBT(II)	15.1	B
C	WBR	22	WBT(I)	18.0	B
D	WBL - WBU	380	WBL(I) + WBT(I) - SBT(II)	38.0	F
E	SBL(INT) - WBU	109	SBL(II) + SBT(II) + SBT(I)	42.2	C
F	SBR(EXT)	65	SBT(I)	25.3	B
G	NBR(EXT)	108	NBT(II)	12.7	A
H	NBL(INT) - EBU	184	NBL(I) + NBT(I) + NBT(II)	46.4	C
I	SBT(INT) - WBL + WBU	681	SBT(I) + SBT(II)	39.5	C
J	NBT(INT) - EBL + EBU	492	NBT(I) + NBT(II)	25.7	B
K	EBT	0	EBT	-	-
L	WBT	90	WBT	-	-
M	EBU	0	EBU	-	-
N	WBU	0	WBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	21.0		0.0	23.7	18.0		23.8	3.0			25.3	25.8
Level of Service (LOS)	C			C	B		C	A			C	C
Approach Delay, s/veh / LOS	21.0	C		22.4	C		7.6	A		25.5	C	
Intersection Delay, s/veh / LOS	17.7						B					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	12.7		15.1					22.7	12.7	17.0	14.3	
Level of Service (LOS)	B		B					C	B	B	B	
Approach Delay, s/veh / LOS	14.3	B		0.0			21.3	C		14.5	B	
Intersection Delay, s/veh / LOS	16.6						B					

HCS 2010 Signalized Intersection Results Summary

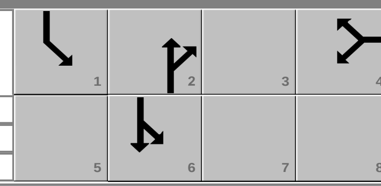
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM existing	PHF	0.90
Intersection	49th Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	pm existing.xus				
Project Description	I-229/Cliff interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				48		244		482	67	467	908	

Signal Information			
Cycle, s	75.0	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	22.4	16.7	21.2	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.5	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				4		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				26.2		21.8	27.0	48.8
Change Period, (Y+R_c), s				5.0		5.1	4.6	5.1
Max Allow Headway (MAH), s				3.4		0.0	3.2	0.0
Queue Clearance Time (g_s), s				9.5			16.9	
Green Extension Time (g_e), s				0.4		0.0	0.6	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				0.00			0.26	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				7		14		2	12	1	6	
Adjusted Flow Rate (v), veh/h				53		182		304	295	488	949	
Adjusted Saturation Flow Rate (s), veh/h/ln				1681		1496		1714	1650	1672	1624	
Queue Service Time (g_s), s				1.8		7.5		12.6	12.4	14.9	15.1	
Cycle Queue Clearance Time (g_c), s				1.8		7.5		12.6	12.4	14.9	15.1	
Green Ratio (g/C)				0.28		0.28		0.22	0.22	0.55	0.58	
Capacity (c), veh/h				475		423		382	368	640	1892	
Volume-to-Capacity Ratio (X)				0.112		0.431		0.797	0.802	0.762	0.501	
Available Capacity (c_a), veh/h				475		423		382	368	640	1892	
Back of Queue (Q), veh/ln (50th percentile)				0.7		2.5		6.0	5.9	6.5	5.5	
Queue Storage Ratio (RQ) (50th percentile)				0.21		0.00		0.00	0.00	0.67	0.00	
Uniform Delay (d_1), s/veh				19.9		22.0		24.8	24.8	18.4	12.1	
Incremental Delay (d_2), s/veh				0.0		0.3		15.8	16.7	3.0	0.6	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (d), s/veh				20.0		22.2		40.6	41.5	21.4	12.7	
Level of Service (LOS)				B		C		D	D	C	B	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	0.0		21.7	C	41.1	D	15.7	B
Intersection Delay, s/veh / LOS	23.0				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	2.9	C	2.4	B	0.7	A
Bicycle LOS Score / LOS				F	1.0	A	1.7	A

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:32:22 AM

I-229/26th Street Interchange Modification Justification Report

APPENDIX

PART 3

2035 Interstate Level of Service

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	AM Peak
Freeway/Direction:	I-229/SB
From/To:	10th/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2490	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	692	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1487	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1487	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	2	
Density, D	22.9	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	AM Peak
Freeway/Direction:	I-229/SB
From/To:	26th/41st
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2750	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	764	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1044	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1044	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	16.1	pc/mi/ln
Level of service, LOS	B	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	AM Peak
Freeway/Direction:	I-229/NB
From/To:	41st/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3340	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	928	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1268	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1268	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.5	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	AM Peak
Freeway/Direction:	I-229/NB
From/To:	26th/10th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3370	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	936	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2013	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	2013	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	59.7	mi/h
Number of lanes, N	2	
Density, D	33.7	pc/mi/ln
Level of service, LOS	D	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	PM Peak
Freeway/Direction:	I-229/SB
From/To:	10th/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3870	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1075	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2311	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	2311	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	53.2	mi/h
Number of lanes, N	2	
Density, D	43.4	pc/mi/ln
Level of service, LOS	E	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	PM Peak
Freeway/Direction:	I-229/SB
From/To:	26th/41st
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3710	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1031	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1408	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1408	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.7	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	PM Peak
Freeway/Direction:	I-229/NB
From/To:	41st/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3100	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	861	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1177	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1177	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.1	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	1/8/2014
Analysis Time Period:	PM Peak
Freeway/Direction:	I-229/NB
From/To:	26th/10th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2460	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	683	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1469	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1469	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	2	
Density, D	22.6	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

______________________Diverge Analysis______________________

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH STREET
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

______________________Freeway Data______________________

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3150	vph

______________________Off Ramp Data______________________

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1150	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

______________________Adjacent Ramp Data (if one exists)______________________

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	490	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1710	ft

______________________Conversion to pc/h Under Base Conditions______________________

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3150		1150		490	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	875		319		136	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3762        1374        585       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.603   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2813   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  3762          6990            No
      Fi   F
     v  = v - v              2388          6990            No
      FO   F   R
     v                       1374          2100            No
      R
     v  or v                 949  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2813                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                        Actual        Max Desirable        Violation?
     v                  2813          4400                 No
      12
_________________Level of Service Determination (if not F)______________________

Density,                 D = 4.252 + 0.0086 v  - 0.009  L   =   19.4    pc/mi/ln
                          R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.422
                                              S
Space mean speed in ramp influence area,     S  = 54.1    mph
                                              R
Space mean speed in outer lanes,             S  = 69.1    mph
                                              0
Space mean speed for all vehicles,           S  = 57.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2000	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	490	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1150	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2000	490	1150	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	556	136	319	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2389	585	1374	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2389 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2974	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2389 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2974	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 20.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.288		
Space mean speed in ramp influence area,	S_R = 56.9	mph	
Space mean speed in outer lanes,	S_0 = N/A	mph	
Space mean speed for all vehicles,	S = 56.9	mph	

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2490	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	530	vph
Length of first accel/decel lane	580	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	790	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2490		530		790	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	692		147		219	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           2836        604         900       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =           (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000  Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  2836   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                2836          4660            No
      Fi   F
     v  = v - v            2232          4660            No
      FO   F   R
     v                     604           2100            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2836                    (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2836          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   23.4    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.352
                                              S
Space mean speed in ramp influence area,     S  = 55.6    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 55.6    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1960	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	790	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	530	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1960		790		530	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	544		219		147	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           2232        900         604        pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L   =             (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2232   pc/h
                   12   F   FM

_______________________________Capacity Checks_______________________________

                           Actual        Maximum         LOS F?
     v                     3132          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2232                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                3132          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   23.2    pc/mi/ln
          R                    R           12             A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.320
                                              S
Space mean speed in ramp influence area,     S  = 56.3    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 56.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 1/8/2014
Analysis time period: AM PEAK
Freeway/Dir of Travel: I-229 SB
Junction: 41ST ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2750	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	390	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	810	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2750		390		810	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	764		108		225	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3132	444	923	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.661 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2222 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3132	6990	No
$v_{FO} = v_F - v_R$	2688	6990	No
v_R	444	2100	No
v_3 or v_{av34}	910 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2222 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2222	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 14.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.338

Space mean speed in ramp influence area, S_R = 55.9 mph

Space mean speed in outer lanes, S_0 = 69.1 mph

Space mean speed for all vehicles, S = 59.2 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2360	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	810	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	390	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2360		810		390	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	656		225		108	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2688        923         444        pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L   =             (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2688   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     3611          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2688                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                3611          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   26.9    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.375
                                              S
Space mean speed in ramp influence area,     S  = 55.1    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 55.1    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3210	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	570	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	700	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3210		570		700	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	892		158		194	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3656        649         797       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.639   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2570   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                3656          6990            No
      Fi   F
     v  = v - v            3007          6990            No
      FO   F   R
     v                     649           2100            No
      R
     v  or v               1086 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2570                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2570          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   17.4    pc/mi/ln
                        R                 12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.356
                                              S
Space mean speed in ramp influence area,     S  = 55.5    mph
                                              R
Space mean speed in outer lanes,             S  = 68.8    mph
                                              0
Space mean speed for all vehicles,           S  = 58.9    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2640	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	700	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	570	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2640		700		570	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	733		194		158	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3007	797	649	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1209.46 (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3007 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3804	4660	No

v_3 or v_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3007 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3804	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 28.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, M_S = 0.406

Space mean speed in ramp influence area, S_R = 54.5 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 54.5 mph

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Phone: Fax:
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Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3340	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	540	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	570	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3340		540		570	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	928		150		158	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

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Heavy vehicle adjustment, fHV            0.976        0.976        0.976
Driver population factor, fP             1.00         1.00         1.00
Flow rate, vp                            3804         615          649        pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.637   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2645   pc/h
                   12   R      F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                3804          6990            No
      Fi   F
     v  = v - v            3189          6990            No
      FO   F   R
     v                     615           2100            No
      R
     v  or v               1159 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2645                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2645          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   18.0    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.353
                                              S
Space mean speed in ramp influence area,     S  = 55.6    mph
                                              R
Space mean speed in outer lanes,             S  = 68.5    mph
                                              0
Space mean speed for all vehicles,           S  = 59.0    mph
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Phone: Fax:
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Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2800	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	570	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	540	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2800	570	540	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	778	158	150	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3189	649	615	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3189 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3838	4660	No

v_3 or v_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3189 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3838	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 28.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, M_S = 0.403

Space mean speed in ramp influence area, S_R = 54.5 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 54.5 mph

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Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 1/8/2014
Analysis time period: AM PEAK
Freeway/Dir of Travel: I-229 NB
Junction: 10TH ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3370	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	740	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	760	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3370		740		760	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	936		206		211	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4025	884	908	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4025 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4025	4660	No
$v_{FO} = v_F - v_R$	3141	4660	No
v_R	884	2100	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 4025 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	4025	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 28.0- pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.378	
Space mean speed in ramp influence area,	S_R = 55.1	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 55.1	mph

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Phone: Fax:
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Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	AM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2630	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	760	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	740	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2630	760	740	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	731	211	206	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           3141        908         884       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3141   pc/h
                   12   F   FM

_______________________________Capacity Checks________________________________

                           Actual        Maximum         LOS F?
     v                     4049          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34        12
If yes, v    = 3141                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                4049          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   30.4    pc/mi/ln
         R                    R           12            A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.455
                                              S
Space mean speed in ramp influence area,     S  = 53.5    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 53.5    mph
_______________________________________________________________________________
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Phone: Fax:
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Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH STREET
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	4180	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	930	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4180		930		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1161		258		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          4993        1111        741        pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.584   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  3378   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  4993          6990            No
      Fi   F
     v  = v - v              3882          6990            No
      FO   F   R
     v                       1111          2100            No
      R
     v  or v                 1615 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 3378                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                3378          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   24.3    pc/mi/ln
                        R                   12          D
Level of service for ramp-freeway junction areas of influence C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.398
                                              S
Space mean speed in ramp influence area,     S  = 54.6    mph
                                              R
Space mean speed in outer lanes,             S  = 66.7    mph
                                              0
Space mean speed for all vehicles,           S  = 58.0    mph
_______________________________________________________________________________
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HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3250	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	930	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3250	620	930	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	903	172	258	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3882        741         1111      pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3882   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4623          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3882                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                4623          4600                  Yes
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   33.6    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.609
                                              S
Space mean speed in ramp influence area,     S  = 50.2    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.2    mph
_______________________________________________________________________________
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HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3870	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	780	vph
Length of first accel/decel lane	580	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3870		780		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1075		217		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4408	888	706	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4408 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4408	4660	No
$v_{FO} = v_F - v_R$	3520	4660	No
v_R	888	2100	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 4408 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	4408	4400	Yes

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 36.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence E

Speed Estimation

Intermediate speed variable, D_S = 0.378

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 55.1 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3090	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	780	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3090	620	780	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	858	172	217	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3519        706         888       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3519   pc/h
                   12   F   FM

_______________________________Capacity Checks_______________________________

                           Actual        Maximum         LOS F?
     v                     4225          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34          12
If yes, v    = 3519                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                4225          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   31.8    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.498
                                              S
Space mean speed in ramp influence area,     S  = 52.5    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 52.5    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 1/8/2014
Analysis time period: PM PEAK
Freeway/Dir of Travel: I-229 SB
Junction: 41ST ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3710	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	630	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	880	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3710		630		880	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1031		175		244	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4225	718	1002	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.621 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2897 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4225	6990	No
$v_{FO} = v_F - v_R$	3507	6990	No
v_R	718	2100	No
v_3 or v_{av34}	1328 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2897 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2897	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 20.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.363

Space mean speed in ramp influence area, S_R = 55.4 mph

Space mean speed in outer lanes, S_0 = 67.8 mph

Space mean speed for all vehicles, S = 58.8 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3080	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	880	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	630	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3080		880		630	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	856		244		175	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3508        1002        718       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3508   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4510          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3508                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual       Max Desirable        Violation?
     v                4510         4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   33.9    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.586
                                              S
Space mean speed in ramp influence area,     S  = 50.7    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.7    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3400	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1000	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	310	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3400		1000		310	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	944		278		86	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3872        1139        353       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.611   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2808   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  3872          6990            No
      Fi   F
     v  = v - v              2733          6990            No
      FO   F   R
     v                       1139          2100            No
      R
     v  or v                 1064 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2808                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                      Actual        Max Desirable         Violation?
     v                2808          4400                  No
      12
_________________Level of Service Determination (if not F)______________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   19.4    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.401
                                              S
Space mean speed in ramp influence area,     S  = 54.6    mph
                                              R
Space mean speed in outer lanes,             S  = 68.9    mph
                                              0
Space mean speed for all vehicles,           S  = 57.9    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2400	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	310	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1000	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2400	310	1000	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	667	86	278	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2733        353         1139      pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =    1055.80 (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2733   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     3086          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2733                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                3086          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   23.1    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.316
                                              S
Space mean speed in ramp influence area,     S  = 56.4    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 56.4    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3100	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	800	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	160	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3100		800		160	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	861		222		44	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           3531        911         182       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =           (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.630   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2561   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks__________________________________

                           Actual        Maximum         LOS F?
     v  = v                3531          6990            No
      Fi   F
     v  = v - v            2620          6990            No
      FO   F   R
     v                     911           2100            No
      R
     v  or v               970  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2561                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2561          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   17.3    pc/mi/ln
                        R                   12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.380
                                              S
Space mean speed in ramp influence area,     S  = 55.0    mph
                                              R
Space mean speed in outer lanes,             S  = 69.1    mph
                                              0
Space mean speed for all vehicles,           S  = 58.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2300	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	160	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	800	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2300	160	800	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	639	44	222	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2619        182         911       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2619   pc/h
                   12   F   FM

_______________________________Capacity Checks_______________________________

                           Actual        Maximum         LOS F?
     v                     2801          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2619                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2801          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   20.3    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.286
                                              S
Space mean speed in ramp influence area,     S  = 57.0    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.0    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2460	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1090	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2460		1090		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	683		303		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2938        1302        741       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  2938   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  2938          4660            No
      Fi   F
     v  = v - v              1636          4660            No
      FO   F   R
     v                       1302          2100            No
      R
     v  or v                 0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2938                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2938          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   18.6    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.415
                                              S
Space mean speed in ramp influence area,     S  = 54.3    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 54.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	1/8/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1370	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1090	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1370	620	1090	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	381	172	303	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1636	741	1302	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1636 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2377	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 1636 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2377	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 17.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.273

Space mean speed in ramp influence area, S_R = 57.3 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 57.3 mph

FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	AM PEAK

Site Information

Freeway/Dir of Travel	I-229/SB
Weaving Segment Location	26TH TO 41ST
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2900ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2724	0.90	5	0	1.5	1.2	0.976	1.00	3102
V_{RF}	764	0.90	5	0	1.5	1.2	0.976	1.00	870
V_{FR}	364	0.90	5	0	1.5	1.2	0.976	1.00	415
V_{RR}	26	0.90	5	0	1.5	1.2	0.976	1.00	30
V_{NW}	3132							V =	4417
V_W	1285								
VR	0.291								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1285 lc/h
Weaving lane changes, LC_W	1559 lc/h
Non-weaving lane changes, LC_{NW}	1639 lc/h
Total lane changes, LC_{ALL}	3198 lc/h
Non-weaving vehicle index, I_{NW}	636

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4309 veh/h
Weaving segment capacity, c_w	6299 veh/h
Weaving segment v/c ratio	0.684
Weaving segment density, D	29.6 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.244
Weaving segment speed, S	49.8 mph
Average weaving speed, S_W	59.5 mph
Average non-weaving speed, S_{NW}	46.7 mph
Maximum weaving length, L_{MAX}	5487 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	AM PEAK

Site Information

Freeway/Dir of Travel	I-229/NB
Weaving Segment Location	41ST TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3317	0.90	5	0	1.5	1.2	0.976	1.00	3778
V_{RF}	677	0.90	5	0	1.5	1.2	0.976	1.00	771
V_{FR}	517	0.90	5	0	1.5	1.2	0.976	1.00	589
V_{RR}	23	0.90	5	0	1.5	1.2	0.976	1.00	26
V_{NW}	3804							V =	5164
V_W	1360								
VR	0.263								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1360 lc/h
Weaving lane changes, LC_W	1636 lc/h
Non-weaving lane changes, LC_{NW}	1805 lc/h
Total lane changes, LC_{ALL}	3441 lc/h
Non-weaving vehicle index, I_{NW}	786

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5038 veh/h
Weaving segment capacity, c_w	6375 veh/h
Weaving segment v/c ratio	0.790
Weaving segment density, D	35.9 pc/mi/ln
Level of Service, LOS	E
Weaving intensity factor, W	0.255
Weaving segment speed, S	48.0 mph
Average weaving speed, S_W	59.3 mph
Average non-weaving speed, S_{NW}	44.9 mph
Maximum weaving length, L_{MAX}	5194 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	PM PEAK

Site Information

Freeway/Dir of Travel	I-229 NB
Weaving Segment Location	CLIFF TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3090	0.90	5	0	1.5	1.2	0.976	1.00	3519
V_{RF}	300	0.90	5	0	1.5	1.2	0.976	1.00	342
V_{FR}	790	0.90	5	0	1.5	1.2	0.976	1.00	900
V_{RR}	10	0.90	5	0	1.5	1.2	0.976	1.00	11
V_{NW}	3530							V =	4772
V_W	1242								
VR	0.260								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1518 lc/h
Non-weaving lane changes, LC_{NW}	1748 lc/h
Total lane changes, LC_{ALL}	3266 lc/h
Non-weaving vehicle index, I_{NW}	729

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4656 veh/h
Weaving segment capacity, c_w	6383 veh/h
Weaving segment v/c ratio	0.729
Weaving segment density, D	32.3 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.245
Weaving segment speed, S	49.2 mph
Average weaving speed, S_W	59.5 mph
Average non-weaving speed, S_{NW}	46.4 mph
Maximum weaving length, L_{MAX}	5162 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	PM PEAK

Site Information

Freeway/Dir of Travel	I-229 NB
Weaving Segment Location	CLIFF TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3090	0.90	5	0	1.5	1.2	0.976	1.00	3519
V_{RF}	300	0.90	5	0	1.5	1.2	0.976	1.00	342
V_{FR}	790	0.90	5	0	1.5	1.2	0.976	1.00	900
V_{RR}	10	0.90	5	0	1.5	1.2	0.976	1.00	11
V_{NW}	3530							V =	4772
V_W	1242								
VR	0.260								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1518 lc/h
Non-weaving lane changes, LC_{NW}	1748 lc/h
Total lane changes, LC_{ALL}	3266 lc/h
Non-weaving vehicle index, I_{NW}	729

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4656 veh/h
Weaving segment capacity, c_w	6383 veh/h
Weaving segment v/c ratio	0.729
Weaving segment density, D	32.3 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.245
Weaving segment speed, S	49.2 mph
Average weaving speed, S_W	59.5 mph
Average non-weaving speed, S_{NW}	46.4 mph
Maximum weaving length, L_{MAX}	5162 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	AM Peak, ALT 5A
Freeway/Direction:	I-229/SB
From/To:	10th/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2490	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	692	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1487	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1487	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	2	
Density, D	22.9	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	AM Peak, ALT 5A
Freeway/Direction:	I-229/SB
From/To:	26th/41st
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2750	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	764	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1044	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1044	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	16.1	pc/mi/ln
Level of service, LOS	B	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	AM Peak, ALT 5A
Freeway/Direction:	I-229/NB
From/To:	41st/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3340	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	928	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1268	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1268	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.5	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	AM Peak, ALT 5A
Freeway/Direction:	I-229/NB
From/To:	26th/10th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3370	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	936	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2013	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	2013	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	59.7	mi/h
Number of lanes, N	2	
Density, D	33.7	pc/mi/ln
Level of service, LOS	D	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	PM Peak, ALT 5A
Freeway/Direction:	I-229/SB
From/To:	10th/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3870	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1075	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2311	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	2311	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	53.2	mi/h
Number of lanes, N	2	
Density, D	43.4	pc/mi/ln
Level of service, LOS	E	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	PM Peak, ALT 5A
Freeway/Direction:	I-229/SB
From/To:	26th/41st
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3710	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1031	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1408	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1408	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.7	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	PM Peak, ALT 5A
Freeway/Direction:	I-229/NB
From/To:	41st/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3100	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	861	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1177	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1177	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	PM Peak, ALT 5A
Freeway/Direction:	I-229/NB
From/To:	26th/10th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2460	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	683	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1469	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1469	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	2	
Density, D	22.6	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH STREET
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3150	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1150	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	490	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3150		1150		490	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	875		319		136	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3762        1374        585       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =             (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.603   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2813   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  3762          6990            No
      Fi   F
     v  = v - v              2388          6990            No
      FO   F   R
     v                       1374          2100            No
      R
     v  or v                 949  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2813                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                        Actual        Max Desirable        Violation?
     v                  2813          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,                 D = 4.252 + 0.0086 v  - 0.009  L   =   19.4    pc/mi/ln
                          R                 12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.422
                                              S
Space mean speed in ramp influence area,     S  = 54.1    mph
                                              R
Space mean speed in outer lanes,             S  = 69.1    mph
                                              0
Space mean speed for all vehicles,           S  = 57.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT. 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2000	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	490	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1150	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2000	490	1150	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	556	136	319	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2389	585	1374	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2389 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2974	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2389 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2974	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 20.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.288

Space mean speed in ramp influence area, S_R = 56.9 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 56.9 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2490	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	530	vph
Length of first accel/decel lane	1060	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	790	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2560	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2490		530		790	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	692		147		219	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2836        604         900        pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  2836   pc/h
                   12   R      F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                2836          4660            No
      Fi   F
     v  = v - v            2232          4660            No
      FO   F   R
     v                     604           2100            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2836                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2836          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   19.1    pc/mi/ln
                        R                   12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.352
                                              S
Space mean speed in ramp influence area,     S  = 55.6    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 55.6    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT. 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1960	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	790	vph
Length of first accel/decel lane	1350	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	530	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2560	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1960		790		530	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	544		219		147	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2232        900         604        pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2232   pc/h
                   12   F   FM

_______________________________Capacity Checks_______________________________

                             Actual        Maximum         LOS F?
     v                       3132          4660            No
      FO
     v  or v                 0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34        12
If yes, v    = 2232                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                3132          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   21.0    pc/mi/ln
         R                    R           12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.289
                                              S
Space mean speed in ramp influence area,     S  = 56.9    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 56.9    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 4/7/2014
Analysis time period: AM PEAK, ALT 5A
Freeway/Dir of Travel: I-229 SB
Junction: 41ST ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2750	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	390	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	810	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2750		390		810	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	764		108		225	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3132        444         923       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.661   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2222   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  3132          6990            No
      Fi   F
     v  = v - v              2688          6990            No
      FO   F   R
     v                       444           2100            No
      R
     v  or v                 910  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2222                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                      Actual        Max Desirable        Violation?
     v                2222          4400                 No
      12
_________________Level of Service Determination (if not F)______________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   14.4    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.338
                                              S
Space mean speed in ramp influence area,     S  = 55.9    mph
                                              R
Space mean speed in outer lanes,             S  = 69.1    mph
                                              0
Space mean speed for all vehicles,           S  = 59.2    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2360	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	810	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	390	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2360		810		390	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	656		225		108	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2688        923         444       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2688   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     3611          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2688                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                3611          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   26.9    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                M  = 0.375
                                             S
Space mean speed in ramp influence area,    S  = 55.1    mph
                                             R
Space mean speed in outer lanes,            S  =  N/A    mph
                                             0
Space mean speed for all vehicles,          S  = 55.1    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 4/7/2014
Analysis time period: AM PEAK, ALT 5A
Freeway/Dir of Travel: I-229 NB
Junction: 41ST ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3210	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	570	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	700	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3210		570		700	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	892		158		194	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           3656        649         797       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =           (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.639   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2570   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                3656          6990            No
      Fi   F
     v  = v - v            3007          6990            No
      FO   F   R
     v                     649           2100            No
      R
     v  or v               1086 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2570                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                      Actual        Max Desirable        Violation?
     v                2570          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   17.4    pc/mi/ln
                        R                   12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.356
                                              S
Space mean speed in ramp influence area,     S  = 55.5    mph
                                              R
Space mean speed in outer lanes,             S  = 68.8    mph
                                              0
Space mean speed for all vehicles,           S  = 58.9    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2640	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	700	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	570	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2640		700		570	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	733		194		158	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3007	797	649	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1209.46 (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3007 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3804	4660	No

v_3 or v_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3007 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3804	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 28.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, M_S = 0.406

Space mean speed in ramp influence area, S_R = 54.5 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 54.5 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3340	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	540	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	570	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3340		540		570	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	928		150		158	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3804	615	649	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.637 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2645 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3804	6990	No
$v_{FO} = v_F - v_R$	3189	6990	No
v_R	615	2100	No
v_3 or v_{av34}	1159 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2645 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2645	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 18.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.353	
Space mean speed in ramp influence area,	S_R = 55.6	mph
Space mean speed in outer lanes,	S_0 = 68.5	mph
Space mean speed for all vehicles,	S = 59.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2800	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	570	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	540	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2800		570		540	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	778		158		150	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3189	649	615	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F\,(P_{FM})$ = 3189 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3838	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3189 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3838	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\,v_R + 0.0078\,v_{12} - 0.00627\,L_A$ = 28.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M_S = 0.403	
Space mean speed in ramp influence area,	S_R = 54.5	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 54.5	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3370	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	740	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	760	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3370		740		760	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	936		206		211	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           4025        884         908       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L   =            (Equation 13-12 or 13-13)
                   EQ
                  P   =    1.000   Using Equation  0
                   FD
                  v   = v  + (v - v ) P  =  4025   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                4025          4660            No
      Fi   F
     v  = v - v            3141          4660            No
      FO   F   R
     v                     884           2100            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 4025                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                4025          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   28.0-   pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.378
                                              S
Space mean speed in ramp influence area,     S  = 55.1    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 55.1    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 4/7/2014
Analysis time period: AM PEAK, ALT 5A
Freeway/Dir of Travel: I-229 NB
Junction: 10TH ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2630	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	760	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	740	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2630	760	740	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	731	211	206	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           3141        908         884       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =             (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3141   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4049          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3141                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                4049          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   30.4    pc/mi/ln
         R                    R           12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.455
                                              S
Space mean speed in ramp influence area,     S  = 53.5    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 53.5    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH STREET
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	4180	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	930	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4180		930		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1161		258		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           4993        1111        741        pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.584   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  3378   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  4993          6990            No
      Fi   F
     v  = v - v              3882          6990            No
      FO   F   R
     v                       1111          2100            No
      R
     v  or v                 1615 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 3378                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                3378          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   24.3    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.398
                                              S
Space mean speed in ramp influence area,     S  = 54.6    mph
                                              R
Space mean speed in outer lanes,             S  = 66.7    mph
                                              0
Space mean speed for all vehicles,           S  = 58.0    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3250	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	930	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3250	620	930	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	903	172	258	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3882        741         1111      pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3882   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4623          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3882                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                4623          4600                 Yes
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   33.6    pc/mi/ln
          R                   R          12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.609
                                              S
Space mean speed in ramp influence area,     S  = 50.2    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.2    mph
_______________________________________________________________________________
```

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3870	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	780	vph
Length of first accel/decel lane	580	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2560	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3870		780		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1075		217		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV             0.976       0.976       0.976
Driver population factor, fP              1.00        1.00        1.00
Flow rate, vp                             4408        888         706       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L   =            (Equation 13-12 or 13-13)
                   EQ
                  P   =    1.000   Using Equation  0
                   FD
                  v   = v  + (v - v ) P  =  4408   pc/h
                   12   R      F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum          LOS F?
     v  = v                4408          4660             No
      Fi   F
     v  = v - v            3520          4660             No
      FO   F   R
     v                     888           2100             No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 4408                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                4408          4400                  Yes
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   36.9    pc/mi/ln
                        R                   12          D
Level of service for ramp-freeway junction areas of influence E

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                D  = 0.378
                                             S
Space mean speed in ramp influence area,    S  = 55.1    mph
                                             R
Space mean speed in outer lanes,            S  =  N/A    mph
                                             0
Space mean speed for all vehicles,          S  = 55.1    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3090	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	780	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2560	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3090	620	780	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	858	172	217	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3519        706         888       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L   =            (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v   = v  (P   ) =  3519   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4225          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3519                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                4225          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   31.8    pc/mi/ln
          R                    R           12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.498
                                              S
Space mean speed in ramp influence area,     S  = 52.5    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 52.5    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 4/7/2014
Analysis time period: PM PEAK, ALT 5A
Freeway/Dir of Travel: I-229 SB
Junction: 41ST ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3710	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	630	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	880	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3710		630		880	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1031		175		244	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4225	718	1002	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.621 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2897 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4225	6990	No
$v_{FO} = v_F - v_R$	3507	6990	No
v_R	718	2100	No
v_3 or v_{av34}	1328 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2897 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2897	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 20.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.363	
Space mean speed in ramp influence area,	S_R = 55.4	mph
Space mean speed in outer lanes,	S_0 = 67.8	mph
Space mean speed for all vehicles,	S = 58.8	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3080	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	880	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	630	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3080	880	630	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	856	244	175	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           3508        1002        718       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3508   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4510          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3508                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                4510          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   33.9    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.586
                                              S
Space mean speed in ramp influence area,     S  = 50.7    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.7    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3400	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1000	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	310	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3400		1000		310	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	944		278		86	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3872	1139	353	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.611 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2808 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3872	6990	No
$v_{FO} = v_F - v_R$	2733	6990	No
v_R	1139	2100	No
v_3 or v_{av34}	1064 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2808 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2808	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 19.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.401

Space mean speed in ramp influence area, S_R = 54.6 mph

Space mean speed in outer lanes, S_0 = 68.9 mph

Space mean speed for all vehicles, S = 57.9 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2400	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	310	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1000	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2400	310	1000	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	667	86	278	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2733        353         1139      pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =    1055.80 (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2733   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v                       3086          4660            No
      FO
     v  or v                 0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2733                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                3086          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   23.1    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.316
                                              S
Space mean speed in ramp influence area,     S  = 56.4    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 56.4    mph
_______________________________________________________________________________
```

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3100	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	800	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	160	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3100		800		160	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	861		222		44	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3531	911	182	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.630 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2561 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3531	6990	No
$v_{FO} = v_F - v_R$	2620	6990	No
v_R	911	2100	No
v_3 or v_{av34}	970 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2561 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2561	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 17.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.380	
Space mean speed in ramp influence area,	S_R = 55.0	mph
Space mean speed in outer lanes,	S_0 = 69.1	mph
Space mean speed for all vehicles,	S = 58.3	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2300	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	160	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	800	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2300		160		800	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	639		44		222	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2619        182         911       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2619   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     2801          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2619                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2801          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   20.3    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.286
                                              S
Space mean speed in ramp influence area,     S  = 57.0    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.0    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2460	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1090	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2460		1090		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	683		303		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2938        1302        741       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  2938   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  2938          4660            No
      Fi   F
     v  = v - v              1636          4660            No
      FO   F   R
     v                       1302          2100            No
      R
     v  or v                 0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2938                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2938          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   18.6    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                D  = 0.415
                                             S
Space mean speed in ramp influence area,    S  = 54.3    mph
                                             R
Space mean speed in outer lanes,            S  =  N/A    mph
                                             0
Space mean speed for all vehicles,          S  = 54.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 5A
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1370	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1090	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1370	620	1090	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	381	172	303	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1636	741	1302	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1636 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2377	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	
If yes, v_{12A} = 1636		(Equation 13-15, 13-16, 13-18, or 13-19)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2377	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.273	
Space mean speed in ramp influence area,	S_R = 57.3	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 57.3	mph

FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	AM PEAK, ALT 5A

Site Information

Freeway/Dir of Travel	I-229/SB
Weaving Segment Location	26TH TO 41ST
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2650ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2724	0.90	5	0	1.5	1.2	0.976	1.00	3102
V_{RF}	764	0.90	5	0	1.5	1.2	0.976	1.00	870
V_{FR}	364	0.90	5	0	1.5	1.2	0.976	1.00	415
V_{RR}	26	0.90	5	0	1.5	1.2	0.976	1.00	30
V_{NW}	3132							V =	4417
V_W	1285								
VR	0.291								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1285 lc/h
Weaving lane changes, LC_W	1545 lc/h
Non-weaving lane changes, LC_{NW}	1504 lc/h
Total lane changes, LC_{ALL}	3049 lc/h
Non-weaving vehicle index, I_{NW}	581

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4309 veh/h
Weaving segment capacity, c_w	6243 veh/h
Weaving segment v/c ratio	0.690
Weaving segment density, D	29.6 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.252
Weaving segment speed, S	49.8 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	46.7 mph
Maximum weaving length, L_{MAX}	5487 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	AM PEAK, ALT 5A

Site Information

Freeway/Dir of Travel	I-229/NB
Weaving Segment Location	41ST TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3317	0.90	5	0	1.5	1.2	0.976	1.00	3778
V_{RF}	677	0.90	5	0	1.5	1.2	0.976	1.00	771
V_{FR}	517	0.90	5	0	1.5	1.2	0.976	1.00	589
V_{RR}	23	0.90	5	0	1.5	1.2	0.976	1.00	26
V_{NW}	3804							V =	5164
V_W	1360								
VR	0.263								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1360 lc/h
Weaving lane changes, LC_W	1636 lc/h
Non-weaving lane changes, LC_{NW}	1805 lc/h
Total lane changes, LC_{ALL}	3441 lc/h
Non-weaving vehicle index, I_{NW}	786

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5038 veh/h
Weaving segment capacity, c_w	6375 veh/h
Weaving segment v/c ratio	0.790
Weaving segment density, D	35.9 pc/mi/ln
Level of Service, LOS	E
Weaving intensity factor, W	0.255
Weaving segment speed, S	48.0 mph
Average weaving speed, S_W	59.3 mph
Average non-weaving speed, S_{NW}	44.9 mph
Maximum weaving length, L_{MAX}	5194 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	PM PEAK, ALT 5A

Site Information

Freeway/Dir of Travel	I-229 SB
Weaving Segment Location	26TH TO CLIFF
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2650ft
Freeway free-flow speed, FFS	63 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3690	0.90	5	0	1.5	1.2	0.976	1.00	4203
V_{RF}	600	0.90	5	0	1.5	1.2	0.976	1.00	683
V_{FR}	610	0.90	5	0	1.5	1.2	0.976	1.00	695
V_{RR}	20	0.90	5	0	1.5	1.2	0.976	1.00	23
V_{NW}	4226							V =	5604
V_W	1378								
VR	0.246								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	0 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	0 lc/h
Weaving lane changes, LC_W	260 lc/h
Non-weaving lane changes, LC_{NW}	1729 lc/h
Total lane changes, LC_{ALL}	1989 lc/h
Non-weaving vehicle index, I_{NW}	784

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5467 veh/h
Weaving segment capacity, c_w	6348 veh/h
Weaving segment v/c ratio	0.861
Weaving segment density, D	33.7 pc/mi/ln
Level of Service, LOS	D

Weaving intensity factor, W	0.180
Weaving segment speed, S	55.4 mph
Average weaving speed, S_W	60.3 mph
Average non-weaving speed, S_{NW}	54.0 mph
Maximum weaving length, L_{MAX}	5011 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	4/7/2014
Analysis Time Period	PM PEAK, ALT 5A

Site Information

Freeway/Dir of Travel	I-229 NB
Weaving Segment Location	CLIFF TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3090	0.90	5	0	1.5	1.2	0.976	1.00	3519
V_{RF}	300	0.90	5	0	1.5	1.2	0.976	1.00	342
V_{FR}	790	0.90	5	0	1.5	1.2	0.976	1.00	900
V_{RR}	10	0.90	5	0	1.5	1.2	0.976	1.00	11
V_{NW}	3530							V =	4772
V_W	1242								
VR	0.260								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1518 lc/h
Non-weaving lane changes, LC_{NW}	1748 lc/h
Total lane changes, LC_{ALL}	3266 lc/h
Non-weaving vehicle index, I_{NW}	729

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4656 veh/h
Weaving segment capacity, c_w	6383 veh/h
Weaving segment v/c ratio	0.729
Weaving segment density, D	32.3 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.245
Weaving segment speed, S	49.2 mph
Average weaving speed, S_W	59.5 mph
Average non-weaving speed, S_{NW}	46.4 mph
Maximum weaving length, L_{MAX}	5162 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	AM Peak, ALT 7A
Freeway/Direction:	I-229/SB
From/To:	10th/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2490	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	692	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1487	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1487	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	2	
Density, D	22.9	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	AM Peak, ALT 7A
Freeway/Direction:	I-229/SB
From/To:	26th/41st
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2750	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	764	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1044	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1044	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	16.1	pc/mi/ln
Level of service, LOS	B	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	AM Peak, ALT 7A
Freeway/Direction:	I-229/NB
From/To:	41st/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3340	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	928	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1268	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1268	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.5	pc/mi/ln
Level of service, LOS	C	

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Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	AM Peak, ALT 7A
Freeway/Direction:	I-229/NB
From/To:	26th/10th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3370	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	936	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2013	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	2013	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	59.7	mi/h
Number of lanes, N	2	
Density, D	33.7	pc/mi/ln
Level of service, LOS	D	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	PM Peak, ALT 7A
Freeway/Direction:	I-229/SB
From/To:	10th/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3870	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1075	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2311	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	2311	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	53.2	mi/h
Number of lanes, N	2	
Density, D	43.4	pc/mi/ln
Level of service, LOS	E	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	PM Peak, ALT 7A
Freeway/Direction:	I-229/SB
From/To:	26th/41st
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3710	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1031	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1408	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1408	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.7	pc/mi/ln
Level of service, LOS	C	

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Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	PM Peak, ALT 7A
Freeway/Direction:	I-229/NB
From/To:	41st/26th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	3100	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	861	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.976	
Driver population factor, fp	1.00	
Flow rate, vp	1177	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1177	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.1	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Basic Freeway Segments Release 6.60

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	HDR
Agency or Company:	SDDOT/City of SF
Date Performed:	4/7/2014
Analysis Time Period:	PM Peak, ALT 7A
Freeway/Direction:	I-229/NB
From/To:	26th/10th
Jurisdiction:	City of Sioux Falls
Analysis Year:	2035

Description: I-229/26th St. (Exit 5) Corridor Study

Flow Inputs and Adjustments

Volume, V	2460	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	683	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Rolling	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5	
Recreational vehicle PCE, ER	2.0	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1469	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	63.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	63.0	mi/h

LOS and Performance Measures

Flow rate, vp	1469	pc/h/ln
Free-flow speed, FFS	63.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	2	
Density, D	22.6	pc/mi/ln
Level of service, LOS	C	

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH STREET
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3150	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1150	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	490	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3150		1150		490	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	875		319		136	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3762        1374        585       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.603   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2813   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  3762          6990            No
      Fi   F
     v  = v - v              2388          6990            No
      FO   F   R
     v                       1374          2100            No
      R
     v  or v                 949  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2813                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                        Actual        Max Desirable         Violation?
     v                  2813          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,                 D = 4.252 + 0.0086 v  - 0.009  L   =   19.4    pc/mi/ln
                          R                  12           D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.422
                                              S
Space mean speed in ramp influence area,     S  = 54.1    mph
                                              R
Space mean speed in outer lanes,             S  = 69.1    mph
                                              0
Space mean speed for all vehicles,           S  = 57.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT. 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2000	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	490	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1150	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2000	490	1150	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	556	136	319	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2389	585	1374	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2389 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2974	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2389 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2974	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 20.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.288	
Space mean speed in ramp influence area,	S_R = 56.9	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 56.9	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2490	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	530	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	790	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1900	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2490		530		790	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	692		147		219	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2836        604         900       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  2836   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  2836          4660            No
      Fi   F
     v  = v - v              2232          4660            No
      FO   F   R
     v                       604           2100            No
      R
     v  or v                 0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2836                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2836          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   15.1    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                D  = 0.352
                                             S
Space mean speed in ramp influence area,    S  = 55.6    mph
                                             R
Space mean speed in outer lanes,            S  =  N/A    mph
                                             0
Space mean speed for all vehicles,          S  = 55.6    mph
_______________________________________________________________________________
```

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT. 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1960	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	790	vph
Length of first accel/decel lane	1180	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	530	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1900	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1960		790		530	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	544		219		147	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           2232        900         604       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2232   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     3132          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2232                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                3132          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   22.1    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.304
                                              S
Space mean speed in ramp influence area,     S  = 56.6    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 56.6    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2750	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	390	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	810	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2750		390		810	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	764		108		225	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3132        444         923       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.661   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2222   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  3132          6990            No
      Fi   F
     v  = v - v              2688          6990            No
      FO   F   R
     v                       444           2100            No
      R
     v  or v                 910  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2222                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                      Actual        Max Desirable        Violation?
     v                2222          4400                 No
      12
_________________Level of Service Determination (if not F)______________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   14.4    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.338
                                              S
Space mean speed in ramp influence area,     S  = 55.9    mph
                                              R
Space mean speed in outer lanes,             S  = 69.1    mph
                                              0
Space mean speed for all vehicles,           S  = 59.2    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 4/7/2014
Analysis time period: AM PEAK, ALT 7A
Freeway/Dir of Travel: I-229 SB
Junction: 41ST ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2360	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	810	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	390	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2360		810		390	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	656		225		108	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2688	923	444	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2688 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3611	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2688 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3611	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 26.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.375	
Space mean speed in ramp influence area,	S_R = 55.1	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 55.1	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3210	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	570	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	700	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3210		570		700	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	892		158		194	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           3656        649         797       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.639   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2570   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks________________________________

                           Actual        Maximum         LOS F?
     v  = v                3656          6990            No
      Fi   F
     v  = v - v            3007          6990            No
      FO   F   R
     v                     649           2100            No
      R
     v  or v               1086 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2570                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                      Actual        Max Desirable        Violation?
     v                2570          4400                 No
      12
_________________Level of Service Determination (if not F)______________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   17.4    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.356
                                              S
Space mean speed in ramp influence area,     S  = 55.5    mph
                                              R
Space mean speed in outer lanes,             S  = 68.8    mph
                                              0
Space mean speed for all vehicles,           S  = 58.9    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2640	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	700	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	570	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2640		700		570	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	733		194		158	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3007        797         649       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L   =    1209.46 (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3007   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     3804          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3007                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                3804          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   28.5    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.406
                                              S
Space mean speed in ramp influence area,     S  = 54.5    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 54.5    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3340	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	540	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	570	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3340		540		570		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	928		150		158		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

```
Heavy vehicle adjustment, fHV           0.976       0.976       0.976
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           3804        615         649       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.637   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2645   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks________________________________

                           Actual        Maximum         LOS F?
     v  = v                3804          6990            No
      Fi   F
     v  = v - v            3189          6990            No
      FO   F   R
     v                     615           2100            No
      R
     v  or v               1159 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2645                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2645          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   18.0    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.353
                                              S
Space mean speed in ramp influence area,     S  = 55.6    mph
                                              R
Space mean speed in outer lanes,             S  = 68.5    mph
                                              0
Space mean speed for all vehicles,           S  = 59.0    mph
_______________________________________________________________________________
```

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2800	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	570	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	540	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2800		570		540	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	778		158		150	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3189	649	615	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3189 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3838	4660	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3189 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3838	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 28.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M_S = 0.403	
Space mean speed in ramp influence area,	S_R = 54.5	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 54.5	mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3370	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	740	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	760	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3370		740		760	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	936		206		211	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          4025        884         908       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  4025   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                4025          4660            No
      Fi   F
     v  = v - v            3141          4660            No
      FO   F   R
     v                     884           2100            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 4025                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                4025          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   28.0-   pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.378
                                              S
Space mean speed in ramp influence area,     S  = 55.1    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 55.1    mph
_______________________________________________________________________________
```

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	AM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2630	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	760	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	740	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2630	760	740	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	731	211	206	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           3141        908         884        pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3141   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v                       4049          4660            No
      FO
     v  or v                 0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 3141                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                        Actual        Max Desirable        Violation?
     v                  4049          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   30.4    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.455
                                              S
Space mean speed in ramp influence area,     S  = 53.5    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 53.5    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 4/7/2014
Analysis time period: PM PEAK, ALT 7A
Freeway/Dir of Travel: I-229 SB
Junction: 10TH STREET
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	4180	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	930	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4180		930		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1161		258		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          4993        1111        741       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.584   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  3378   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v  = v                  4993          6990            No
      Fi   F
     v  = v - v              3882          6990            No
      FO   F   R
     v                       1111          2100            No
      R
     v  or v                 1615 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 3378                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                3378          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   24.3    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.398
                                              S
Space mean speed in ramp influence area,     S  = 54.6    mph
                                              R
Space mean speed in outer lanes,             S  = 66.7    mph
                                              0
Space mean speed for all vehicles,           S  = 58.0    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	10TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3250	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	930	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1710	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3250	620	930	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	903	172	258	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV              0.930        0.930        0.930
Driver population factor, fP               1.00         1.00         1.00
Flow rate, vp                              3882         741          1111       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L   =             (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v   = v  (P   ) =  3882   pc/h
                   12   F    FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4623          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34          12
If yes, v    = 3882                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                4623          4600                 Yes
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   33.6    pc/mi/ln
          R                   R            12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.609
                                              S
Space mean speed in ramp influence area,     S  = 50.2    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.2    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3870	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	780	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1900	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3870		780		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1075		217		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4408	888	706	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4408 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4408	4660	No
$v_{FO} = v_F - v_R$	3520	4660	No
v_R	888	2100	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 4408 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	4408	4400	Yes

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 28.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, D_S = 0.378

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 55.1 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3090	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1180	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	780	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1900	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3090		620		780	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	858		172		217	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3519        706         888       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3519   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4225          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3519                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area______________________
                      Actual        Max Desirable        Violation?
     v                4225          4600                 No
      R12
_________________Level of Service Determination (if not F)______________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   30.7    pc/mi/ln
          R                   R           12             A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation___________________________________

Intermediate speed variable,                 M  = 0.481
                                              S
Space mean speed in ramp influence area,     S  = 52.9    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 52.9    mph
_______________________________________________________________________________
```

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3710	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	630	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	880	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3710		630		880	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	1031		175		244	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.976	0.976	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4225	718	1002	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.621 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2897 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4225	6990	No
$v_{FO} = v_F - v_R$	3507	6990	No
v_R	718	2100	No
v_3 or v_{av34}	1328 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2897 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2897	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 20.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.363	
Space mean speed in ramp influence area,	S_R = 55.4	mph
Space mean speed in outer lanes,	S_0 = 67.8	mph
Space mean speed for all vehicles,	S = 58.8	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 SB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3080	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	880	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	630	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3080	880	630	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	856	244	175	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3508        1002        718        pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =           (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3508   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     4510          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3508                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                4510          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   33.9    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  D

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.586
                                              S
Space mean speed in ramp influence area,     S  = 50.7    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.7    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3400	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1000	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	310	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3400		1000		310	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	944		278		86	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3872        1139        353       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =           (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.611   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2808   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks________________________________

                             Actual        Maximum         LOS F?
     v  = v                  3872          6990            No
      Fi   F
     v  = v - v              2733          6990            No
      FO   F   R
     v                       1139          2100            No
      R
     v  or v                 1064 pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2808                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2808          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   19.4    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.401
                                              S
Space mean speed in ramp influence area,     S  = 54.6    mph
                                              R
Space mean speed in outer lanes,             S  = 68.9    mph
                                              0
Space mean speed for all vehicles,           S  = 57.9    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.60

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	41ST ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2400	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	310	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1000	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2420	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2400		310		1000	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	667		86		278	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2733        353         1139      pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =    1055.80 (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2733   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     3086          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2733                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable          Violation?
     v                3086          4600                   No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   23.1    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.316
                                              S
Space mean speed in ramp influence area,     S  = 56.4    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 56.4    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	63.0	mph
Volume on freeway	3100	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	800	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	160	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3100		800		160	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	861		222		44	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          3531        911         182       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    0.630   Using Equation  5
                   FD
                  v  = v  + (v - v ) P  =  2561   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                3531          6990            No
      Fi   F
     v  = v - v            2620          6990            No
      FO   F   R
     v                     911           2100            No
      R
     v  or v               970  pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 2561                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2561          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   17.3    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,               D  = 0.380
                                            S
Space mean speed in ramp influence area,   S  = 55.0    mph
                                            R
Space mean speed in outer lanes,           S  = 69.1    mph
                                            0
Space mean speed for all vehicles,         S  = 58.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	26TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2300	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	160	vph
Length of first accel/decel lane	1100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	800	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1310	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2300		160		800	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	639		44		222	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade		%		%		%
Length		mi		mi		mi
Trucks and buses PCE, ET	1.5		1.5		1.5	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

```
Heavy vehicle adjustment, fHV          0.976       0.976       0.976
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          2619        182         911       pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  2619   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     2801          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34        12
If yes, v    = 2619                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2801          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   20.3    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.286
                                              S
Space mean speed in ramp influence area,     S  = 57.0    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.0    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	HDR
Agency/Co.:	SDDOT/CITY OF SIOUX FALLS
Date performed:	4/7/2014
Analysis time period:	PM PEAK, ALT 7A
Freeway/Dir of Travel:	I-229 NB
Junction:	10TH ST.
Jurisdiction:	SIOUX FALLS
Analysis Year:	2035

Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	2460	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	1090	vph
Length of first accel/decel lane	1210	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	620	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2460		1090		620	vph
Peak-hour factor, PHF	0.90		0.90		0.90	
Peak 15-min volume, v15	683		303		172	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Rolling		Rolling		Rolling	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5		2.5		2.5	
Recreational vehicle PCE, ER	2.0		2.0		2.0	

```
Heavy vehicle adjustment, fHV           0.930       0.930       0.930
Driver population factor, fP            1.00        1.00        1.00
Flow rate, vp                           2938        1302        741       pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  2938   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks________________________________

                             Actual        Maximum         LOS F?
     v  = v                  2938          4660            No
      Fi   F
     v  = v - v              1636          4660            No
      FO   F   R
     v                       1302          2100            No
      R
     v  or v                 0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 2938                     (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                2938          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   18.6    pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.415
                                              S
Space mean speed in ramp influence area,     S  = 54.3    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 54.3    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Merge Analysis

Analyst: HDR
Agency/Co.: SDDOT/CITY OF SIOUX FALLS
Date performed: 4/7/2014
Analysis time period: PM PEAK, ALT 7A
Freeway/Dir of Travel: I-229 NB
Junction: 10TH ST.
Jurisdiction: SIOUX FALLS
Analysis Year: 2035
Description: I-229/26TH ST. (EXIT 5) CORRIDOR STUDY

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	63.0	mph
Volume on freeway	1370	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	620	vph
Length of first accel/decel lane	1000	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1090	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1720	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1370	620	1090	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	381	172	303	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

```
Heavy vehicle adjustment, fHV          0.930       0.930       0.930
Driver population factor, fP           1.00        1.00        1.00
Flow rate, vp                          1636        741         1302      pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1636   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     2377          4660            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1636                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2377          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   17.4    pc/mi/ln
          R                   R           12            A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.273
                                              S
Space mean speed in ramp influence area,     S  = 57.3    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 57.3    mph
_______________________________________________________________________________
```

FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	AM PEAK, ALT 7A

Site Information

Freeway/Dir of Travel	I-229/SB
Weaving Segment Location	26TH TO 41ST
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2724	0.90	5	0	1.5	1.2	0.976	1.00	3102
V_{RF}	764	0.90	5	0	1.5	1.2	0.976	1.00	870
V_{FR}	364	0.90	5	0	1.5	1.2	0.976	1.00	415
V_{RR}	26	0.90	5	0	1.5	1.2	0.976	1.00	30
V_{NW}	3132							V =	4417
V_W	1285								
VR	0.291								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1285 lc/h
Weaving lane changes, LC_W	1551 lc/h
Non-weaving lane changes, LC_{NW}	1558 lc/h
Total lane changes, LC_{ALL}	3109 lc/h
Non-weaving vehicle index, I_{NW}	603

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4309 veh/h
Weaving segment capacity, c_w	6266 veh/h
Weaving segment v/c ratio	0.688
Weaving segment density, D	29.6 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.249
Weaving segment speed, S	49.8 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	46.7 mph
Maximum weaving length, L_{MAX}	5487 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	AM PEAK, ALT 7A

Site Information

Freeway/Dir of Travel	I-229/NB
Weaving Segment Location	41ST TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3317	0.90	5	0	1.5	1.2	0.976	1.00	3778
V_{RF}	677	0.90	5	0	1.5	1.2	0.976	1.00	771
V_{FR}	517	0.90	5	0	1.5	1.2	0.976	1.00	589
V_{RR}	23	0.90	5	0	1.5	1.2	0.976	1.00	26
V_{NW}	3804							V =	5164
V_W	1360								
VR	0.263								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1360 lc/h
Weaving lane changes, LC_W	1636 lc/h
Non-weaving lane changes, LC_{NW}	1805 lc/h
Total lane changes, LC_{ALL}	3441 lc/h
Non-weaving vehicle index, I_{NW}	786

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5038 veh/h
Weaving segment capacity, c_w	6375 veh/h
Weaving segment v/c ratio	0.790
Weaving segment density, D	35.9 pc/mi/ln
Level of Service, LOS	E
Weaving intensity factor, W	0.255
Weaving segment speed, S	48.0 mph
Average weaving speed, S_W	59.3 mph
Average non-weaving speed, S_{NW}	44.9 mph
Maximum weaving length, L_{MAX}	5194 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	PM PEAK, ALT 7A

Site Information

Freeway/Dir of Travel	I-229 SB
Weaving Segment Location	26TH TO CLIFF
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3690	0.90	5	0	1.5	1.2	0.976	1.00	4203
V_{RF}	600	0.90	5	0	1.5	1.2	0.976	1.00	683
V_{FR}	610	0.90	5	0	1.5	1.2	0.976	1.00	695
V_{RR}	20	0.90	5	0	1.5	1.2	0.976	1.00	23
V_{NW}	4226							V =	5604
V_W	1378								
VR	0.246								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	0 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	0 lc/h
Weaving lane changes, LC_W	266 lc/h
Non-weaving lane changes, LC_{NW}	1783 lc/h
Total lane changes, LC_{ALL}	2049 lc/h
Non-weaving vehicle index, I_{NW}	814

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5467 veh/h
Weaving segment capacity, c_w	6372 veh/h
Weaving segment v/c ratio	0.858
Weaving segment density, D	33.7 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.179
Weaving segment speed, S	55.4 mph
Average weaving speed, S_W	60.3 mph
Average non-weaving speed, S_{NW}	54.0 mph
Maximum weaving length, L_{MAX}	5011 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	4/7/2014
Analysis Time Period	PM PEAK, ALT 7A

Site Information

Freeway/Dir of Travel	I-229 NB
Weaving Segment Location	CLIFF TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	3
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3090	0.90	5	0	1.5	1.2	0.976	1.00	3519
V_{RF}	300	0.90	5	0	1.5	1.2	0.976	1.00	342
V_{FR}	790	0.90	5	0	1.5	1.2	0.976	1.00	900
V_{RR}	10	0.90	5	0	1.5	1.2	0.976	1.00	11
V_{NW}	3530							V =	4772
V_W	1242								
VR	0.260								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1518 lc/h
Non-weaving lane changes, LC_{NW}	1748 lc/h
Total lane changes, LC_{ALL}	3266 lc/h
Non-weaving vehicle index, I_{NW}	729

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4656 veh/h
Weaving segment capacity, c_w	6383 veh/h
Weaving segment v/c ratio	0.729
Weaving segment density, D	32.3 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.245
Weaving segment speed, S	49.2 mph
Average weaving speed, S_W	59.5 mph
Average non-weaving speed, S_{NW}	46.4 mph
Maximum weaving length, L_{MAX}	5162 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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The following sheets represent an added additional lane on I-229 for justification of a future year LOS of "C" or better

FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	AM PEAK

Site Information

Freeway/Dir of Travel	I-229/SB
Weaving Segment Location	26TH TO 41ST
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided	Segment type	Freeway
Weaving number of lanes, N	4	Freeway minimum speed, S_{MIN}	45
Weaving segment length, L_S	2900ft	Freeway maximum capacity, C_{IFL}	2350
Freeway free-flow speed, FFS	63 mph	Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2724	0.90	5	0	1.5	1.2	0.976	1.00	3102
V_{RF}	764	0.90	5	0	1.5	1.2	0.976	1.00	870
V_{FR}	364	0.90	5	0	1.5	1.2	0.976	1.00	415
V_{RR}	26	0.90	5	0	1.5	1.2	0.976	1.00	30
V_{NW}	3132							V =	4417
V_W	1285								
VR	0.291								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1285 lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	1771 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1447 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3218 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	636

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4309 veh/h	Weaving intensity factor, W	0.245
Weaving segment capacity, c_w	8048 veh/h	Weaving segment speed, S	51.2 mph
Weaving segment v/c ratio	0.535	Average weaving speed, S_W	59.5 mph
Weaving segment density, D	21.6 pc/mi/ln	Average non-weaving speed, S_{NW}	48.4 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	5487 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	AM PEAK

Site Information

Freeway/Dir of Travel	I-229/NB
Weaving Segment Location	41ST TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3317	0.90	5	0	1.5	1.2	0.976	1.00	3778
V_{RF}	677	0.90	5	0	1.5	1.2	0.976	1.00	771
V_{FR}	517	0.90	5	0	1.5	1.2	0.976	1.00	589
V_{RR}	23	0.90	5	0	1.5	1.2	0.976	1.00	26
V_{NW}	3804							V =	5164
V_W	1360								
VR	0.263								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1360 lc/h
Weaving lane changes, LC_W	1851 lc/h
Non-weaving lane changes, LC_{NW}	1612 lc/h
Total lane changes, LC_{ALL}	3463 lc/h
Non-weaving vehicle index, I_{NW}	786

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5038 veh/h
Weaving segment capacity, c_w	8500 veh/h
Weaving segment v/c ratio	0.593
Weaving segment density, D	26.0 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.256
Weaving segment speed, S	49.7 mph
Average weaving speed, S_W	59.3 mph
Average non-weaving speed, S_{NW}	47.0 mph
Maximum weaving length, L_{MAX}	5194 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	PM PEAK

Site Information

Freeway/Dir of Travel	I-229 SB
Weaving Segment Location	26TH TO CLIFF
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2900ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3690	0.90	5	0	1.5	1.2	0.976	1.00	4203
V_{RF}	600	0.90	5	0	1.5	1.2	0.976	1.00	683
V_{FR}	610	0.90	5	0	1.5	1.2	0.976	1.00	695
V_{RR}	20	0.90	5	0	1.5	1.2	0.976	1.00	23
V_{NW}	4226							V =	5604
V_W	1378								
VR	0.246								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	0 lc/h
Interchange density, ID	0.7 int/mi	Weaving lane changes, LC_W	486 lc/h
Minimum RF lane changes, LC_{RF}	0 lc/pc	Non-weaving lane changes, LC_{NW}	1672 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	2158 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	858

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5467 veh/h	Weaving intensity factor, W	0.179
Weaving segment capacity, c_w	8542 veh/h	Weaving segment speed, S	57.2 mph
Weaving segment v/c ratio	0.640	Average weaving speed, S_W	60.3 mph
Weaving segment density, D	24.5 pc/mi/ln	Average non-weaving speed, S_{NW}	56.3 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	5011 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	1/8/2014
Analysis Time Period	PM PEAK

Site Information

Freeway/Dir of Travel	I-229 NB
Weaving Segment Location	CLIFF TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3090	0.90	5	0	1.5	1.2	0.976	1.00	3519
V_{RF}	300	0.90	5	0	1.5	1.2	0.976	1.00	342
V_{FR}	790	0.90	5	0	1.5	1.2	0.976	1.00	900
V_{RR}	10	0.90	5	0	1.5	1.2	0.976	1.00	11
V_{NW}	3530							V =	4772
V_W	1242								
VR	0.260								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1733 lc/h
Non-weaving lane changes, LC_{NW}	1556 lc/h
Total lane changes, LC_{ALL}	3289 lc/h
Non-weaving vehicle index, I_{NW}	729

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4656 veh/h
Weaving segment capacity, c_w	8511 veh/h
Weaving segment v/c ratio	0.547
Weaving segment density, D	23.5 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.246
Weaving segment speed, S	50.8 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	48.3 mph
Maximum weaving length, L_{MAX}	5162 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	AM PEAK, ALT 5A

Site Information

Freeway/Dir of Travel	I-229/SB
Weaving Segment Location	26TH TO 41ST
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2650ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	2724	0.90	5	0	1.5	1.2	0.976	1.00	3102
V_{RF}	764	0.90	5	0	1.5	1.2	0.976	1.00	870
V_{FR}	364	0.90	5	0	1.5	1.2	0.976	1.00	415
V_{RR}	26	0.90	5	0	1.5	1.2	0.976	1.00	30
V_{NW}	3132							V =	4417
V_W	1285								
VR	0.291								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1285 lc/h
Weaving lane changes, LC_W	1747 lc/h
Non-weaving lane changes, LC_{NW}	1311 lc/h
Total lane changes, LC_{ALL}	3058 lc/h
Non-weaving vehicle index, I_{NW}	581

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4309 veh/h
Weaving segment capacity, c_w	8048 veh/h
Weaving segment v/c ratio	0.535
Weaving segment density, D	21.6 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.253
Weaving segment speed, S	51.2 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	48.4 mph
Maximum weaving length, L_{MAX}	5487 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	AM PEAK, ALT 5A

Site Information

Freeway/Dir of Travel	I-229/NB
Weaving Segment Location	41ST TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3317	0.90	5	0	1.5	1.2	0.976	1.00	3778
V_{RF}	677	0.90	5	0	1.5	1.2	0.976	1.00	771
V_{FR}	517	0.90	5	0	1.5	1.2	0.976	1.00	589
V_{RR}	23	0.90	5	0	1.5	1.2	0.976	1.00	26
V_{NW}	3804							V =	5164
V_W	1360								
VR	0.263								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1360 lc/h
Weaving lane changes, LC_W	1851 lc/h
Non-weaving lane changes, LC_{NW}	1612 lc/h
Total lane changes, LC_{ALL}	3463 lc/h
Non-weaving vehicle index, I_{NW}	786

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5038 veh/h
Weaving segment capacity, c_w	8500 veh/h
Weaving segment v/c ratio	0.593
Weaving segment density, D	26.0 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.256
Weaving segment speed, S	49.7 mph
Average weaving speed, S_W	59.3 mph
Average non-weaving speed, S_{NW}	47.0 mph
Maximum weaving length, L_{MAX}	5194 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	PM PEAK, ALT 5A

Site Information

Freeway/Dir of Travel	I-229 SB
Weaving Segment Location	26TH TO CLIFF
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2650ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3690	0.90	5	0	1.5	1.2	0.976	1.00	4203
V_{RF}	600	0.90	5	0	1.5	1.2	0.976	1.00	683
V_{FR}	610	0.90	5	0	1.5	1.2	0.976	1.00	695
V_{RR}	20	0.90	5	0	1.5	1.2	0.976	1.00	23
V_{NW}	4226							V =	5604
V_W	1378								
VR	0.246								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	0 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	0 lc/h
Weaving lane changes, LC_W	462 lc/h
Non-weaving lane changes, LC_{NW}	1536 lc/h
Total lane changes, LC_{ALL}	1998 lc/h
Non-weaving vehicle index, I_{NW}	784

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5467 veh/h
Weaving segment capacity, c_w	8464 veh/h
Weaving segment v/c ratio	0.646
Weaving segment density, D	24.5 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.181
Weaving segment speed, S	57.2 mph
Average weaving speed, S_W	60.2 mph
Average non-weaving speed, S_{NW}	56.3 mph
Maximum weaving length, L_{MAX}	5011 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	4/7/2014
Analysis Time Period	PM PEAK, ALT 5A

Site Information

Freeway/Dir of Travel	I-229 NB
Weaving Segment Location	CLIFF TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph

Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3090	0.90	5	0	1.5	1.2	0.976	1.00	3519
V_{RF}	300	0.90	5	0	1.5	1.2	0.976	1.00	342
V_{FR}	790	0.90	5	0	1.5	1.2	0.976	1.00	900
V_{RR}	10	0.90	5	0	1.5	1.2	0.976	1.00	11
V_{NW}	3530							V =	4772
V_W	1242								
VR	0.260								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc

Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1733 lc/h
Non-weaving lane changes, LC_{NW}	1556 lc/h
Total lane changes, LC_{ALL}	3289 lc/h
Non-weaving vehicle index, I_{NW}	729

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4656 veh/h
Weaving segment capacity, c_w	8511 veh/h
Weaving segment v/c ratio	0.547
Weaving segment density, D	23.5 pc/mi/ln
Level of Service, LOS	C

Weaving intensity factor, W	0.246
Weaving segment speed, S	50.8 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	48.3 mph
Maximum weaving length, L_{MAX}	5162 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	AM PEAK, ALT 7A

Site Information

Freeway/Dir of Travel	I-229/SB
Weaving Segment Location	26TH TO 41ST
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2724	0.90	5	0	1.5	1.2	0.976	1.00	3102
V_{RF}	764	0.90	5	0	1.5	1.2	0.976	1.00	870
V_{FR}	364	0.90	5	0	1.5	1.2	0.976	1.00	415
V_{RR}	26	0.90	5	0	1.5	1.2	0.976	1.00	30
V_{NW}	3132							V =	4417
V_W	1285								
VR	0.291								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1285 lc/h
Weaving lane changes, LC_W	1757 lc/h
Non-weaving lane changes, LC_{NW}	1365 lc/h
Total lane changes, LC_{ALL}	3122 lc/h
Non-weaving vehicle index, I_{NW}	603

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4309 veh/h
Weaving segment capacity, c_w	8048 veh/h
Weaving segment v/c ratio	0.535
Weaving segment density, D	21.6 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.250
Weaving segment speed, S	51.2 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	48.4 mph
Maximum weaving length, L_{MAX}	5487 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	AM PEAK, ALT 7A

Site Information

Freeway/Dir of Travel	I-229/NB
Weaving Segment Location	41ST TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3317	0.90	5	0	1.5	1.2	0.976	1.00	3778
V_{RF}	677	0.90	5	0	1.5	1.2	0.976	1.00	771
V_{FR}	517	0.90	5	0	1.5	1.2	0.976	1.00	589
V_{RR}	23	0.90	5	0	1.5	1.2	0.976	1.00	26
V_{NW}	3804							V =	5164
V_W	1360								
VR	0.263								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1360 lc/h
Weaving lane changes, LC_W	1851 lc/h
Non-weaving lane changes, LC_{NW}	1612 lc/h
Total lane changes, LC_{ALL}	3463 lc/h
Non-weaving vehicle index, I_{NW}	786

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5038 veh/h
Weaving segment capacity, c_w	8500 veh/h
Weaving segment v/c ratio	0.593
Weaving segment density, D	26.0 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.256
Weaving segment speed, S	49.7 mph
Average weaving speed, S_W	59.3 mph
Average non-weaving speed, S_{NW}	47.0 mph
Maximum weaving length, L_{MAX}	5194 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	2/7/2014
Analysis Time Period	PM PEAK, ALT 7A

Site Information

Freeway/Dir of Travel	I-229 SB
Weaving Segment Location	26TH TO CLIFF
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2750ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3690	0.90	5	0	1.5	1.2	0.976	1.00	4203
V_{RF}	600	0.90	5	0	1.5	1.2	0.976	1.00	683
V_{FR}	610	0.90	5	0	1.5	1.2	0.976	1.00	695
V_{RR}	20	0.90	5	0	1.5	1.2	0.976	1.00	23
V_{NW}	4226							V =	5604
V_W	1378								
VR	0.246								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	0 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	0 lc/h
Weaving lane changes, LC_W	472 lc/h
Non-weaving lane changes, LC_{NW}	1591 lc/h
Total lane changes, LC_{ALL}	2063 lc/h
Non-weaving vehicle index, I_{NW}	814

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5467 veh/h
Weaving segment capacity, c_w	8496 veh/h
Weaving segment v/c ratio	0.643
Weaving segment density, D	24.5 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.180
Weaving segment speed, S	57.2 mph
Average weaving speed, S_W	60.3 mph
Average non-weaving speed, S_{NW}	56.3 mph
Maximum weaving length, L_{MAX}	5011 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	HDR
Agency/Company	SDDOT/CITY OF SIOUX FALLS
Date Performed	4/7/2014
Analysis Time Period	PM PEAK, ALT 7A

Site Information

Freeway/Dir of Travel	I-229 NB
Weaving Segment Location	CLIFF TO 26TH
Analysis Year	2035

Project Description I-229/26TH ST (EXIT 5) CORRIDOR STUDY

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	2950ft
Freeway free-flow speed, FFS	63 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	45
Freeway maximum capacity, C_{IFL}	2350
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	fp	v (pc/h)
V_{FF}	3090	0.90	5	0	1.5	1.2	0.976	1.00	3519
V_{RF}	300	0.90	5	0	1.5	1.2	0.976	1.00	342
V_{FR}	790	0.90	5	0	1.5	1.2	0.976	1.00	900
V_{RR}	10	0.90	5	0	1.5	1.2	0.976	1.00	11
V_{NW}	3530							V =	4772
V_W	1242								
VR	0.260								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	0.7 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	1242 lc/h
Weaving lane changes, LC_W	1733 lc/h
Non-weaving lane changes, LC_{NW}	1556 lc/h
Total lane changes, LC_{ALL}	3289 lc/h
Non-weaving vehicle index, I_{NW}	729

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4656 veh/h
Weaving segment capacity, c_w	8511 veh/h
Weaving segment v/c ratio	0.547
Weaving segment density, D	23.5 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.246
Weaving segment speed, S	50.8 mph
Average weaving speed, S_W	59.4 mph
Average non-weaving speed, S_{NW}	48.3 mph
Maximum weaving length, L_{MAX}	5162 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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I-229/26th Street Interchange Modification Justification Report

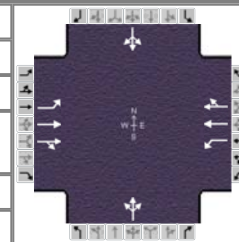
APPENDIX

PART 4

2035 Crossroad Level of Service

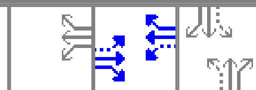
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM 2035 NO BUILD	PHF	0.90
Intersection	Lowell Avenue	Analysis Year	2013	Analysis Period	1> 7:00
File Name	AM 2035 NO BUILD.xus				
Project Description	AM 2035 NO BUILD				

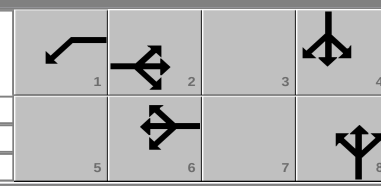


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	5	460	10	50	1590	60	10	20	40	70	20	10

Signal Information			
Cycle, s	120.0	Reference Phase	2
Offset, s	112	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	3.0	88.3	11.2	0.0	0.0	0.0
Yellow	4.5	5.0	5.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	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		94.3	8.5	102.8		17.2		17.2
Change Period, ($Y+R_c$), s		6.0	5.5	6.0		6.0		6.0
Max Allow Headway (MAH), s		0.0	3.2	0.0		3.3		3.3
Queue Clearance Time (g_s), s			2.7			7.2		11.0
Green Extension Time (g_e), s		0.0	0.0	0.0		0.3		0.3
Phase Call Probability			0.75			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	6	261	259	42	696	689		73			109	
Adjusted Saturation Flow Rate (s), veh/h/ln	389	1698	1687	1681	1698	1677		1619			1427	
Queue Service Time (g_s), s	0.0	0.4	0.4	0.7	3.1	3.0		0.0			3.7	
Cycle Queue Clearance Time (g_c), s	0.0	0.4	0.4	0.7	3.1	3.0		5.2			9.0	
Green Ratio (g/C)	0.74	0.74	0.74	0.78	0.81	0.81		0.09			0.09	
Capacity (c), veh/h	346	1249	1241	745	1369	1353		186			185	
Volume-to-Capacity Ratio (X)	0.016	0.209	0.209	0.057	0.508	0.509		0.394			0.589	
Available Capacity (c_a), veh/h	346	1249	1241	958	1369	1353		363			347	
Back of Queue (Q), veh/ln (50th percentile)	0.0	0.2	0.2	0.2	0.6	0.6		2.1			3.3	
Queue Storage Ratio (RQ) (50th percentile)	0.00	0.00	0.00	0.10	0.00	0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	0.3	0.3	0.3	3.1	0.4	0.4		51.7			53.3	
Incremental Delay (d_2), s/veh	0.1	0.4	0.4	0.0	0.5	0.5		0.5			1.1	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (d), s/veh	0.4	0.7	0.7	3.1	0.9	0.9		52.2			54.4	
Level of Service (LOS)	A	A	A	A	A	A		D			D	
Approach Delay, s/veh / LOS	0.7	A		1.0	A		52.2	D		54.4	D	
Intersection Delay, s/veh / LOS	5.4						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	0.9	A	2.0	B	0.6	A	0.7	A

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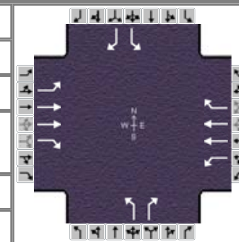
HCS 2010 Signalized Intersection Results Summary

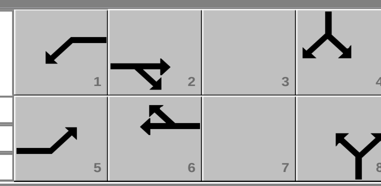
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM 2035 NO BUILD	PHF	0.90
Intersection	I-229	Analysis Year	2013	Analysis Period	1> 7:00
File Name	AM 2035 NO BUILD.xus				
Project Description	AM 2035 NO BUILD				



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	410	0	480	850	0	260		0	560		0

Signal Information			
Cycle, s	120.0	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	38.3	5.1	14.2	44.8	0.0	0.0
Yellow	5.0	0.0	5.0	3.6	0.0	0.0
Red	1.0	0.0	1.0	2.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	20.2	25.3	44.3	49.4		50.4		50.4
Change Period, (*Y+R*c), s	6.0	6.0	6.0	6.0		5.6		5.6
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		2.9		2.9
Queue Clearance Time (g_s), s	14.4		40.3			17.9		42.1
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		1.6		0.7
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	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		18	7		14
Adjusted Flow Rate (*v*), veh/h	170	464	0	664	1175	0	289		0	622		0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1613	1566	1497	1807	1658	1497	1656		1578	1789		1704
Queue Service Time (g_s), s	12.4	17.4	0.0	38.3	41.3	0.0	15.9		0.0	40.1		0.0
Cycle Queue Clearance Time (g_c), s	12.4	17.4	0.0	38.3	41.3	0.0	15.9		0.0	40.1		0.0
Green Ratio (*g/C*)	0.12	0.16	0.16	0.32	0.36	0.36	0.37		0.37	0.37		0.37
Capacity (*c*), veh/h	191	504	241	577	1200	541	678		589	728		636
Volume-to-Capacity Ratio (*X*)	0.889	0.921	0.000	1.151	0.980	0.000	0.426		0.000	0.855		0.000
Available Capacity (c_a), veh/h	191	504	241	577	1200	541	678		589	728		636
Back of Queue (*Q*), veh/ln (50th percentile)	6.6	8.3	0.0	20.0	13.1	0.0	6.1		0.0	18.4		0.0
Queue Storage Ratio (*RQ*) (50th percentile)	0.53	0.00	0.00	1.62	0.00	0.00	1.06		0.00	3.22		0.00
Uniform Delay (d_1), s/veh	49.9	47.5	0.0	20.1	23.9	0.0	28.5		0.0	36.1		0.0
Incremental Delay (d_2), s/veh	34.5	24.1	0.0	69.9	4.4	0.0	0.2		0.0	9.3		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
Control Delay (*d*), s/veh	84.4	71.6	0.0	89.9	28.3	0.0	28.7		0.0	45.5		0.0
Level of Service (LOS)	F	E		F	C		C			D		
Approach Delay, s/veh / LOS	75.0	E		50.5	D		28.7	C		45.5	D	
Intersection Delay, s/veh / LOS	52.3						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.0	A	1.7	A		F		F

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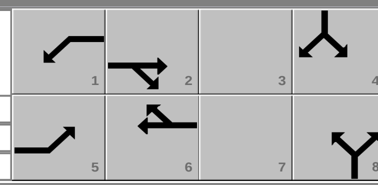
HCS 2010 Interchanges Results Summary

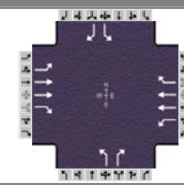
General Information				Interchange Information	
Agency	HDR			Interchange Type	SPUI
Analyst	RL	Analysis Date	Oct 7, 2013	Segment Distance, ft	
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-229	PHF	0.90	Arterial Direction	East-West
File Name	AM 2035 NO BUILD.xus				
Project Description	AM 2035 NO BUILD				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection Demand (v), veh/h	150	410	0	480	850	0	260		0	560		0

Signal Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	38.3	5.1	14.2	44.8	0.0	0.0
Yellow	5.0	0.0	5.0	3.6	0.0	0.0
Red	1.0	0.0	1.0	2.0	0.0	0.0





Interchange Results

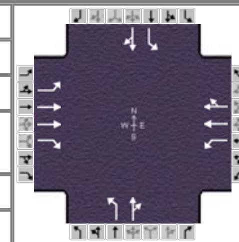
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL	289	NBL	28.7	B
B	NBR	0	NBR	0.0	A
C	SBR	0	SBR	0.0	A
D	SBL	622	SBL	45.5	D
E	EBL	170	EBL	84.4	D
F	EBR	0	EBR	0.0	A
G	WBR	0	WBR	0.0	A
H	WBL	664	WBL	89.9	F
I	EBT	464	EBT	71.6	D
J	WBT	1175	WBT	28.3	B
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M		0		-	-
N		0		-	-

Signalized Intersection Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	84.4	71.6	0.0	89.9	28.3	0.0	28.7		0.0	45.5		0.0
Level of Service (LOS)	F	E		F	C		C			D		
Approach Delay, s/veh / LOS	75.0	E		50.5	D		28.7	C		45.5	D	
Intersection Delay, s/veh / LOS	52.3						D					

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:44:17 AM

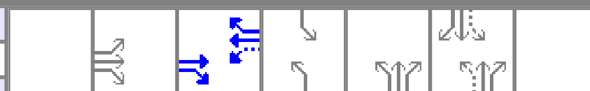
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM 2035 NO BUILD	PHF	0.90
Intersection	Cleveland Avenue	Analysis Year	2013	Analysis Period	1> 7:00
File Name	AM 2035 NO BUILD.xus				
Project Description	AM 2035 NO BUILD				

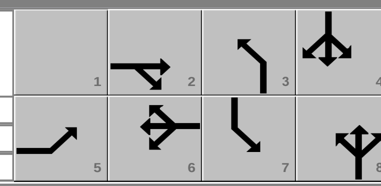


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	140	1040	270	40	1380	60	290	260	20	60	180	270

Signal Information			
Cycle, s	120.0	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	4.5	50.0	4.1	2.9	30.0	0.0
Yellow	4.5	5.0	4.5	4.5	5.0	0.0
Red	1.0	1.0	1.0	1.0	1.0	0.0



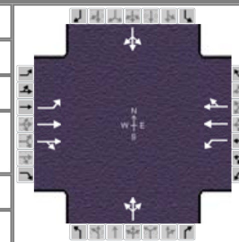
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	3.0		6.3	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	66.0		56.0	18.0	44.4	9.6	36.0
Change Period, (Y+R_c), s	5.5	6.0		6.0	5.5	6.0	5.5	6.0
Max Allow Headway (*MAH*), s	3.2	0.0		0.0	3.2	3.2	3.2	3.2
Queue Clearance Time (g_s), s	6.5				14.5	17.8	5.6	32.0
Green Extension Time (g_e), s	0.0	0.0		0.0	0.0	1.7	0.0	0.0
Phase Call Probability	0.97				1.00	1.00	0.89	1.00
Max Out Probability	1.00				1.00	0.00	1.00	1.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	104	771	178	44	798	791	322	306		67	467	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1641	1510	694	1681	1659	1672	1738		1681	1594	
Queue Service Time (g_s), s	4.5	16.3	9.4	4.1	50.0	50.0	12.5	15.8		3.6	30.0	
Cycle Queue Clearance Time (g_c), s	4.5	16.3	9.4	10.6	50.0	50.0	12.5	15.8		3.6	30.0	
Green Ratio (*g/C*)	0.04	0.50	0.50	0.42	0.42	0.42	0.37	0.32		0.28	0.25	
Capacity (*c*), veh/h	64	1641	755	313	700	691	234	556		301	399	
Volume-to-Capacity Ratio (*X*)	1.622	0.470	0.236	0.142	1.139	1.145	1.376	0.549		0.221	1.171	
Available Capacity (c_a), veh/h	64	1641	755	313	700	691	234	556		301	399	
Back of Queue (*Q*), veh/ln (50th percentile)	7.4	5.7	5.2	0.7	32.7	32.7	17.3	6.2		1.4	22.1	
Queue Storage Ratio (*RQ*) (50th percentile)	1.33	0.00	0.95	0.13	0.00	0.00	3.14	0.00		0.26	0.00	
Uniform Delay (d_1), s/veh	58.3	16.0	20.9	19.7	26.7	26.7	30.7	27.9		32.0	40.0	
Incremental Delay (d_2), s/veh	303.6	0.3	0.3	0.9	79.0	81.5	193.7	0.7		0.1	100.6	
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	361.8	16.3	21.2	20.6	105.7	108.2	224.4	28.6		32.2	140.6	
Level of Service (LOS)	F	B	C	C	F	F	F	C		C	F	
Approach Delay, s/veh / LOS	51.2		D	104.6		F	129.1		F	127.0		F
Intersection Delay, s/veh / LOS	97.1						F					

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	1.8	A	1.8	A	1.5	A	1.4	A

HCS 2010 Signalized Intersection Results Summary

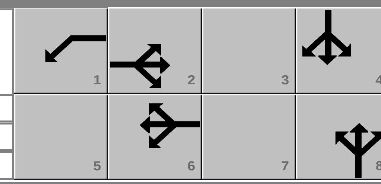
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM 2035 NO BUILD	PHF	0.90
Intersection	Lowell Avenue	Analysis Year	2013	Analysis Period	1> 7:00
File Name	PM 2035 NO BUILD.xus				
Project Description	PM 2035 NO BUILD				



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	1120	20	160	1150	80	20	30	30	100	50	10

Signal Information				
Cycle, s	120.0	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	15.9	61.6	25.0	0.0	0.0	0.0
Yellow	4.5	5.0	5.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



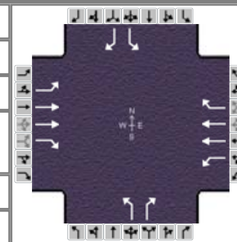
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		4
Case Number		6.3	1.0	4.0		8.0		8.0
Phase Duration, s		67.6	21.4	89.0		31.0		31.0
Change Period, (Y+R_c), s		6.0	5.5	6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.3		3.3
Queue Clearance Time (g_s), s			5.4			7.2		14.8
Green Extension Time (g_e), s		0.0	0.1	0.0		0.5		0.4
Phase Call Probability			1.00			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	22	634	630	125	483	473		86			176	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	583	1698	1688	1681	1698	1661		1584			1466	
Queue Service Time (g_s), s	1.5	28.1	28.2	3.4	5.1	5.0		0.0			7.6	
Cycle Queue Clearance Time (g_c), s	1.5	28.1	28.2	3.4	5.1	5.0		5.2			12.8	
Green Ratio (*g/C*)	0.51	0.51	0.51	0.66	0.69	0.69		0.21			0.21	
Capacity (*c*), veh/h	359	872	866	404	1175	1149		368			354	
Volume-to-Capacity Ratio (*X*)	0.062	0.727	0.728	0.310	0.411	0.411		0.233			0.495	
Available Capacity (c_a), veh/h	359	872	866	404	1175	1149		368			354	
Back of Queue (*Q*), veh/ln (50th percentile)	0.2	9.7	9.6	1.3	1.5	1.4		2.2			4.8	
Queue Storage Ratio (*RQ*) (50th percentile)	0.05	0.00	0.00	0.66	0.00	0.00		0.00			0.00	
Uniform Delay (d_1), s/veh	9.5	13.7	13.7	14.7	2.0	1.9		39.7			42.6	
Incremental Delay (d_2), s/veh	0.3	5.3	5.3	0.1	0.8	0.8		0.1			0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	
Control Delay (*d*), s/veh	9.8	18.9	19.0	14.8	2.8	2.7		39.8			43.0	
Level of Service (LOS)	A	B	B	B	A	A		D			D	
Approach Delay, s/veh / LOS	18.8	B		4.1	A		39.8	D		43.0	D	
Intersection Delay, s/veh / LOS	15.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.1	B	2.1	B	2.9	C	2.9	C
Bicycle LOS Score / LOS	1.5	A	1.8	A	0.6	A	0.8	A

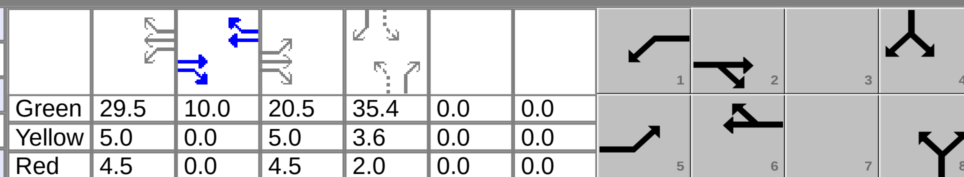
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM 2035 NO BUILD	PHF	0.90
Intersection	I-229	Analysis Year	2013	Analysis Period	1> 7:00
File Name	PM 2035 NO BUILD.xus				
Project Description	PM 2035 NO BUILD				



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	0	560	820	0	200		0	630		0

Signal Information			
Cycle, s	120.0	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	29.5	10.0	20.5	35.4	0.0	0.0
Yellow	5.0	0.0	5.0	3.6	0.0	0.0
Red	4.5	0.0	4.5	2.0	0.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	2.0	3.0	2.0	3.0		5.0		5.0
Phase Duration, s	30.0	40.0	39.0	49.0		41.0		41.0
Change Period, (*Y*+*R*c), s	9.5	9.5	9.5	0.0		5.6		5.6
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		2.9		2.9
Queue Clearance Time (*g*s), s	20.3		31.5			15.3		37.4
Green Extension Time (*g*e), s	0.1	0.0	0.0	0.0		1.7		0.0
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	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		18	7		14
Adjusted Flow Rate (*v*), veh/h	257	1132	0	609	892	0	222		0	700		0
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1644	1652	1497	1783	1620	1497	1632		1555	1823		1737
Queue Service Time (*g*s), s	18.3	30.5	0.0	29.5	18.8	0.0	13.3		0.0	35.4		0.0
Cycle Queue Clearance Time (*g*c), s	18.3	30.5	0.0	29.5	18.8	0.0	13.3		0.0	35.4		0.0
Green Ratio (*g/C*)	0.17	0.25	0.25	0.25	0.41	0.41	0.30		0.30	0.30		0.30
Capacity (*c*), veh/h	281	840	381	438	1323	611	541		459	598		512
Volume-to-Capacity Ratio (*X*)	0.914	1.348	0.000	1.390	0.674	0.000	0.410		0.000	1.171		0.000
Available Capacity (*c*a), veh/h	281	840	381	438	1323	611	541		459	598		512
Back of Queue (*Q*), veh/ln (50th percentile)	8.9	30.0	0.0	28.5	4.5	0.0	5.2		0.0	33.3		0.0
Queue Storage Ratio (*RQ*) (50th percentile)	0.72	0.00	0.00	2.30	0.00	0.00	0.90		0.00	5.82		0.00
Uniform Delay (*d*1), s/veh	45.2	37.8	0.0	24.2	13.5	0.0	34.5		0.0	44.1		0.0
Incremental Delay (*d*2), s/veh	23.4	161.7	0.0	176.6	0.3	0.0	0.2		0.0	93.8		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	68.6	199.5	0.0	200.9	13.8	0.0	34.7		0.0	137.9		0.0
Level of Service (LOS)	E	F		F	B		C			F		
Approach Delay, s/veh / LOS	175.3	F		89.7	F		34.7	C		137.9	F	
Intersection Delay, s/veh / LOS	126.5						F					

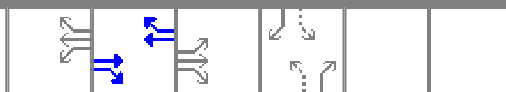
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.3	B	2.3	B	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.6	A	1.8	A		F		F

HCS 2010 Interchanges Results Summary

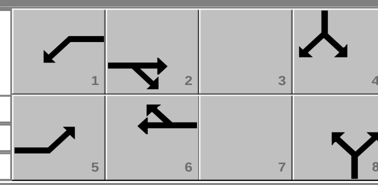
General Information				Interchange Information	
Agency	HDR			Interchange Type	SPUI
Analyst	RL	Analysis Date	Oct 7, 2013	Segment Distance, ft	
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-229	PHF	0.90	Arterial Direction	East-West
File Name	PM 2035 NO BUILD.xus				
Project Description	PM 2035 NO BUILD				

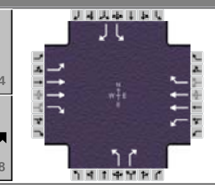
Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection Demand (v), veh/h	220	970	0	560	820	0	200		0	630		0

Signal Information	
Cycle, s	120.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed



Green	29.5	10.0	20.5	35.4	0.0	0.0
Yellow	5.0	0.0	5.0	3.6	0.0	0.0
Red	4.5	0.0	4.5	2.0	0.0	0.0





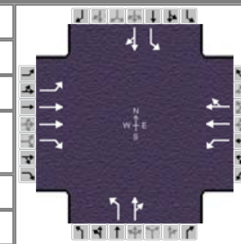
Interchange Results					
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL	222	NBL	34.7	C
B	NBR	0	NBR	0.0	A
C	SBR	0	SBR	0.0	A
D	SBL	700	SBL	137.9	F
E	EBL	257	EBL	68.6	D
F	EBR	0	EBR	0.0	A
G	WBR	0	WBR	0.0	A
H	WBL	609	WBL	200.9	F
I	EBT	1132	EBT	199.5	F
J	WBT	892	WBT	13.8	A
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M		0		-	-
N		0		-	-

Signalized Intersection Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	68.6	199.5	0.0	200.9	13.8	0.0	34.7		0.0	137.9		0.0
Level of Service (LOS)	E	F		F	B		C			F		
Approach Delay, s/veh / LOS	175.3	F		89.7	F		34.7	C		137.9	F	
Intersection Delay, s/veh / LOS	126.5						F					

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:47:29 AM

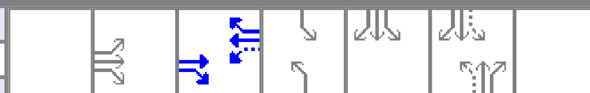
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 7, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM 2035 NO BUILD	PHF	0.90
Intersection	Cleveland Avenue	Analysis Year	2013	Analysis Period	1> 7:00
File Name	PM 2035 NO BUILD.xus				
Project Description	PM 2035 NO BUILD				

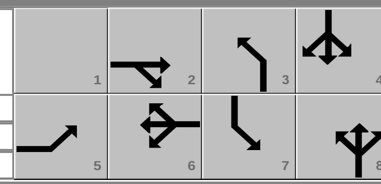


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	260	1920	240	50	1300	130	200	270	100	280	380	280

Signal Information			
Cycle, s	120.0	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	9.5	44.0	6.5	6.8	30.2	0.0
Yellow	4.5	5.0	4.5	0.0	5.0	0.0
Red	1.0	1.0	1.0	0.0	1.0	0.0



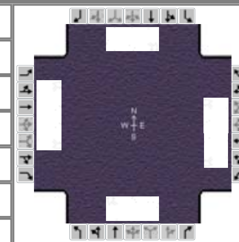
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2		6	3	8	7	4
Case Number	2.0	3.0		6.3	1.1	4.0	1.1	4.0
Phase Duration, s	15.0	65.0		50.0	12.0	36.2	18.8	43.0
Change Period, (*Y+R*$_c$), s	5.5	6.0		6.0	5.5	6.0	0.0	6.0
Max Allow Headway (*MAH*), s	3.2	0.0		0.0	3.2	3.2	3.2	3.2
Queue Clearance Time (g_s), s	11.5				8.5	29.2	17.9	39.0
Green Extension Time (g_e), s	0.0	0.0		0.0	0.0	0.4	0.1	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	153	1128	123	56	794	779	222	394		311	700	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1706	1641	1510	496	1681	1631	1672	1681		1681	1644	
Queue Service Time (g_s), s	9.5	32.6	7.3	9.9	44.0	44.0	6.5	27.2		15.9	37.0	
Cycle Queue Clearance Time (g_c), s	9.5	32.6	7.3	28.7	44.0	44.0	6.5	27.2		15.9	37.0	
Green Ratio (*g/C*)	0.08	0.49	0.49	0.37	0.37	0.37	0.31	0.25		0.42	0.31	
Capacity (*c*), veh/h	135	1614	743	169	616	598	151	423		348	507	
Volume-to-Capacity Ratio (*X*)	1.131	0.699	0.166	0.328	1.287	1.302	1.476	0.933		0.895	1.381	
Available Capacity (c_a), veh/h	135	1614	743	169	616	598	151	423		348	507	
Back of Queue (*Q*), veh/ln (50th percentile)	6.8	12.6	4.4	1.5	40.1	40.0	11.9	13.7		8.1	39.4	
Queue Storage Ratio (*RQ*) (50th percentile)	1.22	0.00	0.80	0.28	0.00	0.00	2.15	0.00		1.47	0.00	
Uniform Delay (d_1), s/veh	56.8	24.8	24.1	34.0	30.7	30.7	39.4	38.9		26.8	35.3	
Incremental Delay (d_2), s/veh	68.1	0.2	0.0	5.1	141.3	147.9	246.3	27.2		23.7	183.6	
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	124.8	25.0	24.1	39.1	172.0	178.6	285.7	66.1		50.5	218.9	
Level of Service (LOS)	F	C	C	D	F	F	F	E		D	F	
Approach Delay, s/veh / LOS	35.8	D		170.6	F		145.2	F		167.1	F	
Intersection Delay, s/veh / LOS	125.9						F					

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	2.7	B	1.8	A	1.5	A	2.2	B

HCS 2010 Signalized Intersection Results Summary

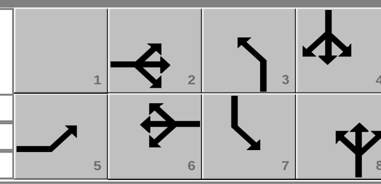
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Intersection	14TH ST.	Analysis Year	2035 no build	Analysis Period	1> 7:00
File Name	AM 2035.xus				
Project Description	I-229/26TH IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	250	270	90	40	1340	340	270	730	10	90	610	300

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.0	85.6	5.0	3.0	28.3	0.0
Yellow	4.0	3.6	4.0	0.0	3.6	0.0
Red	1.0	1.8	1.0	0.0	2.1	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		5.3	1.1	4.0	1.1	4.0
Phase Duration, s	12.0	103.0		91.0	13.0	37.0	10.0	34.0
Change Period, ($Y+R_c$), s	5.0	5.4		5.4	5.0	5.7	5.0	5.7
Max Allow Headway (*MAH*), s	3.1	0.0		0.0	3.2	3.2	3.2	3.2
Queue Clearance Time (g_s), s	9.0				10.0	33.3	7.0	30.3
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	278	300	100	44	1489	378	300	412	410	100	536	476
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	1075	1680	1496	1664	1748	1739	1664	1748	1552
Queue Service Time (g_s), s	7.0	5.1	3.8	2.0	54.3	21.3	8.0	31.3	31.3	5.0	28.3	28.3
Cycle Queue Clearance Time (g_c), s	7.0	5.1	3.8	2.0	54.3	21.3	8.0	31.3	31.3	5.0	28.3	28.3
Green Ratio (*g/C*)	0.63	0.65	0.65	0.57	0.57	0.57	0.24	0.21	0.21	0.22	0.19	0.19
Capacity (*c*), veh/h	200	2186	973	661	1917	853	137	365	363	103	330	293
Volume-to-Capacity Ratio (*X*)	1.390	0.137	0.103	0.067	0.776	0.443	2.194	1.130	1.130	0.966	1.624	1.624
Available Capacity (c_a), veh/h	200	2186	973	661	1917	853	137	365	363	103	330	293
Back of Queue (*Q*), veh/ln (50th percentile)	15.7	1.9	1.3	0.5	22.5	7.4	22.9	22.1	22.0	3.8	39.0	34.8
Queue Storage Ratio (*RQ*) (50th percentile)	2.35	0.00	0.19	0.13	0.00	1.88	4.51	0.00	0.00	0.65	0.00	0.00
Uniform Delay (d_1), s/veh	33.5	10.0	9.8	10.3	29.7	17.8	53.2	54.1	54.1	57.4	56.1	56.1
Incremental Delay (d_2), s/veh	203.2	0.1	0.2	0.1	1.7	0.9	560.3	87.3	87.4	77.0	294.4	296.2
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	236.7	10.2	10.0	10.4	31.4	18.7	613.5	141.4	141.6	134.4	350.6	352.3
Level of Service (LOS)	F	B	B	B	C	B	F	F	F	F	F	F
Approach Delay, s/veh / LOS	103.0	F		28.4	C		267.7	F		331.9	F	
Intersection Delay, s/veh / LOS	164.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	3.0	C	3.0	C
Bicycle LOS Score / LOS	1.0	A	2.1	B	1.4	A	1.4	A

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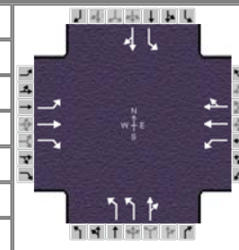
HCS 2010 Signalized Intersection Results Summary

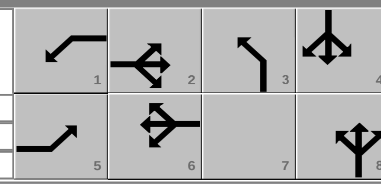
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Intersection	SOUTHEASTERN AVE.	Analysis Year	2035 no build	Analysis Period	1> 7:00
File Name	AM 2035.xus				
Project Description	I-229/26TH IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	20	180	170	80	450	30	1250	170	30	10	50	20

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.1	39.1	38.1	44.1	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	2.3	2.3	2.3	2.3	0.0	0.0



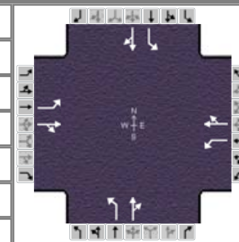
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8		4
Case Number	1.1	3.0	1.1	4.0	1.0	4.0		6.3
Phase Duration, s	11.0	45.0	11.0	45.0	44.0	94.0		50.0
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9	5.9	5.9		5.9
Max Allow Headway (*MAH*), s	3.1	0.0	3.2	0.0	3.2	3.2		3.2
Queue Clearance Time (g_s), s	3.4		7.1		40.1	11.2		7.1
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.6		0.6
Phase Call Probability	1.00		1.00		1.00	1.00		1.00
Max Out Probability	1.00		1.00		1.00	0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	22	199	188	89	269	264	1389	222		11	78	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1765	1496	1681	1765	1726	1632	1718		1154	1678	
Queue Service Time (g_s), s	1.4	13.8	16.8	5.1	19.9	20.1	38.1	9.2		1.0	5.1	
Cycle Queue Clearance Time (g_c), s	1.4	13.8	16.8	5.1	19.9	20.1	38.1	9.2		1.0	5.1	
Green Ratio (*g/C*)	0.29	0.26	0.26	0.29	0.26	0.26	0.56	0.59		0.29	0.29	
Capacity (*c*), veh/h	204	460	390	288	460	450	1608	1009		387	493	
Volume-to-Capacity Ratio (*X*)	0.109	0.433	0.483	0.309	0.585	0.588	0.863	0.220		0.029	0.158	
Available Capacity (c_a), veh/h	204	460	390	288	460	450	1608	1009		387	493	
Back of Queue (*Q*), veh/ln (50th percentile)	0.6	6.3	7.0	0.5	9.4	9.3	5.6	3.7		0.3	2.2	
Queue Storage Ratio (*RQ*) (50th percentile)	0.17	0.00	1.98	0.17	0.00	0.00	0.00	0.00		0.07	0.00	
Uniform Delay (d_1), s/veh	39.6	44.5	51.5	42.0	48.4	48.4	27.2	14.7		37.7	39.2	
Incremental Delay (d_2), s/veh	0.1	2.8	4.0	0.2	4.5	4.6	4.9	0.0		0.0	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	0.0	
Control Delay (*d*), s/veh	39.7	47.3	55.5	42.2	52.8	53.0	32.1	14.7		37.8	39.3	
Level of Service (LOS)	D	D	E	D	D	D	C	B		D	D	
Approach Delay, s/veh / LOS	50.7		D	51.4		D	29.7		C	39.1		D
Intersection Delay, s/veh / LOS	38.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	2.3	B	2.4	B	2.9	C
Bicycle LOS Score / LOS	1.2	A	1.0	A	3.1	C	0.6	A

HCS 2010 Signalized Intersection Results Summary

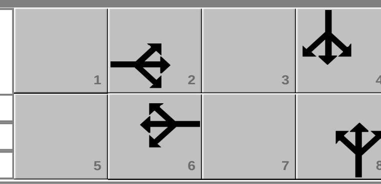
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	AM PEAK	PHF	0.90
Intersection	CLEVELAND AVE.	Analysis Year	2035 no build	Analysis Period	1> 7:00
File Name	AM 2035.xus				
Project Description	I-229/26TH IMJR				



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	90	50	30	330	90	90	210	50	50	180	140

Signal Information			
Cycle, s	70.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	33.0	27.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



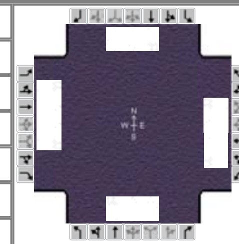
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		38.0		38.0		32.0		32.0
Change Period, (Y+R_c), s		5.0		5.0		5.0		5.0
Max Allow Headway (*MAH*), s		3.3		3.3		3.4		3.4
Queue Clearance Time (g_s), s		21.4		16.0		20.0		14.1
Green Extension Time (g_e), s		1.5		1.7		1.3		1.7
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.04		0.00		0.26		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	89	155		33	467		100	289		56	356	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	922	1628		1227	1702		1022	1692		1086	1623	
Queue Service Time (g_s), s	5.4	3.9		1.1	14.0		6.0	8.9		2.8	12.1	
Cycle Queue Clearance Time (g_c), s	19.4	3.9		5.0	14.0		18.0	8.9		11.6	12.1	
Green Ratio (*g/C*)	0.47	0.47		0.47	0.47		0.39	0.39		0.39	0.39	
Capacity (*c*), veh/h	354	768		613	803		321	653		384	626	
Volume-to-Capacity Ratio (*X*)	0.251	0.202		0.054	0.581		0.312	0.443		0.145	0.568	
Available Capacity (c_a), veh/h	354	768		613	803		321	653		384	626	
Back of Queue (*Q*), veh/ln (50th percentile)	1.1	1.3		0.3	4.9		1.4	3.2		0.7	4.3	
Queue Storage Ratio (*RQ*) (50th percentile)	0.41	0.00		0.12	0.00		0.27	0.00		0.13	0.00	
Uniform Delay (d_1), s/veh	20.5	10.8		12.3	13.5		24.0	15.9		20.2	16.9	
Incremental Delay (d_2), s/veh	0.1	0.0		0.0	0.7		0.2	0.2		0.1	0.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	20.7	10.9		12.3	14.2		24.2	16.1		20.3	17.7	
Level of Service (LOS)	C	B		B	B		C	B		C	B	
Approach Delay, s/veh / LOS	14.4	B		14.1	B		18.2	B		18.0	B	
Intersection Delay, s/veh / LOS	16.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	0.9	A	1.3	A	1.1	A	1.2	A

HCS 2010 Signalized Intersection Results Summary

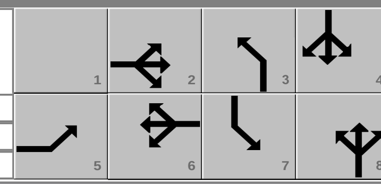
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Intersection	14TH ST.	Analysis Year	2035 no-build	Analysis Period	1> 7:00
File Name	PM 2035 no-build.xus				
Project Description	I-229/26TH IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	440	1460	280	20	350	100	80	570	20	370	840	280

Signal Information			
Cycle, s	150.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	24.0	56.6	5.0	14.0	24.3	0.0
Yellow	4.0	3.6	4.0	4.0	3.6	0.0
Red	1.0	1.8	1.0	1.0	2.1	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		5.3	1.1	4.0	1.1	4.0
Phase Duration, s	29.0	91.0		62.0	10.0	30.0	29.0	49.0
Change Period, ($Y+R_c$), s	5.0	5.4		5.4	5.0	5.7	5.0	5.7
Max Allow Headway (*MAH*), s	3.1	0.0		0.0	3.2	3.2	3.2	3.2
Queue Clearance Time (g_s), s	26.0				7.0	26.3	26.0	45.3
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	489	1622	311	22	389	111	89	330	326	411	648	596
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1680	1496	310	1680	1496	1664	1748	1726	1664	1748	1598
Queue Service Time (g_s), s	24.0	60.1	16.9	7.2	12.9	6.7	5.0	24.3	24.3	24.0	43.3	43.3
Cycle Queue Clearance Time (g_c), s	24.0	60.1	16.9	40.1	12.9	6.7	5.0	24.3	24.3	24.0	43.3	43.3
Green Ratio (*g/C*)	0.55	0.57	0.57	0.38	0.38	0.38	0.20	0.16	0.16	0.34	0.29	0.29
Capacity (*c*), veh/h	605	1917	853	101	1268	564	103	283	280	314	504	461
Volume-to-Capacity Ratio (*X*)	0.807	0.846	0.365	0.221	0.307	0.197	0.859	1.164	1.166	1.308	1.285	1.293
Available Capacity (c_a), veh/h	605	1917	853	101	1268	564	103	283	280	314	504	461
Back of Queue (*Q*), veh/ln (50th percentile)	12.0	24.4	6.1	0.8	5.5	2.5	2.5	18.7	18.5	23.4	37.8	35.2
Queue Storage Ratio (*RQ*) (50th percentile)	1.79	0.00	0.91	0.20	0.00	0.64	0.48	0.00	0.00	3.99	0.00	0.00
Uniform Delay (d_1), s/veh	24.7	26.7	17.5	42.9	35.5	27.6	57.7	58.8	58.8	41.9	46.1	46.1
Incremental Delay (d_2), s/veh	7.4	4.8	1.2	4.9	0.6	0.8	45.6	105.4	106.3	159.7	142.5	147.4
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	32.1	31.6	18.7	47.8	36.1	28.4	103.4	164.2	165.1	201.7	188.7	193.5
Level of Service (LOS)	C	C	B	D	D	C	F	F	F	F	F	F
Approach Delay, s/veh / LOS	30.0	C		35.0	C		157.3	F		193.6	F	
Intersection Delay, s/veh / LOS	98.9						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	3.0	C	3.0	C
Bicycle LOS Score / LOS	2.5	B	0.9	A	1.1	A	1.9	A

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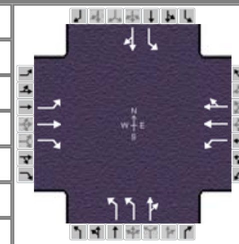
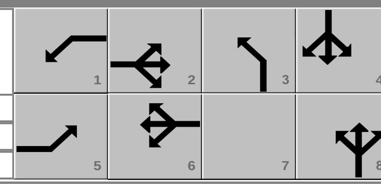
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Intersection	SOUTHEASTERN AVE.	Analysis Year	2035 no-build	Analysis Period	1> 7:00
File Name	PM 2035 no-build.xus				
Project Description	I-229/26TH IMJR				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	40	690	1120	60	200	30	260	130	70	30	80	10

Signal Information										
Cycle, s	150.0	Reference Phase	2							
Offset, s	0	Reference Point	Begin	Green	5.1	55.1	22.1	44.1	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.3	2.3	2.3	2.3	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8		4
Case Number	1.1	3.0	1.1	4.0	1.0	4.0		6.3
Phase Duration, s	11.0	61.0	11.0	61.0	28.0	78.0		50.0
Change Period, ($Y+R_c$), s	5.9	5.9	5.9	5.9	5.9	5.9		5.9
Max Allow Headway (MAH), s	3.1	0.0	3.2	0.0	3.2	3.2		3.2
Queue Clearance Time (g_s), s	4.3		5.7		9.9	14.0		8.5
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.6	0.7		0.7
Phase Call Probability	1.00		1.00		1.00	1.00		1.00
Max Out Probability	1.00		1.00		0.00	0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	42	729	1184	67	129	126	289	222		33	100	
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1765	1496	1681	1765	1685	1632	1660		1154	1730	
Queue Service Time (g_s), s	2.3	55.1	55.1	3.7	7.5	7.7	7.9	12.0		3.1	6.5	
Cycle Queue Clearance Time (g_c), s	2.3	55.1	55.1	3.7	7.5	7.7	7.9	12.0		3.2	6.5	
Green Ratio (g/C)	0.40	0.37	0.37	0.40	0.37	0.37	0.45	0.48		0.29	0.29	
Capacity (c), veh/h	444	648	549	105	648	619	1223	798		387	509	
Volume-to-Capacity Ratio (X)	0.095	1.125	2.155	0.634	0.199	0.204	0.236	0.278		0.086	0.197	
Available Capacity (c_a), veh/h	444	648	549	105	648	619	1223	798		387	509	
Back of Queue (Q), veh/ln (50th percentile)	0.9	35.8	79.5	2.8	3.4	3.3	3.1	4.8		0.9	2.8	
Queue Storage Ratio (RQ) (50th percentile)	0.26	0.00	22.45	0.90	0.00	0.00	0.00	0.00		0.21	0.00	
Uniform Delay (d_1), s/veh	27.6	52.7	59.1	38.1	32.4	32.5	24.7	23.4		38.5	39.7	
Incremental Delay (d_2), s/veh	0.0	61.5	521.2	8.2	0.6	0.7	0.0	0.1		0.0	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	0.0	
Control Delay (d), s/veh	27.6	114.2	580.3	46.3	33.0	33.1	24.8	23.4		38.5	39.7	
Level of Service (LOS)	C	F	F	D	C	C	C	C		D	D	
Approach Delay, s/veh / LOS	394.5		F	35.8		D	24.2		C	39.4		D
Intersection Delay, s/veh / LOS	274.0						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	2.4	B	2.9	C
Bicycle LOS Score / LOS	3.9	D	0.8	A	1.3	A	0.7	A

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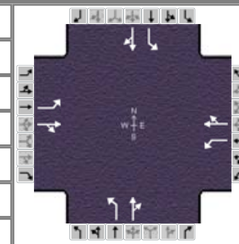
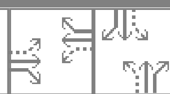
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Jan 8, 2014	Area Type	Other
Jurisdiction	SIOUX FALLS	Time Period	PM PEAK	PHF	0.90
Intersection	CLEVELAND AVE.	Analysis Year	2035 no-build	Analysis Period	1> 7:00
File Name	PM 2035 no-build.xus				
Project Description	I-229/26TH IMJR				

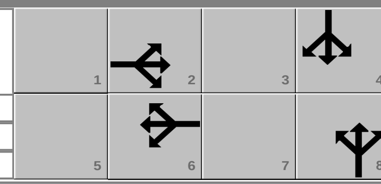


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	180	550	60	10	130	50	60	270	50	80	360	100

Signal Information			
Cycle, s	70.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	Yes	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	34.0	26.0	0.0	0.0	0.0	0.0
Yellow	3.6	3.6	0.0	0.0	0.0	0.0
Red	1.4	1.4	0.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		8		4
Case Number		6.0		6.0		6.0		6.0
Phase Duration, s		39.0		39.0		31.0		31.0
Change Period, (Y+R_c), s		5.0		5.0		5.0		5.0
Max Allow Headway (MAH), s		3.2		3.2		3.3		3.3
Queue Clearance Time (g_s), s		20.9		21.7		26.3		21.2
Green Extension Time (g_e), s		2.0		2.0		0.0		1.4
Phase Call Probability		1.00		1.00		1.00		1.00
Max Out Probability		0.04		0.05		1.00		0.64

Movement Group Results	EB			WB			NB			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	173	586		11	200		67	356		89	511	
Adjusted Saturation Flow Rate (s), veh/h/ln	1178	1703		826	1684		885	1703		1022	1685	
Queue Service Time (g_s), s	7.0	18.9		0.7	4.9		5.1	11.6		5.3	19.2	
Cycle Queue Clearance Time (g_c), s	11.9	18.9		19.7	4.9		24.3	11.6		16.9	19.2	
Green Ratio (g/C)	0.49	0.49		0.49	0.49		0.37	0.37		0.37	0.37	
Capacity (c), veh/h	593	827		281	818		189	632		313	626	
Volume-to-Capacity Ratio (X)	0.292	0.709		0.040	0.245		0.352	0.562		0.284	0.817	
Available Capacity (c_a), veh/h	593	827		281	818		189	632		313	626	
Back of Queue (Q), veh/ln (50th percentile)	1.7	6.4		0.1	1.6		1.1	4.3		1.2	8.2	
Queue Storage Ratio (RQ) (50th percentile)	0.62	0.00		0.06	0.00		0.21	0.00		0.24	0.00	
Uniform Delay (d_1), s/veh	14.0	14.1		21.8	10.5		30.8	17.5		24.2	19.9	
Incremental Delay (d_2), s/veh	0.0	0.2		0.0	0.1		0.4	0.7		0.2	7.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	14.0	14.3		21.8	10.6		31.2	18.2		24.4	27.6	
Level of Service (LOS)	B	B		C	B		C	B		C	C	
Approach Delay, s/veh / LOS	14.3	B		11.2	B		20.2	C		27.1	C	
Intersection Delay, s/veh / LOS	19.1						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.9	A	0.8	A	1.2	A	1.5	A

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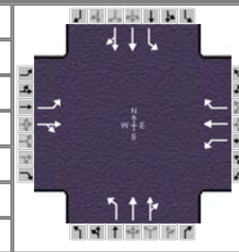
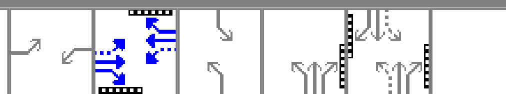
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	CLIFF AVENUE	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD AM phf.xus				
Project Description	AM PEAK, 2035 NO BUILD				

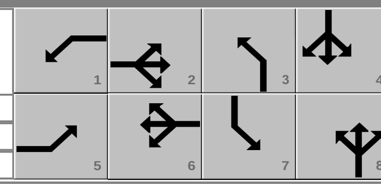


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	100	310	90	60	750	350	140	780	20	110	320	80

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	92	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.0	63.0	6.0	1.0	30.0	0.0
Yellow	4.0	4.0	4.0	4.0	4.0	0.0
Red	1.0	1.0	1.0	1.0	1.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	68.0	10.0	68.0	17.0	41.0	11.0	35.0
Change Period, ($Y+R_c$), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0	3.2	3.1	3.2	3.1
Queue Clearance Time (g_s), s	6.4		4.0		10.9	34.2	8.0	17.5
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	0.7	0.0	2.5
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	0.09

Movement Group Results	EB			WB			NB			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	433		52	646	275	156	444	440	122	225	211
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1681	1695		1681	1765	1464	1657	1739	1724	1640	1722	1578
Queue Service Time (g_s), s	4.4	17.8		2.0	41.9	17.9	8.9	32.2	32.2	6.0	15.0	15.5
Cycle Queue Clearance Time (g_c), s	4.4	17.8		2.0	41.9	17.9	8.9	32.2	32.2	6.0	15.0	15.5
Green Ratio (*g/C*)	0.52	0.48		0.52	0.48	0.48	0.34	0.28	0.28	0.28	0.23	0.23
Capacity (*c*), veh/h	235	821		436	855	709	313	482	477	139	397	364
Volume-to-Capacity Ratio (*X*)	0.473	0.528		0.119	0.755	0.388	0.497	0.922	0.922	0.877	0.567	0.581
Available Capacity (c_a), veh/h	235	821		436	855	709	313	482	477	139	397	364
Back of Queue (*Q*), veh/ln (50th percentile)	1.7	6.4		0.8	19.7	7.1	3.6	16.9	16.8	2.9	6.6	6.2
Queue Storage Ratio (*RQ*) (50th percentile)	0.54	0.00		0.19	0.00	1.80	0.59	0.00	0.00	0.68	0.00	0.00
Uniform Delay (d_1), s/veh	24.1	15.0		16.9	35.1	26.5	32.8	45.6	45.6	44.5	44.2	44.4
Incremental Delay (d_2), s/veh	0.6	2.4		0.0	4.3	1.1	0.5	22.9	23.1	41.0	1.2	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	0.0
Control Delay (*d*), s/veh	24.7	17.4		16.9	39.3	27.5	33.3	68.6	68.7	85.5	45.4	46.0
Level of Service (LOS)	C	B		B	D	C	C	E	E	F	D	D
Approach Delay, s/veh / LOS	18.9	B		34.8	C		63.4	E		54.4	D	
Intersection Delay, s/veh / LOS	45.1						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	2.8	C	2.7	B
Bicycle LOS Score / LOS	3.0	C	4.2	D	3.2	C	2.8	C

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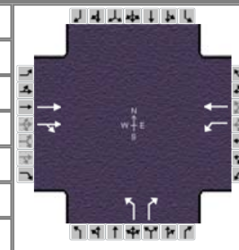
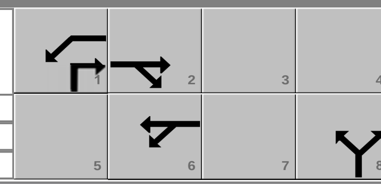
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	YEAGER ROAD	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD AM phf.xus				
Project Description	AM PEAK, 2035 NO BUILD				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		420	60	950	910		240		280			

Signal Information										
Cycle, s	130.0	Reference Phase	2							
Offset, s	80	Reference Point	Begin	Green	72.5	21.5	20.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.9	1.9	1.0	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		27.0	78.0	105.0		25.0		
Change Period, ($Y+R_c$), s		5.5	5.5	5.5		5.0		
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.3		
Queue Clearance Time (g_s), s			41.2			22.0		
Green Extension Time (g_e), s		0.0	2.0	0.0		0.0		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		224	220	794	761		267		289			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1721	1683	1888	1867		1594		1524			
Queue Service Time (g_s), s		17.5	16.8	39.2	24.2		20.0		8.8			
Cycle Queue Clearance Time (g_c), s		17.5	16.8	39.2	24.2		20.0		8.8			
Green Ratio (*g/C*)		0.17	0.17	0.74	0.77		0.15		0.71			
Capacity (*c*), veh/h		285	278	1141	1429		245		1085			
Volume-to-Capacity Ratio (*X*)		0.787	0.792	0.696	0.532		1.087		0.266			
Available Capacity (c_a), veh/h		285	278	1141	1429		245		1085			
Back of Queue (*Q*), veh/ln (50th percentile)		8.9	8.8	21.8	9.4		13.6		2.6			
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.00	0.00	0.00		3.45		0.00			
Uniform Delay (d_1), s/veh		58.4	58.7	24.2	7.7		55.0		6.7			
Incremental Delay (d_2), s/veh		14.9	15.5	0.6	0.5		82.7		0.0			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		73.3	74.2	24.8	8.3		137.7		6.7			
Level of Service (LOS)		E	E	C	A		F		A			

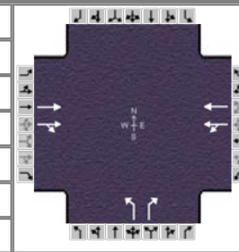
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	73.8	E	16.7	B	69.6	E	0.0	
Intersection Delay, s/veh / LOS	38.1				D			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	0.7	A	3.1	C	2.8	C
Bicycle LOS Score / LOS	2.6	B	6.1	F		F		

 HCS 2010™ Streets Version 6.60 Generated: 8/21/2014 1:00:55 PM

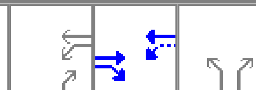
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	I-229 NORTHBOUND	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD AM phf.xus				
Project Description	AM PEAK, 2035 NO BUILD				

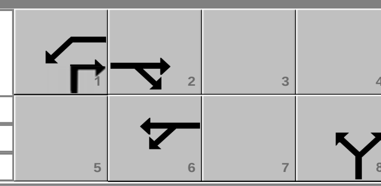


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		570	130	440	1740		120		420			

Signal Information			
Cycle, s	130.0	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	5.0	93.9	16.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.9	1.0	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	0.0	14.0		9.0		
Phase Duration, s		99.4	9.6	109.0		21.0		
Change Period, ($Y+R_c$), s		5.5	4.6	5.5		5.0		
Max Allow Headway (MAH), s		0.0	0.0	0.0		3.1		
Queue Clearance Time (g_s), s						18.0		
Green Extension Time (g_e), s		0.0	0.0	0.0		0.0		
Phase Call Probability						1.00		
Max Out Probability						1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (v), veh/h		340	329	661	1120		133		422			
Adjusted Saturation Flow Rate (s), veh/h/ln		1755	1693	552	1758		1474		1515			
Queue Service Time (g_s), s		15.7	14.0	5.0	59.2		11.3		16.0			
Cycle Queue Clearance Time (g_c), s		15.7	14.0	103.5	59.2		11.3		16.0			
Green Ratio (g/C)		0.44	0.44	0.80	0.80		0.12		0.16			
Capacity (c), veh/h		776	1223	483	1400		181		245			
Volume-to-Capacity Ratio (X)		0.437	0.269	1.368	0.800		0.735		1.725			
Available Capacity (c_a), veh/h		776	1223	483	1400		181		245			
Back of Queue (Q), veh/ln (50th percentile)		6.4	5.0	35.8	23.5		4.8		31.1			
Queue Storage Ratio (RQ) (50th percentile)		0.00	0.00	0.00	0.00		0.42		0.00			
Uniform Delay (d_1), s/veh		12.0	17.8	49.6	16.9		55.0		54.5			
Incremental Delay (d_2), s/veh		1.4	0.4	166.9	0.5		12.7		342.9			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (d), s/veh		13.5	18.2	216.6	17.4		67.7		397.4			
Level of Service (LOS)		B	B	F	B		E		F			

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	15.8	B	91.3	F	318.2	F	0.0	
Intersection Delay, s/veh / LOS	116.4				F			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	0.6	A	3.2	C	3.2	C
Bicycle LOS Score / LOS	3.2	C	3.6	D		F		

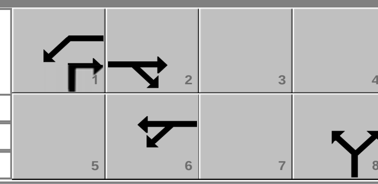
HCS 2010 Interchanges Results Summary

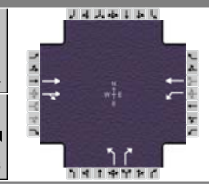
General Information				Interchange Information	
Agency	SDDOT/Sioux Falls			Interchange Type	Parclo A-2Q
Analyst	HDR	Analysis Date	Sep 18, 2012	Segment Distance, ft	1082
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-229 NORTHBOUND	PHF	0.90	Arterial Direction	East-West
File Name	26TH 2035 NO BUILD AM phf.xus				
Project Description	AM PEAK, 2035 NO BUILD				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		420	60	950	910		240		280			
Intersection Two Demand (*v*), veh/h		570	130	440	1740		120		420			

Signal One Information	
Cycle, s	130.0
Offset, s	80
Uncoordinated	No
Force Mode	Fixed

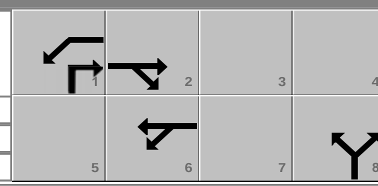
Green	72.5	21.5	20.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.9	1.9	1.0	0.0	0.0	0.0

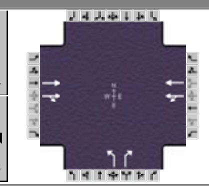




Signal Two Information	
Cycle, s	130.0
Offset, s	80
Uncoordinated	No
Force Mode	Fixed

Green	5.0	93.9	16.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.9	1.0	0.0	0.0	0.0





Interchange Results

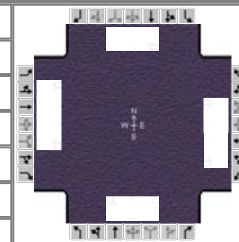
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	133	NBL(II) + NBT(II) + WBT(I)	75.9	D
B	NBR	422	NBT(II)	397.4	F
C	SBR	0	SBT(I)	0.0	A
D	SBL - SBU	0	SBL(I) + SBT(I) - EBT(II)	13.5	A
E	EBR(INT) - SBU	73	EBT(II) + EBT(I)	91.5	E
F	EBL(EXT)	0	EBL(I) + EBT(I)	0.0	A
G	WBL(EXT)	360	WBL(II) + WBT(II)	216.6	F
H	WBR(INT) - NBU	0	WBT(I) + WBT(II)	17.4	B
I	EBT(INT) - SBL + SBU	596	EBT(I) + EBT(II)	86.8	E
J	WBT(INT) - NBL + NBU	628	WBT(I) + WBT(II)	25.6	B
K		-		-	-
L		-		-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		73.3	74.2	24.8	8.3		137.7		6.7			
Level of Service (LOS)		E	E	C	A		F		A			
Approach Delay, s/veh / LOS	73.8		E	16.7		B	69.6		E	0.0		
Intersection Delay, s/veh / LOS	38.1						D					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		13.5	18.2	216.6	17.4		67.7		397.4			
Level of Service (LOS)		B	B	F	B		E		F			
Approach Delay, s/veh / LOS	15.8		B	91.3		F	318.2		F	0.0		
Intersection Delay, s/veh / LOS	116.4						F					

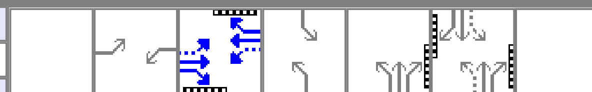
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	SOUTHEASTERN AVE.	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD AM phf.xus				
Project Description	AM PEAK, 2035 NO BUILD				

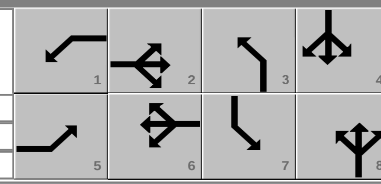


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	70	760	160	50	1140	300	980	1080	180	110	130	60

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	120	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.1	38.3	6.1	28.1	26.3	0.0
Yellow	3.9	3.9	3.9	3.9	3.9	0.0
Red	1.0	1.8	1.0	1.0	1.8	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	3.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	44.0	10.0	44.0	44.0	65.0	11.0	32.0
Change Period, ($Y+R_c$), s	4.9	5.7	4.9	5.7	4.9	5.7	4.9	5.7
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0	3.2	3.1	3.2	3.1
Queue Clearance Time (g_s), s	5.4		4.9		41.1	48.4	8.1	8.8
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.4
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	0.22	1.00	0.06

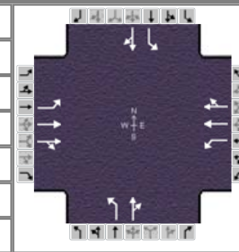
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	63	681	126	56	1267	300	1089	696	682	122	102	98
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1672	1672	1543	1690	1705	1486	1590	1765	1722	1681	1765	1584
Queue Service Time (g_s), s	3.4	22.5	5.7	2.9	38.3	23.9	39.1	46.0	46.4	6.1	6.4	6.8
Cycle Queue Clearance Time (g_c), s	3.4	22.5	5.7	2.9	38.3	23.9	39.1	46.0	46.4	6.1	6.4	6.8
Green Ratio (*g/C*)	0.33	0.29	0.29	0.33	0.29	0.29	0.52	0.46	0.46	0.25	0.20	0.20
Capacity (*c*), veh/h	121	985	455	203	1005	438	710	805	785	167	357	320
Volume-to-Capacity Ratio (*X*)	0.519	0.692	0.276	0.273	1.261	0.685	1.534	0.865	0.868	0.731	0.286	0.306
Available Capacity (c_a), veh/h	121	985	455	203	1005	438	710	805	785	167	357	320
Back of Queue (*Q*), veh/ln (50th percentile)	2.1	8.9	1.9	1.2	33.3	10.4	54.6	21.1	20.8	1.8	2.8	2.7
Queue Storage Ratio (*RQ*) (50th percentile)	1.08	0.00	0.98	0.28	0.00	1.06	4.63	0.00	0.00	0.42	0.00	0.00
Uniform Delay (d_1), s/veh	36.2	36.2	22.1	32.0	47.1	44.3	30.4	31.7	31.8	44.6	43.9	44.1
Incremental Delay (d_2), s/veh	0.4	0.8	0.3	0.2	122.3	5.2	247.3	9.3	9.8	13.3	0.2	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	0.0	0.0	0.0
Control Delay (*d*), s/veh	36.6	37.0	22.4	32.2	169.4	49.5	277.7	41.0	41.6	57.9	44.1	44.3
Level of Service (LOS)	D	D	C	C	F	D	F	D	D	E	D	D
Approach Delay, s/veh / LOS	34.9	C		142.5	F		145.7	F		49.4	D	
Intersection Delay, s/veh / LOS	120.6						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.1	C	3.4	C	3.4	C
Bicycle LOS Score / LOS	3.7	D	4.2	D	4.9	E	3.2	C

 HCS 2010™ Streets Version 6.60 Generated: 8/21/2014 1:00:55 PM

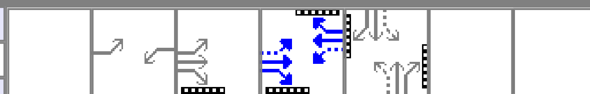
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	CLEVELAND AVE.	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD AM phf.xus				
Project Description	AM PEAK, 2035 NO BUILD				

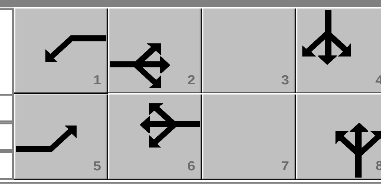


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	130	900	20	10	1260	110	60	80	20	70	20	170

Signal Information			
Cycle, s	130.0	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	5.4	5.4	75.0	24.5	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	1.0	1.0	1.4	1.9	0.0	0.0



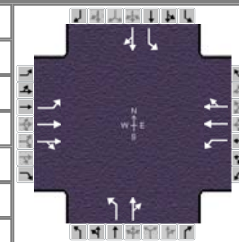
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		6.0		6.0
Phase Duration, s	20.0	90.0	10.0	80.0		30.0		30.0
Change Period, ($Y+R_c$), s	4.6	5.0	4.6	5.0		5.5		5.5
Max Allow Headway (MAH), s	3.2	0.0	3.2	0.0		3.4		3.4
Queue Clearance Time (g_s), s	5.0		2.3			25.2		17.9
Green Extension Time (g_e), s	0.1	0.0	0.0	0.0		0.0		0.6
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			1.00		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	124	440	437	11	764	747	67	109		78	194	
Adjusted Saturation Flow Rate (s), veh/h/ln	1655	1738	1724	1689	1774	1719	1182	1682		1273	1481	
Queue Service Time (g_s), s	3.0	24.6	24.8	0.3	31.9	32.3	7.3	7.3		7.3	15.9	
Cycle Queue Clearance Time (g_c), s	3.0	24.6	24.8	0.3	31.9	32.3	23.2	7.3		14.6	15.9	
Green Ratio (g/C)	0.71	0.65	0.65	0.62	0.58	0.58	0.19	0.19		0.19	0.19	
Capacity (c), veh/h	363	1137	1127	409	1023	992	133	317		224	279	
Volume-to-Capacity Ratio (X)	0.342	0.387	0.387	0.027	0.746	0.754	0.501	0.344		0.348	0.697	
Available Capacity (c_a), veh/h	363	1137	1127	409	1023	992	133	317		224	279	
Back of Queue (Q), veh/ln (50th percentile)	1.2	11.2	11.3	0.1	10.3	10.0	2.2	3.1		2.4	6.4	
Queue Storage Ratio (RQ) (50th percentile)	0.21	0.00	0.00	0.04	0.00	0.00	0.70	0.00		0.50	0.00	
Uniform Delay (d_1), s/veh	12.3	22.3	22.7	11.1	10.9	10.8	60.1	45.8		52.1	49.3	
Incremental Delay (d_2), s/veh	0.1	0.6	0.6	0.0	3.9	4.2	1.1	0.2		0.3	6.3	
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	12.4	23.0	23.3	11.1	14.8	15.0	61.2	46.0		52.5	55.5	
Level of Service (LOS)	B	C	C	B	B	B	E	D		D	E	
Approach Delay, s/veh / LOS	21.8	C		14.9	B		51.8	D		54.7	D	
Intersection Delay, s/veh / LOS	23.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.5	B	3.3	C	3.3	C
Bicycle LOS Score / LOS	3.1	C	3.4	C	2.8	C	2.9	C

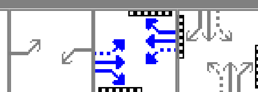
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM Peak	PHF	0.90
Intersection	VILLAGE SQUARE PLACE	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD AM phf.xus				
Project Description	AM PEAK, 2035 NO BUILD				

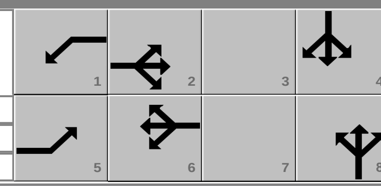


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	970	10	10	1300	5	60	5	40	10	0	20

Signal Information			
Cycle, s	130.0	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	5.4	87.0	22.8	0.0	0.0	0.0
Yellow	3.6	3.6	3.2	0.0	0.0	0.0
Red	1.0	1.4	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		6.0		6.0
Phase Duration, s	10.0	92.0	10.0	92.0		28.0		28.0
Change Period, (Y+R_c), s	4.6	5.0	4.6	5.0		5.2		5.2
Max Allow Headway (MAH), s	3.2	0.0	3.2	0.0		3.3		3.3
Queue Clearance Time (g_s), s	2.2		2.2			8.9		6.1
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.2		0.2
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	1.00		1.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	10	475	473	11	725	724	67	44		11	20	
Adjusted Saturation Flow Rate (s), veh/h/ln	1672	1756	1750	1689	1774	1771	1400	1540		1370	1510	
Queue Service Time (g_s), s	0.2	7.9	7.8	0.2	12.6	12.6	5.4	3.2		0.9	1.4	
Cycle Queue Clearance Time (g_c), s	0.2	7.9	7.8	0.2	12.6	12.6	6.9	3.2		4.1	1.4	
Green Ratio (g/C)	0.71	0.67	0.67	0.71	0.67	0.67	0.18	0.18		0.18	0.18	
Capacity (c), veh/h	328	1175	1171	477	1187	1185	285	270		262	265	
Volume-to-Capacity Ratio (X)	0.030	0.404	0.404	0.023	0.611	0.611	0.234	0.165		0.042	0.076	
Available Capacity (c_a), veh/h	328	1175	1171	477	1187	1185	285	270		262	265	
Back of Queue (Q), veh/ln (50th percentile)	0.1	2.5	2.5	0.1	3.2	3.2	1.9	1.2		0.3	0.6	
Queue Storage Ratio (RQ) (50th percentile)	0.03	0.00	0.00	0.03	0.00	0.00	0.98	0.00		0.16	0.00	
Uniform Delay (d_1), s/veh	6.5	3.7	3.7	5.8	3.0	3.0	47.7	45.5		47.2	44.8	
Incremental Delay (d_2), s/veh	0.0	1.0	1.0	0.0	2.3	2.4	0.2	0.1		0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	6.6	4.7	4.7	5.8	5.3	5.3	47.8	45.6		47.3	44.8	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	4.7		A	5.3		A	46.9		D	45.7		D
Intersection Delay, s/veh / LOS	7.4						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	3.2	C	3.3	C
Bicycle LOS Score / LOS	3.0	C	3.3	C	2.7	B	2.5	B

This Urban Streets text report was created on August 22, 2014 at 09:21:36

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	6
Number of Segments	5
Analysis period duration, h	0.25
System cycle length, s	130
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	50
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

Saturation Flowrate of 1800 was used, report indicates 1900 here but 1800 was used.

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	30	30	2	1	2143	2143	36	36	0	0	100	100	0	0
2	30	30	2	1	1082	1082	36	48	0	0	0	100	0	0
3	30	30	2	2	1280	1280	48	60	0	0	0	0	0	0
4	30	30	2	2	771	771	48	60	0	0	100	100	0	0
5	30	30	2	2	1214	1214	36	36	0	0	100	100	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

SEGMENT 5

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	EB LT 5	EB TH 2	EB RT 12	WB LT 1	WB TH 6	WB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	999	999
1	ShrdLane Spillback Time, h			1003.9	999		999.69
1	Base Free-Flow Speed, mph		38.06			36.88	
1	Running Time, s		40.5			44.25	
1	Running Speed, mph		36.08			33.02	
1	Through Delay, s/veh		73.74			39.35	
1	Travel Speed, mph		12.79			17.48	
1	Stop Rate, stops/veh		1.1			0.84	
1	Spatial Stop Rate, stops/mi		2.71			2.08	
1	Through vol/cap ratio		0.79			0.75	
1	Percent of Base FFS		33.61			47.39	
1	Level of Service		E			D	
1	Automobile Perception Score		2.8			2.46	
2	Bay/Lane Spillback Time, h	999	999	999	999	999	999
2	ShrdLane Spillback Time, h						
2	Base Free-Flow Speed, mph		39.7			39.23	
2	Running Time, s		21.85			25.01	
2	Running Speed, mph		33.77			29.49	
2	Through Delay, s/veh		15.5			8.26	
2	Travel Speed, mph		19.75			22.17	
2	Stop Rate, stops/veh		0.48			0.34	
2	Spatial Stop Rate, stops/mi		2.35			1.68	
2	Through vol/cap ratio		0.37			0.53	
2	Percent of Base FFS		49.76			56.52	
2	Level of Service		D			C	
2	Automobile Perception Score		2.73			2.62	
3	Bay/Lane Spillback Time, h	999	999	999	0	999	999
3	ShrdLane Spillback Time, h	999		999			
3	Base Free-Flow Speed, mph		38.7			38.69	
3	Running Time, s		24.4			26.54	
3	Running Speed, mph		35.76			32.89	
3	Through Delay, s/veh		37.02			59.51	
3	Travel Speed, mph		14.21			10.14	
3	Stop Rate, stops/veh		0.73			0.82	
3	Spatial Stop Rate, stops/mi		2.99			3.4	
3	Through vol/cap ratio		0.69			0.92	
3	Percent of Base FFS		36.72			26.22	
3	Level of Service		E			F	
3	Automobile Perception Score		2.61			2.68	
4	Bay/Lane Spillback Time, h	999	999	999	999	0.22	999
4	ShrdLane Spillback Time, h	999			999.13		999.06
4	Base Free-Flow Speed, mph		39.23			39.23	
4	Running Time, s		17.46			17.89	
4	Running Speed, mph		30.11			29.39	
4	Through Delay, s/veh		23.11			169.37	
4	Travel Speed, mph		12.96			2.81	
4	Stop Rate, stops/veh		0.71			1.64	
4	Spatial Stop Rate, stops/mi		4.86			11.25	
4	Through vol/cap ratio		0.39			1.26	
4	Percent of Base FFS		33.03			7.16	
4	Level of Service		E			F	
4	Automobile Perception Score		2.94			4.19	
5	Bay/Lane Spillback Time, h	999	999	999	999	999	999
5	ShrdLane Spillback Time, h	999			999		
5	Base Free-Flow Speed, mph		37.48			37.48	
5	Running Time, s		25.27			25.83	
5	Running Speed, mph		32.75			32.04	
5	Through Delay, s/veh		4.69			14.88	
5	Travel Speed, mph		27.63			20.33	
5	Stop Rate, stops/veh		0.14			0.37	

5	Spatial Stop Rate, stops/mi	0.63	1.62
5	Through vol/cap ratio	0.4	0.75
5	Percent of Base FFS	73.71	54.24
5	Level of Service	B	C
5	Automobile Perception Score	2.23	2.39

Facility Travel Time, s	283.54	430.89
Facility Travel Speed, mph	15.61	10.27
Facility Spatial Stop Rate, veh/mi	2.57	3.28
Facility Base Free Flow Speed, mph	38.47	38
Facility Percent Base Free Flow Speed	40.56	27.03
Facility Level of Service	D	F
Facility Automobile Perception Score	2.64	2.64
Facility Pedestrian Space	0	0
Facility Pedestrian Travel Speed	2.6	3.31
Facility Pedestrian LOS Score	4.22	4.39
Facility Pedestrian LOS	F	F
Facility Bicycle Travel Speed	10.98	12.55
Facility Bicycle LOS Score	4.33	5.55
Facility Bicycle LOS	E	F
Facility Transit Travel Speed	12.84	17.48
Facility Transit LOS Score	5.82	5.94
Facility Transit LOS	F	F
SPILLBACK TIME, h	0.22	

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	4.77	6.42
1	Ped LOS Score for Intersection	3.13	3.11
1	Ped LOS Score for Segment	4.57	5.2
1	Ped Segment LOS	F	
1	Bicycle LOS Score for Link	3.84	4.49
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	2.64	4.18
1	Number of access point approaches	13	20
1	Segment Length, ft	2143	2143
1	Bicycle LOS Score for Segment	4.74	6.01
1	Bicycle Segment LOS	E	F
1	Transit Wait-Ride Score	0.9	1.01
1	Ped LOS Score for Link	4.77	6.42
1	Transit LOS Score for Segment	5.37	5.44
1	Transit Segment LOS	F	F
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	4.01	5.49
2	Ped LOS Score for Intersection	2.79	0.65
2	Ped LOS Score for Segment	4.2	4.2
2	Ped Segment LOS	D	D
2	Bicycle LOS Score for Link	3.74	4.61
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	3.25	6.07
2	Number of access point approaches	0	0
2	Segment Length, ft	1082	1082
2	Bicycle LOS Score for Segment	3.73	8.35
2	Bicycle Segment LOS	D	F
2	Transit Wait-Ride Score	0	0
2	Ped LOS Score for Link	4.01	5.49
2	Transit LOS Score for Segment	6.6	6.82
2	Transit Segment LOS	F	F
3	Roadway crossing difficulty factor	1.2	1.2
3	Ped LOS Score for Link	4.25	4.07
3	Ped LOS Score for Intersection	3.27	0.64
3	Ped LOS Score for Segment	4.41	3.65
3	Ped Segment LOS	E	D
3	Bicycle LOS Score for Link	3.88	4.42
3	Indicator Variable	1	1

3	Bicycle LOS Score for Intersection	3.7	3.56
3	Number of access point approaches	4	1
3	Segment Length, ft	1280	1280
3	Bicycle LOS Score for Segment	4.49	4.09
3	Bicycle Segment LOS	E	D
3	Transit Wait-Ride Score	0	0
3	Ped LOS Score for Link	4.25	4.07
3	Transit LOS Score for Segment	6.64	6.61
3	Transit Segment LOS	F	F
4	Roadway crossing difficulty factor	1.2	1.2
4	Ped LOS Score for Link	3.11	3.84
4	Ped LOS Score for Intersection	2.36	3.14
4	Ped LOS Score for Segment	3.74	4.22
4	Ped Segment LOS	D	D
4	Bicycle LOS Score for Link	4.05	4.28
4	Indicator Variable	1	1
4	Bicycle LOS Score for Intersection	3.07	4.15
4	Number of access point approaches	0	0
4	Segment Length, ft	771	771
4	Bicycle LOS Score for Segment	3.74	4.23
4	Bicycle Segment LOS	D	D
4	Transit Wait-Ride Score	0	0
4	Ped LOS Score for Link	3.11	3.84
4	Transit LOS Score for Segment	6.47	6.58
4	Transit Segment LOS	F	F
5	Roadway crossing difficulty factor	1.2	1.2
5	Ped LOS Score for Link	3.13	3.76
5	Ped LOS Score for Intersection	2.35	2.51
5	Ped LOS Score for Segment	3.74	4.03
5	Ped Segment LOS	D	D
5	Bicycle LOS Score for Link	4.11	4.33
5	Indicator Variable	1	1
5	Bicycle LOS Score for Intersection	3.02	3.37
5	Number of access point approaches	4	5
5	Segment Length, ft	1214	1214
5	Bicycle LOS Score for Segment	4.34	4.62
5	Bicycle Segment LOS	E	E
5	Transit Wait-Ride Score	1.21	1.08
5	Ped LOS Score for Link	3.13	3.76
5	Transit LOS Score for Segment	4.65	4.95
5	Transit Segment LOS	E	E

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

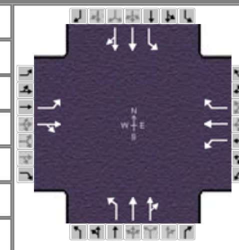
SEGMENT 3

SEGMENT 4

SEGMENT 5

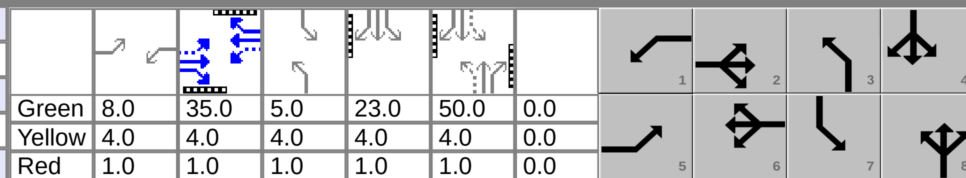
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM Peak	PHF	0.90
Intersection	CLIFF AVENUE	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD PM phf.xus				
Project Description	PM PEAK, 2035 NO BUILD				



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	370	40	80	480	80	90	400	50	300	940	120

Signal Information			
Cycle, s	146.0	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	8.0	35.0	5.0	23.0	50.0	0.0
Yellow	4.0	4.0	4.0	4.0	4.0	0.0
Red	1.0	1.0	1.0	1.0	1.0	0.0

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	13.0	40.0	13.0	40.0	10.0	55.0	38.0	83.0
Change Period, ($Y+R_c$), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Allow Headway (MAH), s	3.2	0.0	3.2	0.0	3.2	3.1	3.2	3.1
Queue Clearance Time (g_s), s	6.2		7.1		7.0	18.4	17.6	38.2
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	3.9	0.6	3.9
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	0.01	0.00	0.00

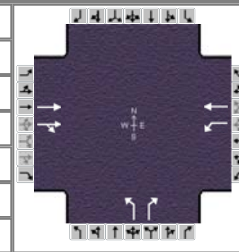
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	67	450		80	478	70	100	251	243	333	597	570
Adjusted Saturation Flow Rate (s), veh/h/ln	1681	1734		1681	1765	1456	1657	1739	1664	1640	1722	1640
Queue Service Time (g_s), s	4.2	35.0		5.1	35.0	5.7	5.0	16.2	16.4	15.6	36.1	36.2
Cycle Queue Clearance Time (g_c), s	4.2	35.0		5.1	35.0	5.7	5.0	16.2	16.4	15.6	36.1	36.2
Green Ratio (g/C)	0.29	0.24		0.29	0.24	0.24	0.38	0.34	0.34	0.58	0.53	0.53
Capacity (c), veh/h	141	416		141	423	349	235	596	570	622	920	876
Volume-to-Capacity Ratio (X)	0.471	1.083		0.564	1.131	0.200	0.426	0.422	0.426	0.536	0.649	0.650
Available Capacity (c_a), veh/h	141	416		141	423	349	235	596	570	622	920	876
Back of Queue (Q), veh/ln (50th percentile)	1.8	22.4		2.3	25.8	2.6	0.5	7.0	6.8	5.9	14.9	14.3
Queue Storage Ratio (RQ) (50th percentile)	0.57	0.00		0.57	0.00	0.67	0.08	0.00	0.00	1.39	0.00	0.00
Uniform Delay (d_1), s/veh	41.2	49.7		42.3	60.0	45.9	31.9	36.9	37.0	17.9	24.2	24.3
Incremental Delay (d_2), s/veh	0.9	68.2		3.0	83.0	1.2	0.5	0.2	0.2	0.5	1.3	1.3
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	42.1	117.9		45.3	142.9	47.1	32.4	37.1	37.1	18.4	25.5	25.6
Level of Service (LOS)	D	F		D	F	D	C	D	D	B	C	C
Approach Delay, s/veh / LOS	108.1	F		119.9	F		36.3	D		24.0	C	
Intersection Delay, s/veh / LOS	58.2						E					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.1	C	3.1	C	2.8	C	2.6	B
Bicycle LOS Score / LOS	3.0	C	3.3	C	2.9	C	3.6	D

 HCS 2010™ Streets Version 6.60 Generated: 8/21/2014 1:07:26 PM

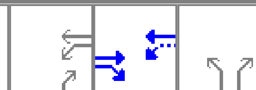
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM Peak	PHF	0.90
Intersection	YEAGER ROAD	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD PM phf.xus				
Project Description	PM PEAK, 2035 NO BUILD				

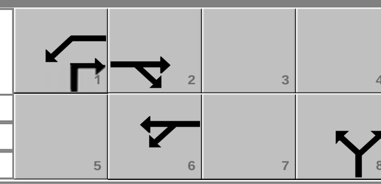


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		620	100	600	510		140		760			

Signal Information				
Cycle, s	146.0	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	56.5	37.5	36.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.9	1.9	1.0	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		43.0	62.0	105.0		41.0		
Change Period, ($Y+R_c$), s		5.5	5.5	5.5		5.0		
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (g_s), s			32.1			38.0		
Green Extension Time (g_e), s		0.0	1.3	0.0		0.0		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		388	370	569	483		156		822			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1785	1691	1810	1794		1560		1560			
Queue Service Time (g_s), s		31.7	30.4	30.1	16.1		12.2		36.0			
Cycle Queue Clearance Time (g_c), s		31.7	30.4	30.1	16.1		12.2		36.0			
Green Ratio (*g/C*)		0.26	0.26	0.66	0.68		0.25		0.63			
Capacity (*c*), veh/h		458	434	780	1223		385		988			
Volume-to-Capacity Ratio (*X*)		0.846	0.851	0.729	0.395		0.404		0.832			
Available Capacity (c_a), veh/h		458	434	780	1223		385		988			
Back of Queue (*Q*), veh/ln (50th percentile)		14.4	14.1	9.6	6.2		4.8		22.0			
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.00	0.00	0.00		1.21		0.00			
Uniform Delay (d_1), s/veh		50.1	51.9	24.4	9.2		46.0		20.7			
Incremental Delay (d_2), s/veh		9.1	9.9	2.2	0.7		0.3		5.8			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		59.2	61.8	26.6	9.9		46.3		26.5			
Level of Service (LOS)		E	E	C	A		D		C			
Approach Delay, s/veh / LOS	60.5	E		18.9	B		29.7	C		0.0		
Intersection Delay, s/veh / LOS	34.0						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	0.7	A	3.1	C	2.7	B
Bicycle LOS Score / LOS	2.9	C	4.7	E		F		

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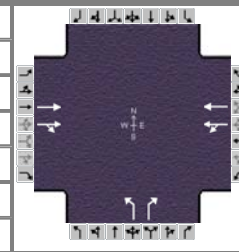
HCS 2010 Signalized Intersection Results Summary

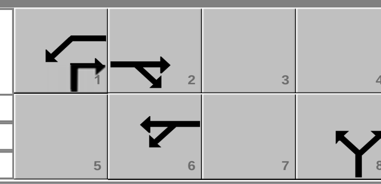
General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM Peak	PHF	0.90
Intersection	I-229 NORTHBOUND	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD PM phf.xus				
Project Description	PM PEAK, 2035 NO BUILD				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1300	80	80	1060		50		750			

Signal Information			
Cycle, s	146.0	Reference Phase	2
Offset, s	79	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.0	106.9	19.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.9	1.0	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	0.0	14.0		9.0		
Phase Duration, s		112.4	9.6	122.0		24.0		
Change Period, ($Y+R_c$), s		5.5	4.6	5.5		5.0		
Max Allow Headway (*MAH*), s		0.0	0.0	0.0		3.1		
Queue Clearance Time (g_s), s						21.0		
Green Extension Time (g_e), s		0.0	0.0	0.0		0.0		
Phase Call Probability						1.00		
Max Out Probability						1.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3		18			
Adjusted Flow Rate (*v*), veh/h		753	742	445	627		56		789			
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1919	1884	227	1684		1450		1491			
Queue Service Time (g_s), s		56.0	36.1	5.0	14.4		5.1		19.0			
Cycle Queue Clearance Time (g_c), s		56.0	36.1	5.0	14.4		5.1		19.0			
Green Ratio (*g/C*)		0.25	0.25	0.80	0.80		0.13		0.16			
Capacity (*c*), veh/h		474	1380	216	1344		189		245			
Volume-to-Capacity Ratio (*X*)		1.588	0.538	2.058	0.467		0.294		3.220			
Available Capacity (c_a), veh/h		474	1380	216	1344		189		245			
Back of Queue (*Q*), veh/ln (50th percentile)		52.5	16.6	36.4	3.9		1.8		77.6			
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.00	0.00	0.00		0.16		0.00			
Uniform Delay (d_1), s/veh		31.5	49.8	42.6	3.7		57.4		61.0			
Incremental Delay (d_2), s/veh		269.0	0.7	480.7	0.3		0.3		1009.4			
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0		0.0			
Control Delay (*d*), s/veh		300.5	50.5	523.4	4.0		57.8		1070.4			
Level of Service (LOS)		F	D	F	A		E		F			
Approach Delay, s/veh / LOS	176.4		F	219.5		F	1003.8		F	0.0		
Intersection Delay, s/veh / LOS	394.8						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.5	B	0.6	A	3.2	C	3.1	C
Bicycle LOS Score / LOS	3.9	D	2.6	B		F		

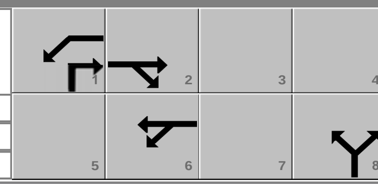
HCS 2010 Interchanges Results Summary

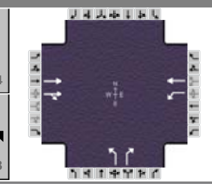
General Information				Interchange Information	
Agency	SDDOT/Sioux Falls			Interchange Type	Parclo A-2Q
Analyst	HDR	Analysis Date	Sep 18, 2012	Segment Distance, ft	1082
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	I-229 NORTHBOUND	PHF	0.90	Arterial Direction	East-West
File Name	26TH 2035 NO BUILD PM phf.xus				
Project Description	PM PEAK, 2035 NO BUILD				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		620	100	600	510		140		760			
Intersection Two Demand (*v*), veh/h		1300	80	80	1060		50		750			

Signal One Information	
Cycle, s	146.0
Offset, s	79
Uncoordinated	No
Force Mode	Fixed

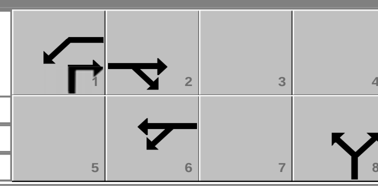
Green	56.5	37.5	36.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.9	1.9	1.0	0.0	0.0	0.0

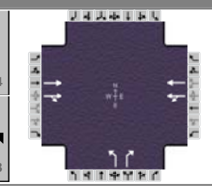




Signal Two Information	
Cycle, s	146.0
Offset, s	79
Uncoordinated	No
Force Mode	Fixed

Green	5.0	106.9	19.0	0.0	0.0	0.0
Yellow	3.6	3.6	4.0	0.0	0.0	0.0
Red	1.0	1.9	1.0	0.0	0.0	0.0





Interchange Results

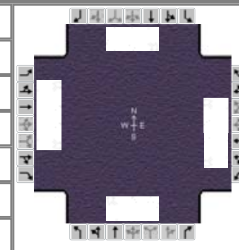
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	56	NBL(II) + NBT(II) + WBT(I)	67.7	D
B	NBR	789	NBT(II)	1070.4	F
C	SBR	0	SBT(I)	0.0	A
D	SBL - SBU	0	SBL(I) + SBT(I) - EBT(II)	300.5	F
E	EBR(INT) - SBU	76	EBT(II) + EBT(I)	109.7	E
F	EBL(EXT)	0	EBL(I) + EBT(I)	0.0	A
G	WBL(EXT)	75	WBL(II) + WBT(II)	523.4	F
H	WBR(INT) - NBU	0	WBT(I) + WBT(II)	4.0	A
I	EBT(INT) - SBL + SBU	1418	EBT(I) + EBT(II)	359.7	F
J	WBT(INT) - NBL + NBU	428	WBT(I) + WBT(II)	13.9	A
K		-		-	-
L		-		-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		59.2	61.8	26.6	9.9		46.3		26.5			
Level of Service (LOS)		E	E	C	A		D		C			
Approach Delay, s/veh / LOS	60.5	E		18.9	B		29.7	C		0.0		
Intersection Delay, s/veh / LOS	34.0						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		300.5	50.5	523.4	4.0		57.8		1070.4			
Level of Service (LOS)		F	D	F	A		E		F			
Approach Delay, s/veh / LOS	176.4	F		219.5	F		1003.8	F		0.0		
Intersection Delay, s/veh / LOS	394.8						F					

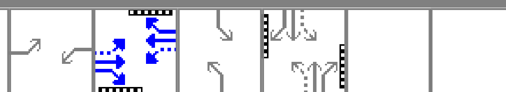
HCS 2010 Signalized Intersection Results Summary

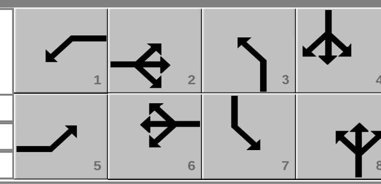
General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM Peak	PHF	0.90
Intersection	SOUTHEASTERN AVE.	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD PM phf.xus				
Project Description	PM PEAK, 2035 NO BUILD				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	70	1410	570	90	690	110	340	280	170	470	680	110

Signal Information										
Cycle, s	146.0	Reference Phase	2							
Offset, s	3	Reference Point	Begin	Green	5.1	78.3	14.1	27.3	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	3.9	3.9	3.9	3.9	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.8	1.0	1.8	0.0	0.0





Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	3.0	1.1	3.0	1.1	4.0	1.1	4.0
Phase Duration, s	10.0	84.0	10.0	84.0	19.0	33.0	19.0	33.0
Change Period, (Y+R_c), s	4.9	5.7	4.9	5.7	4.9	5.7	4.9	5.7
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0	3.1	3.1	3.2	3.1
Queue Clearance Time (g_s), s	3.5		5.9		16.1	22.5	16.1	29.3
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0
Phase Call Probability	1.00		1.00		1.00	1.00	1.00	1.00
Max Out Probability	1.00		1.00		1.00	0.67	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	40	801	295	100	767	111	378	251	226	522	444	422
Adjusted Saturation Flow Rate (s), veh/h/ln	1672	1672	1457	1706	1705	1492	1681	1765	1537	1681	1765	1676
Queue Service Time (g_s), s	1.5	9.8	9.5	3.9	27.0	8.2	14.1	19.7	20.5	14.1	27.3	27.3
Cycle Queue Clearance Time (g_c), s	1.5	9.8	9.5	3.9	27.0	8.2	14.1	19.7	20.5	14.1	27.3	27.3
Green Ratio (g/C)	0.57	0.54	0.54	0.57	0.54	0.54	0.28	0.19	0.19	0.28	0.19	0.19
Capacity (c), veh/h	342	1793	781	421	1829	800	212	330	287	242	330	313
Volume-to-Capacity Ratio (X)	0.116	0.447	0.378	0.238	0.419	0.139	1.785	0.762	0.788	2.162	1.347	1.348
Available Capacity (c_a), veh/h	342	1793	781	421	1829	800	212	330	287	242	330	313
Back of Queue (Q), veh/ln (50th percentile)	0.6	2.7	2.5	1.6	12.3	5.3	28.1	9.6	8.9	38.5	28.3	26.9
Queue Storage Ratio (RQ) (50th percentile)	0.29	0.00	1.27	0.36	0.00	0.54	2.38	0.00	0.00	8.89	0.00	0.00
Uniform Delay (d_1), s/veh	16.2	6.9	8.7	15.1	34.5	27.4	46.7	56.3	56.6	49.6	59.4	59.4
Incremental Delay (d_2), s/veh	0.0	0.1	0.1	0.1	0.5	0.3	371.7	9.0	12.6	536.4	174.9	176.2
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	16.2	7.0	8.9	15.2	35.0	27.6	418.3	65.3	69.1	586.0	234.3	235.5
Level of Service (LOS)	B	A	A	B	D	C	F	E	E	F	F	F
Approach Delay, s/veh / LOS	7.8	A		32.2	C		222.2	F		366.9	F	
Intersection Delay, s/veh / LOS	169.8						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.3	C	3.1	C	3.5	C	3.6	D
Bicycle LOS Score / LOS	4.6	E	3.6	D	3.6	D	4.1	D

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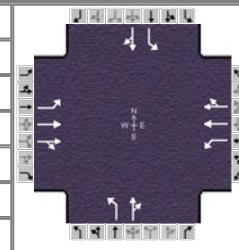
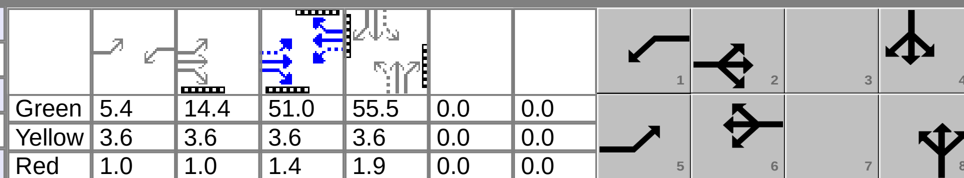
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM Peak	PHF	0.90
Intersection	CLEVELAND AVE.	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD PM phf.xus				
Project Description	PM PEAK, 2035 NO BUILD				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	240	1760	50	40	700	100	30	40	40	190	80	160

Signal Information			
Cycle, s	146.0	Reference Phase	2
Offset, s	34	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.4	14.4	51.0	55.5	0.0	0.0
Yellow	3.6	3.6	3.6	3.6	0.0	0.0
Red	1.0	1.0	1.4	1.9	0.0	0.0

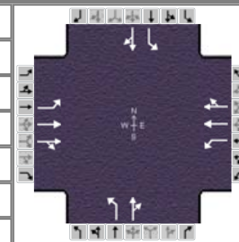
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		8		4
Case Number	1.1	4.0	1.1	4.0		6.0		6.0
Phase Duration, s	29.0	75.0	10.0	56.0		61.0		61.0
Change Period, (*Y+R*c), s	4.6	5.0	4.6	5.0		5.5		5.5
Max Allow Headway (*MAH*), s	3.2	0.0	3.2	0.0		3.4		3.4
Queue Clearance Time (*g*s), s	7.9		4.4			22.1		25.4
Green Extension Time (*g*e), s	0.2	0.0	0.0	0.0		1.3		1.3
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.00		1.00			0.00		0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (*v*), veh/h	144	541	536	44	450	428	33	83		211	244	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1655	1738	1722	1689	1774	1687	1131	1596		1306	1557	
Queue Service Time (*g*s), s	5.9	33.8	33.6	2.4	33.2	33.2	3.3	5.0		18.4	16.9	
Cycle Queue Clearance Time (*g*c), s	5.9	33.8	33.6	2.4	33.2	33.2	20.1	5.0		23.4	16.9	
Green Ratio (*g/C*)	0.53	0.48	0.48	0.39	0.35	0.35	0.38	0.38		0.38	0.38	
Capacity (*c*), veh/h	402	833	825	234	620	589	349	607		501	592	
Volume-to-Capacity Ratio (*X*)	0.358	0.649	0.649	0.190	0.726	0.726	0.096	0.137		0.421	0.413	
Available Capacity (*c*a), veh/h	402	833	825	234	620	589	349	607		501	592	
Back of Queue (*Q*), veh/ln (50th percentile)	2.1	14.0	13.8	1.0	16.1	15.4	0.9	2.0		6.0	6.5	
Queue Storage Ratio (*RQ*) (50th percentile)	0.35	0.00	0.00	0.32	0.00	0.00	0.30	0.00		1.27	0.00	
Uniform Delay (*d*1), s/veh	18.8	27.7	27.4	29.1	45.2	45.0	40.7	29.6		37.2	33.3	
Incremental Delay (*d*2), s/veh	0.0	0.4	0.4	0.1	6.9	7.2	0.0	0.0		0.2	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	0.0	
Control Delay (*d*), s/veh	18.8	28.0	27.7	29.2	52.1	52.3	40.7	29.6		37.5	33.4	
Level of Service (LOS)	B	C	C	C	D	D	D	C		D	C	
Approach Delay, s/veh / LOS	26.8	C		51.1	D		32.8	C		35.3	D	
Intersection Delay, s/veh / LOS	36.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.7	B	3.5	D	3.3	C
Bicycle LOS Score / LOS	4.0	D	2.9	C	2.7	B	3.2	C

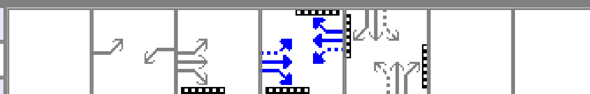
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	SDDOT/Sioux Falls			Duration, h	0.25
Analyst	HDR	Analysis Date	Sep 18, 2012	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM Peak	PHF	0.90
Intersection	VILLAGE SQUARE PLACE	Analysis Year	2035	Analysis Period	1> 7:00
File Name	26TH 2035 NO BUILD PM phf.xus				
Project Description	PM PEAK, 2035 NO BUILD				

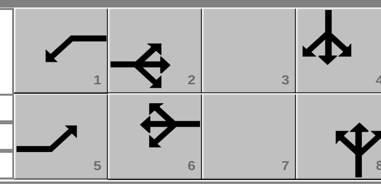


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	30	1890	70	20	790	10	40	0	50	5	0	10

Signal Information			
Cycle, s	146.0	Reference Phase	2
Offset, s	53	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	5.4	1.0	100.0	24.8	0.0	0.0
Yellow	3.6	0.0	3.6	3.2	0.0	0.0
Red	1.0	0.0	1.4	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		6.0
Phase Duration, s	11.0	106.0	10.0	105.0		30.0		30.0
Change Period, ($Y+R_c$), s	4.6	5.0	4.6	5.0		5.2		5.2
Max Allow Headway (MAH), s	3.2	0.0	3.2	0.0		3.4		3.4
Queue Clearance Time (g_s), s	2.5		2.5			6.7		6.7
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.2		0.2
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.22		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	20	643	635	22	444	442	44	50		6	9	
Adjusted Saturation Flow Rate (s), veh/h/ln	1672	1756	1733	1689	1774	1766	1414	1510		1363	1510	
Queue Service Time (g_s), s	0.5	7.6	7.4	0.5	4.8	4.8	4.0	4.1		0.5	0.7	
Cycle Queue Clearance Time (g_c), s	0.5	7.6	7.4	0.5	4.8	4.8	4.7	4.1		4.7	0.7	
Green Ratio (g/C)	0.73	0.69	0.69	0.72	0.68	0.68	0.17	0.17		0.17	0.17	
Capacity (c), veh/h	528	1215	1199	383	1215	1210	283	257		242	257	
Volume-to-Capacity Ratio (X)	0.037	0.529	0.530	0.058	0.366	0.366	0.157	0.195		0.023	0.035	
Available Capacity (c_a), veh/h	528	1215	1199	383	1215	1210	283	257		242	257	
Back of Queue (Q), veh/ln (50th percentile)	0.2	2.0	1.9	0.2	1.6	1.6	1.4	1.6		0.2	0.3	
Queue Storage Ratio (RQ) (50th percentile)	0.06	0.00	0.00	0.06	0.00	0.00	0.73	0.00		0.09	0.00	
Uniform Delay (d_1), s/veh	5.8	1.9	1.8	5.9	2.2	2.2	52.6	52.0		54.0	50.6	
Incremental Delay (d_2), s/veh	0.0	1.3	1.3	0.0	0.9	0.9	0.1	0.1		0.0	0.0	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	5.8	3.2	3.1	5.9	3.1	3.1	52.7	52.2		54.0	50.6	
Level of Service (LOS)	A	A	A	A	A	A	D	D		D	D	
Approach Delay, s/veh / LOS	3.2		A	3.1		A	52.4		D	51.9		D
Intersection Delay, s/veh / LOS	5.5						A					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	2.3	B	3.2	C	3.3	C
Bicycle LOS Score / LOS	3.9	D	2.9	C	2.6	B	2.5	B

 HCS 2010™ Streets Version 6.60 Generated: 8/21/2014 1:07:26 PM

This Urban Streets text report was created on August 22, 2014 at 09:23:46

Period number = 1

Chapter 17 Input

URBAN STREET PARAMETERS

Number of Intersections	6
Number of Segments	5
Analysis period duration, h	0.25
System cycle length, s	146
Urban street forward direction	EB
Sneakers per cycle, veh	2
Saturation flow rate, veh/h/ln	1900
Stored vehicle lane length, ft	25
Detected vehicle length, ft	17
Queue length percent	50
Critical merge gap, s	3.7
Stop threshold speed, mph	5
Acceleration rate, ft/s/s	3.5
Decel. rate (signal), ft/s/s	4
Minimum headway in a platoon, s/veh	1.5
Maximum headway in a platoon, s/veh	3.6
Number of iterations	15
Length of left-turn bay (access pt.), ft	250
Decel. rate (access pt.), ft/s/s	6.7
Right-turn speed (access pt.), ft/s	20
Critical gap from major left (access pt.), s	4.1
Follow-up time from major left (access pt.), s	2.2
Right-turn equivalency factor (access pt.)	2.2
Stored heavy vehicle lane length, ft	45
Proportion of peds who push button	0.65
Critical gap for permissive left-turn, s	4.5
Follow-up time for permissive left-turn, s	2.5
Calibration factor for platoon dispersion	0.14
Average ratio of speed limit to free-flow speed	0.9

Saturation Flowrate of 1800 used, report printout shows 1900 but 1800 was used.

BASIC SEGMENT INFORMATION

Seg	Spd Lmt		TH Lanes		Seg Len		IntWid		LenRM		PctCurb		Other Dly	
Num	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1	30	30	2	1	2143	2143	36	36	0	0	100	100	0	0
2	30	30	2	1	1082	1082	36	48	0	0	0	100	0	0
3	30	30	2	2	1280	1280	48	60	0	0	0	0	0	0
4	30	30	2	2	771	771	48	60	0	0	100	100	0	0
5	30	30	2	2	1214	1214	36	36	0	0	100	100	0	0

ORIGIN-DESTINATION SEED PROPORTIONS - Forward Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ORIGIN-DESTINATION SEED PROPORTIONS - Reverse Direction

	Cross LT	Major TH	Cross RT	MidEntry
Downstream Left	0.02	0.1	0.05	0.02
Downstream Thru	0.91	0.78	0.92	0.97
Downstream Right	0.05	0.1	0.02	0.01
Mid-segment Exit	0.02	0.02	0.01	0

ACCESS POINT DATA

SEGMENT 1

Number of access points: 0

SEGMENT 2

Number of access points: 0

SEGMENT 3

Number of access points: 0

SEGMENT 4

Number of access points: 0

SEGMENT 5

Number of access points: 0

Global Output

SEGMENT DATA

Seg.No.	Movement	EB LT 5	EB TH 2	EB RT 12	WB LT 1	WB TH 6	WB RT 16
1	Bay/Lane Spillback Time, h	999	999	999	999	1.52	999
1	ShrdLane Spillback Time, h			1000.2	999.35		999.59
1	Base Free-Flow Speed, mph		38.06			36.88	
1	Running Time, s		40.85			42.81	
1	Running Speed, mph		35.77			34.13	
1	Through Delay, s/veh		60.29			142.92	
1	Travel Speed, mph		14.45			7.87	
1	Stop Rate, stops/veh		0.93			1.44	
1	Spatial Stop Rate, stops/mi		2.29			3.54	
1	Through vol/cap ratio		0.85			1.13	
1	Percent of Base FFS		37.96			21.33	
1	Level of Service		E			F	
1	Automobile Perception Score		2.72			2.71	
2	Bay/Lane Spillback Time, h	999	0.16	0	999	999	999
2	ShrdLane Spillback Time, h						
2	Base Free-Flow Speed, mph		39.7			39.23	
2	Running Time, s		22.43			23.26	
2	Running Speed, mph		32.89			31.72	
2	Through Delay, s/veh		183.15			9.93	
2	Travel Speed, mph		3.59			22.22	
2	Stop Rate, stops/veh		1.5			0.32	
2	Spatial Stop Rate, stops/mi		7.31			1.55	
2	Through vol/cap ratio		1.1			0.4	
2	Percent of Base FFS		9.04			56.65	
2	Level of Service		F			C	
2	Automobile Perception Score		3.68			2.6	
3	Bay/Lane Spillback Time, h	999	999	999	0	999	999
3	ShrdLane Spillback Time, h	999		999			
3	Base Free-Flow Speed, mph		38.7			38.69	
3	Running Time, s		24.67			25.81	
3	Running Speed, mph		35.38			33.81	
3	Through Delay, s/veh		6.97			196.58	
3	Travel Speed, mph		27.59			3.92	
3	Stop Rate, stops/veh		0.17			1.01	
3	Spatial Stop Rate, stops/mi		0.69			4.17	
3	Through vol/cap ratio		0.45			1.06	
3	Percent of Base FFS		71.28			10.14	
3	Level of Service		B			F	
3	Automobile Perception Score		2.24			2.82	
4	Bay/Lane Spillback Time, h	999	999	999	999	999	999
4	ShrdLane Spillback Time, h	999			999		999
4	Base Free-Flow Speed, mph		39.23			39.23	
4	Running Time, s		17.6			17.45	
4	Running Speed, mph		29.88			30.12	
4	Through Delay, s/veh		27.88			35.04	
4	Travel Speed, mph		11.56			10.02	
4	Stop Rate, stops/veh		0.64			0.79	
4	Spatial Stop Rate, stops/mi		4.35			5.42	
4	Through vol/cap ratio		0.65			0.42	
4	Percent of Base FFS		29.46			25.53	
4	Level of Service		F			F	
4	Automobile Perception Score		2.85			3.04	
5	Bay/Lane Spillback Time, h	999	999	999	999	999	999
5	ShrdLane Spillback Time, h	999			999		
5	Base Free-Flow Speed, mph		37.48			37.48	
5	Running Time, s		25.6			25.25	
5	Running Speed, mph		32.34			32.78	
5	Through Delay, s/veh		3.15			52.15	
5	Travel Speed, mph		28.79			10.69	
5	Stop Rate, stops/veh		0.08			0.89	

5	Spatial Stop Rate, stops/mi	0.33	3.85
5	Through vol/cap ratio	0.53	0.73
5	Percent of Base FFS	76.81	28.53
5	Level of Service	B	F
5	Automobile Perception Score	2.19	2.76

Facility Travel Time, s	412.58	571.21
Facility Travel Speed, mph	10.73	7.75
Facility Spatial Stop Rate, veh/mi	2.69	3.62
Facility Base Free Flow Speed, mph	38.47	38
Facility Percent Base Free Flow Speed	27.88	20.39
Facility Level of Service	F	F
Facility Automobile Perception Score	2.62	2.75
Facility Pedestrian Space	0	0
Facility Pedestrian Travel Speed	2.6	3.31
Facility Pedestrian LOS Score	4.35	4.09
Facility Pedestrian LOS	F	F
Facility Bicycle Travel Speed	10.57	12.31
Facility Bicycle LOS Score	4.66	4.68
Facility Bicycle LOS	E	E
Facility Transit Travel Speed	14.6	7.87
Facility Transit LOS Score	5.85	6.03
Facility Transit LOS	F	F
SPILLBACK TIME, h	0.16	

Multimodal Results

1	Roadway crossing difficulty factor	1.2	1.2
1	Ped LOS Score for Link	5.08	5.61
1	Ped LOS Score for Intersection	2.86	3.14
1	Ped LOS Score for Segment	4.62	4.9
1	Ped Segment LOS	F	F
1	Bicycle LOS Score for Link	4.06	4.28
1	Indicator Variable	1	1
1	Bicycle LOS Score for Intersection	2.88	3.27
1	Number of access point approaches	13	20
1	Segment Length, ft	2143	2143
1	Bicycle LOS Score for Segment	4.82	5.55
1	Bicycle Segment LOS	E	F
1	Transit Wait-Ride Score	0.94	0.74
1	Ped LOS Score for Link	5.08	5.61
1	Transit LOS Score for Segment	5.35	5.73
1	Transit Segment LOS	F	F
2	Roadway crossing difficulty factor	1.2	1.2
2	Ped LOS Score for Link	4.87	4.4
2	Ped LOS Score for Intersection	2.54	0.68
2	Ped LOS Score for Segment	4.45	3.79
2	Ped Segment LOS	E	D
2	Bicycle LOS Score for Link	4.08	4.48
2	Indicator Variable	1	1
2	Bicycle LOS Score for Intersection	3.92	4.7
2	Number of access point approaches	0	0
2	Segment Length, ft	1082	1082
2	Bicycle LOS Score for Segment	4.06	4.77
2	Bicycle Segment LOS	D	E
2	Transit Wait-Ride Score	0	0
2	Ped LOS Score for Link	4.87	4.4
2	Transit LOS Score for Segment	6.73	6.66
2	Transit Segment LOS	F	F
3	Roadway crossing difficulty factor	1.2	1.2
3	Ped LOS Score for Link	4.58	3.28
3	Ped LOS Score for Intersection	3.26	0.64
3	Ped LOS Score for Segment	4.53	3.35
3	Ped Segment LOS	E	C
3	Bicycle LOS Score for Link	4.02	4.19
3	Indicator Variable	1	1

3	Bicycle LOS Score for Intersection	4.65	2.6
3	Number of access point approaches	4	1
3	Segment Length, ft	1280	1280
3	Bicycle LOS Score for Segment	5.22	3.81
3	Bicycle Segment LOS	F	D
3	Transit Wait-Ride Score	0	0
3	Ped LOS Score for Link	4.58	3.28
3	Transit LOS Score for Segment	6.69	6.49
3	Transit Segment LOS	F	F
4	Roadway crossing difficulty factor	1.2	1.2
4	Ped LOS Score for Link	3.37	3.1
4	Ped LOS Score for Intersection	2.4	3.14
4	Ped LOS Score for Segment	3.85	3.94
4	Ped Segment LOS	D	D
4	Bicycle LOS Score for Link	4.15	4.05
4	Indicator Variable	1	1
4	Bicycle LOS Score for Intersection	3.98	3.62
4	Number of access point approaches	0	0
4	Segment Length, ft	771	771
4	Bicycle LOS Score for Segment	4.1	3.91
4	Bicycle Segment LOS	D	D
4	Transit Wait-Ride Score	0	0
4	Ped LOS Score for Link	3.37	3.1
4	Transit LOS Score for Segment	6.5	6.46
4	Transit Segment LOS	F	F
5	Roadway crossing difficulty factor	1.2	1.2
5	Ped LOS Score for Link	3.51	3.1
5	Ped LOS Score for Intersection	2.37	2.68
5	Ped LOS Score for Segment	3.89	3.82
5	Ped Segment LOS	D	D
5	Bicycle LOS Score for Link	4.25	4.09
5	Indicator Variable	1	1
5	Bicycle LOS Score for Intersection	3.93	2.87
5	Number of access point approaches	4	5
5	Segment Length, ft	1214	1214
5	Bicycle LOS Score for Segment	4.7	4.46
5	Bicycle Segment LOS	E	E
5	Transit Wait-Ride Score	1.23	0.84
5	Ped LOS Score for Link	3.51	3.1
5	Transit LOS Score for Segment	4.68	5.21
5	Transit Segment LOS	E	F

ACCESS POINT DATA

SEGMENT 1

SEGMENT 2

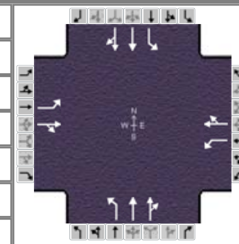
SEGMENT 3

SEGMENT 4

SEGMENT 5

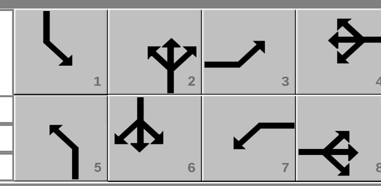
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM 2035 No Build	PHF	0.90
Intersection	33rd Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	am 2035 no build.xus				
Project Description	I-229/Cliff interchange				



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	160	40	90	320	50	140	830	20	50	370	50

Signal Information											
Cycle, s	130.0	Reference Phase	2	Green	4.5	0.7	46.6	5.5	44.2	0.0
Offset, s	121	Reference Point	Begin	Yellow	4.5	4.5	5.0	4.5	5.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Red	1.0	1.0	1.0	1.0	1.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On							



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	3	8	7	4	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	11.0	50.2	11.0	50.2	16.2	58.8	10.0	52.6
Change Period, ($Y+R_c$), s	5.5	6.0	5.5	6.0	5.5	6.0	5.5	6.0
Max Allow Headway (*MAH*), s	3.2	3.1	3.2	3.1	3.2	0.0	3.2	0.0
Queue Clearance Time (g_s), s	5.4	14.6	7.1	28.7	12.7		4.7	
Green Extension Time (g_e), s	0.0	1.2	0.0	1.2	0.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	0.00	1.00	0.00	1.00		1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	3	8	18	7	4	14	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	67	217		100	406		263	800	796	56	234	227
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664	1691		1664	1708		1655	1689	1675	1689	1723	1654
Queue Service Time (g_s), s	3.4	12.6		5.1	26.7		10.7	52.8	52.8	2.7	11.3	11.4
Cycle Queue Clearance Time (g_c), s	3.4	12.6		5.1	26.7		10.7	52.8	52.8	2.7	11.3	11.4
Green Ratio (*g/C*)	0.38	0.34		0.38	0.34		0.46	0.41	0.41	0.39	0.36	0.36
Capacity (*c*), veh/h	241	575		405	581		439	686	680	114	618	593
Volume-to-Capacity Ratio (*X*)	0.277	0.377		0.247	0.698		0.600	1.166	1.170	0.488	0.379	0.383
Available Capacity (c_a), veh/h	241	575		405	581		439	686	680	114	618	593
Back of Queue (*Q*), veh/ln (50th percentile)	1.4	5.2		2.1	11.6		2.0	38.7	38.7	1.9	4.6	4.5
Queue Storage Ratio (*RQ*) (50th percentile)	0.16	0.00		0.70	0.00		0.52	0.00	0.00	0.47	0.00	0.00
Uniform Delay (d_1), s/veh	29.2	32.5		27.1	37.1		25.6	44.8	44.8	32.7	24.7	24.7
Incremental Delay (d_2), s/veh	0.2	0.2		0.1	3.1		1.0	84.8	86.4	1.2	1.8	1.9
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	29.5	32.6		27.2	40.3		26.6	129.6	131.2	33.9	26.5	26.6
Level of Service (LOS)	C	C		C	D		C	F	F	C	C	C
Approach Delay, s/veh / LOS	31.9	C		37.7	D		115.7	F		27.3	C	
Intersection Delay, s/veh / LOS	81.3						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.8	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.0	A	1.3	A	1.4	A	0.9	A

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*RL*
Agency/Co.	*HDR*
Date Performed	*1/9/2014*
Analysis Time Period	*AM PEAK*

Site Information

Intersection	*33RD/SHERMAN*
Jurisdiction	*SIOUX FALLS*
Analysis Year	*2035 no-build*

Project Description *I-229/26TH ST. IMJR*

East/West Street: *33RD STREET* | North/South Street: *SHERMAN AVE.*

Intersection Orientation: *East-West* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*10*	*80*	*140*	*70*	*340*	*10*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*11*	*88*	*155*	*77*	*377*	*11*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*100*	*10*	*30*	*10*	*10*	*20*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*111*	*11*	*33*	*11*	*11*	*22*
Percent Heavy Vehicles	*1*	*1*	*1*	*1*	*1*	*1*
Percent Grade (%)		*1*			*-1*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*11*	*77*		*155*			*44*	
C (m) (veh/h)	*1170*	*1323*		*331*			*419*	
v/c	*0.01*	*0.06*		*0.47*			*0.11*	
95% queue length	*0.03*	*0.19*		*2.57*			*0.35*	
Control Delay (s/veh)	*8.1*	*7.9*		*25.4*			*14.6*	
LOS	*A*	*A*		*D*			*B*	
Approach Delay (s/veh)	--	--		*25.4*			*14.6*	
Approach LOS	--	--		*D*			*B*	

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*RL*	Intersection	*33RD/VAN EPS*
Agency/Co.	*HDR*	Jurisdiction	*SIOUX FALLS*
Date Performed	*1/10/2014*	Analysis Year	*2035 no-build*
Analysis Time Period	*AM PEAK*		

Project Description *I-229/26TH ST. IMJR*

East/West Street: *33RD STREET*	North/South Street: *VAN EPS AVE.*
Intersection Orientation: *East-West*	Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	10	100	10	10	360	5
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	11	111	11	11	400	5
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		1			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	30	5	5	5	5	30
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	33	5	5	5	5	33
Percent Heavy Vehicles	1	1	1	1	1	1
Percent Grade (%)	2			-2		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR			LTR	
v (veh/h)	11	11		43			43	
C (m) (veh/h)	1154	1465		402			599	
v/c	0.01	0.01		0.11			0.07	
95% queue length	0.03	0.02		0.36			0.23	
Control Delay (s/veh)	8.1	7.5		15.0			11.5	
LOS	A	A		C			B	
Approach Delay (s/veh)	--	--	15.0			11.5		
Approach LOS	--	--	C			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*RL*
Agency/Co.	*HDR*
Date Performed	*1/10/2014*
Analysis Time Period	*AM PEAK*

Site Information

Intersection	*33RD/BLAUVELT*
Jurisdiction	*SIOUX FALLS*
Analysis Year	*2035 no-build*

Project Description *I-229/26TH ST. IMJR*

East/West Street: *33RD STREET* | North/South Street: *BLAUVELT AVE.*

Intersection Orientation: *East-West* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*10*	*90*	*10*	*50*	*315*	*5*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*11*	*100*	*11*	*55*	*350*	*5*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*10*	*10*	*40*	*10*	*20*	*50*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*11*	*11*	*44*	*11*	*22*	*55*
Percent Heavy Vehicles	*1*	*1*	*1*	*1*	*1*	*1*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*11*	*55*		*66*			*88*	
C (m) (veh/h)	*1204*	*1479*		*617*			*532*	
v/c	*0.01*	*0.04*		*0.11*			*0.17*	
95% queue length	*0.03*	*0.12*		*0.36*			*0.59*	
Control Delay (s/veh)	*8.0*	*7.5*		*11.5*			*13.1*	
LOS	*A*	*A*		*B*			*B*	
Approach Delay (s/veh)	--	--	*11.5*			*13.1*		
Approach LOS	--	--	*B*			*B*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*RL*	Intersection	*I-229/YEAGER*
Agency/Co.	*HDR*	Jurisdiction	*SIOUX FALLS*
Date Performed	*1/10/2014*	Analysis Year	*2035 no-build*
Analysis Time Period	*AM PEAK*		

Project Description *I-229/26TH ST. IMJR*

East/West Street: *I-229 RAMPS* | North/South Street: *YEAGER ROAD*

Intersection Orientation: *North-South* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*130*	*10*	*780*	*230*	
Peak-Hour Factor, PHF	*0.79*	*0.90*	*0.90*	*0.90*	*0.90*	*0.64*
Hourly Flow Rate, HFR (veh/h)	*0*	*144*	*11*	*866*	*255*	*0*
Percent Heavy Vehicles	*1*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration			*TR*	*L*	*T*	
Upstream Signal		*0*			*1*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*140*		*390*
Peak-Hour Factor, PHF	*0.79*	*0.79*	*0.79*	*0.90*	*0.77*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*155*	*0*	*433*
Percent Heavy Vehicles	*2*	*0*	*0*	*2*	*0*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*	*L*		*R*			
v (veh/h)		*866*	*155*		*433*			
C (m) (veh/h)		*1425*	*21*		*896*			
v/c		*0.61*	*7.38*		*0.48*			
95% queue length		*4.57*	*70.31*		*2.77*			
Control Delay (s/veh)		*11.4*	*11857*		*12.8*			
LOS		*B*	*F*		*B*			
Approach Delay (s/veh)	--	--	*3135*					
Approach LOS	--	--	*F*					

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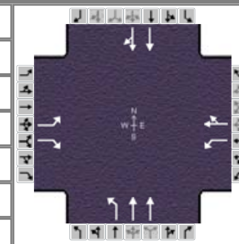
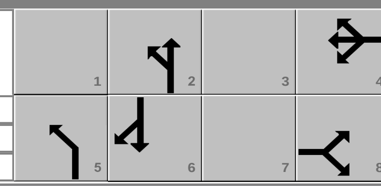
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM 2035 No Build	PHF	0.90
Intersection	41st Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	am 2035 no build.xus				
Project Description	I-229/Cliff interchange				



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		80	170	150	70	250	1420			520	70

Signal Information										
Cycle, s	130.0	Reference Phase	2							
Offset, s	34	Reference Point	Begin	Green	18.5	59.0	35.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.5	5.0	5.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		8		4	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		41.0		41.0	24.0	89.0		65.0
Change Period, ($Y+R_c$), s		6.0		6.0	5.5	6.0		6.0
Max Allow Headway (*MAH*), s		3.2		3.2	3.4	0.0		0.0
Queue Clearance Time (g_s), s		31.1		18.1	15.1			
Green Extension Time (g_e), s		0.5		1.0	0.3	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		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	3		18	7	4	14	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	111		0	189	233		301	1710			277	267
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1061		1442	1527	1607		1482	1766			1678	1599
Queue Service Time (g_s), s	13.0		0.0	13.4	16.1		13.1	42.5			16.8	15.4
Cycle Queue Clearance Time (g_c), s	29.1		0.0	13.4	16.1		13.1	42.5			16.8	15.4
Green Ratio (*g/C*)	0.27		0.27	0.27	0.27		0.61	0.64			0.45	0.45
Capacity (*c*), veh/h	209		388	467	433		538	2255			762	726
Volume-to-Capacity Ratio (*X*)	0.531		0.000	0.405	0.539		0.560	0.758			0.364	0.368
Available Capacity (c_a), veh/h	209		388	467	433		538	2255			762	726
Back of Queue (*Q*), veh/ln (50th percentile)	3.5		0.0	4.9	6.3		4.1	16.0			6.3	6.3
Queue Storage Ratio (*RQ*) (50th percentile)	0.66		0.00	1.43	0.00		1.06	0.00			0.00	0.00
Uniform Delay (d_1), s/veh	53.1		0.0	39.6	40.6		14.0	15.0			25.2	26.1
Incremental Delay (d_2), s/veh	1.3		0.0	0.2	0.7		0.4	1.1			1.3	1.4
Initial Queue Delay (d_3), s/veh	0.0		0.0	0.0	0.0		0.0	0.0			0.0	0.0
Control Delay (*d*), s/veh	54.4		0.0	39.8	41.4		14.4	16.0			26.5	27.5
Level of Service (LOS)	D			D	D		B	B			C	C
Approach Delay, s/veh / LOS	54.4	D		40.7	D		15.8	B		27.0	C	
Intersection Delay, s/veh / LOS	22.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	2.4	B
Bicycle LOS Score / LOS		F	1.2	A	2.0	B	1.0	A

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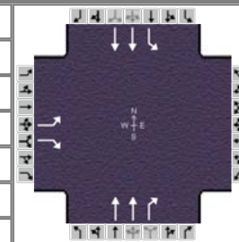
HCS 2010 Signalized Intersection Results Summary

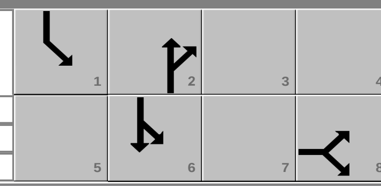
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM 2035 No Build	PHF	0.90
Intersection	I-229 NB	Analysis Year	2013	Analysis Period	1> 7:00
File Name	am 2035 no build.xus				
Project Description	I-229/Cliff interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	380		190					1770	580	120	470	

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	20	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	4.7	76.8	32.0	0.0	0.0	0.0
Yellow	4.5	5.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		8				2	1	6
Case Number		9.0				7.3	1.0	4.0
Phase Duration, s		37.0				82.8	10.2	93.0
Change Period, (*Y+Rc*), s		5.0				6.0	5.5	6.0
Max Allow Headway (*MAH*), s		3.1				0.0	3.3	0.0
Queue Clearance Time (g_s), s		34.0					6.7	
Green Extension Time (g_e), s		0.0				0.0	0.0	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		1.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	3		18					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	422		178					1611	473	156	610	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1626		1554					1757	1587	1524	1606	
Queue Service Time (g_s), s	32.0		12.7					44.7	8.3	4.7	9.8	
Cycle Queue Clearance Time (g_c), s	32.0		12.7					44.7	8.3	4.7	9.8	
Green Ratio (*g/C*)	0.25		0.25					0.59	0.59	0.64	0.67	
Capacity (*c*), veh/h	400		383					2076	937	183	2149	
Volume-to-Capacity Ratio (*X*)	1.055		0.465					0.776	0.505	0.850	0.284	
Available Capacity (c_a), veh/h	400		383					2076	937	183	2149	
Back of Queue (*Q*), veh/ln (50th percentile)	19.3		4.8					17.5	1.8	4.6	3.4	
Queue Storage Ratio (*RQ*) (50th percentile)	3.71		0.00					0.00	0.00	1.18	0.00	
Uniform Delay (d_1), s/veh	49.0		41.7					19.7	3.6	28.9	8.4	
Incremental Delay (d_2), s/veh	60.3		0.3					0.3	0.2	26.9	0.3	
Initial Queue Delay (d_3), s/veh	0.0		0.0					0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	109.3		42.0					19.9	3.8	55.8	8.7	
Level of Service (LOS)	F		D					B	A	E	A	
Approach Delay, s/veh / LOS	89.4		F	0.0			16.3		B	18.3		B
Intersection Delay, s/veh / LOS	29.4						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	3.0	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS		F			2.6	B	1.0	A

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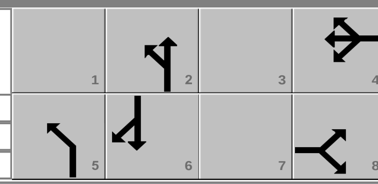
HCS 2010 Interchanges Results Summary

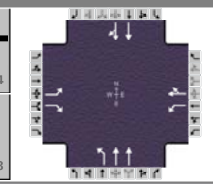
General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Oct 8, 2013	Segment Distance, ft	820
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	East-West
Intersection	I-229 NB	PHF	0.90	Arterial Direction	North-South
File Name	am 2035 no build.xus				
Project Description	I-229/Cliff interchange				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	100		80	170	150	70	250	1420			520	70
Intersection Two Demand (*v*), veh/h	380		190					1770	580	120	470	

Signal One Information	
Cycle, s	130.0
Offset, s	20
Uncoordinated	No
Force Mode	Fixed

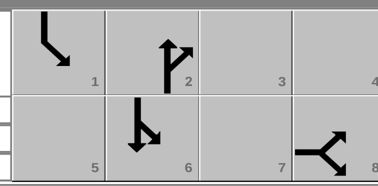
Green	18.5	59.0	35.0	0.0	0.0	0.0
Yellow	4.5	5.0	5.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0

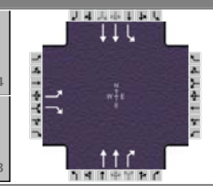




Signal Two Information	
Cycle, s	130.0
Offset, s	20
Uncoordinated	No
Force Mode	Fixed

Green	4.7	76.8	32.0	0.0	0.0	0.0
Yellow	4.5	5.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0





Interchange Results

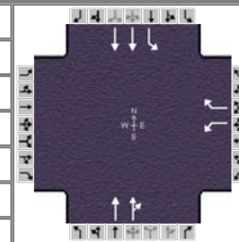
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	EBL - EBU	422	EBL(II) + EBT(II) + NBT(I)	125.3	F
B	EBR	178	EBT(II)	42.0	C
C	WBR	67	WBT(I)	41.4	C
D	WBL - WBU	189	WBL(I) + WBT(I) - SBT(II)	48.5	F
E	SBL(INT) - WBU	156	SBL(II) + SBT(II) + SBT(I)	82.3	F
F	SBR(EXT)	56	SBT(I)	26.5	B
G	NBR(EXT)	473	NBT(II)	3.8	A
H	NBL(INT) - EBU	301	NBL(I) + NBT(I) + NBT(II)	34.3	F
I	SBT(INT) - WBL + WBU	421	SBT(I) + SBT(II)	35.2	C
J	NBT(INT) - EBL + EBU	1288	NBT(I) + NBT(II)	36.0	C
K	EBT	0	EBT	-	-
L	WBT	167	WBT	-	-
M	EBU	0	EBU	-	-
N	WBU	0	WBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	54.4		0.0	39.8	41.4		14.4	16.0			26.5	27.5
Level of Service (LOS)	D			D	D		B	B			C	C
Approach Delay, s/veh / LOS	54.4	D		40.7	D		15.8	B		27.0	C	
Intersection Delay, s/veh / LOS	22.6						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	109.3		42.0					19.9	3.8	55.8	8.7	
Level of Service (LOS)	F		D					B	A	E	A	
Approach Delay, s/veh / LOS	89.4	F		0.0			16.3	B		18.3	B	
Intersection Delay, s/veh / LOS	29.4						C					

HCS 2010 Signalized Intersection Results Summary

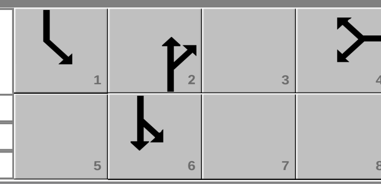
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	AM 2035 No Build	PHF	0.90
Intersection	49th Street	Analysis Year	2013	Analysis Period	1> 7:00
File Name	am 2035 no build.xus				
Project Description	I-229/Cliff interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h				40		740		1610	20	190	470	

Signal Information			
Cycle, s	130.0	Reference Phase	2
Offset, s	112	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.5	58.0	48.0	0.0	0.0	0.0
Yellow	4.5	5.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



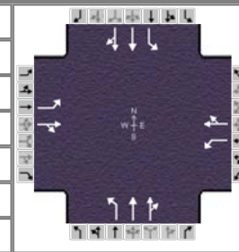
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				4		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				53.0		64.0	13.0	77.0
Change Period, (Y+R_c), s				5.0		6.0	5.5	6.0
Max Allow Headway (MAH), s				3.4		0.0	3.2	0.0
Queue Clearance Time (g_s), s				50.0			9.5	
Green Extension Time (g_e), s				0.0		0.0	0.0	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				1.00			1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				7		14		2	12	1	6	
Adjusted Flow Rate (v), veh/h				44		733		905	904	236	585	
Adjusted Saturation Flow Rate (s), veh/h/ln				1681		1496		1714	1707	1672	1624	
Queue Service Time (g_s), s				2.2		48.0		80.7	58.0	7.5	15.9	
Cycle Queue Clearance Time (g_c), s				2.2		48.0		80.7	58.0	7.5	15.9	
Green Ratio (g/C)				0.37		0.37		0.45	0.45	0.52	0.55	
Capacity (c), veh/h				621		552		765	762	152	1774	
Volume-to-Capacity Ratio (X)				0.072		1.328		1.183	1.187	1.557	0.330	
Available Capacity (c_a), veh/h				621		552		765	762	152	1774	
Back of Queue (Q), veh/ln (50th percentile)				0.9		41.9		40.6	40.8	14.2	6.6	
Queue Storage Ratio (RQ) (50th percentile)				0.29		0.00		0.00	0.00	1.44	0.00	
Uniform Delay (d_1), s/veh				26.6		41.0		26.3	26.3	37.7	22.0	
Incremental Delay (d_2), s/veh				0.0		159.8		95.5	97.0	279.0	0.5	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (d), s/veh				26.6		200.8		121.9	123.3	316.7	22.5	
Level of Service (LOS)				C		F		F	F	F	C	
Approach Delay, s/veh / LOS	0.0			190.9	F		122.6	F		107.2	F	
Intersection Delay, s/veh / LOS	134.5						F					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.4	B	0.7	A
Bicycle LOS Score / LOS				F	2.0	A	1.1	A

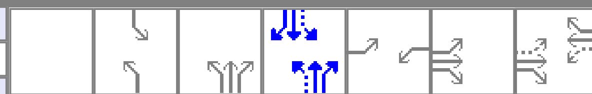
 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:49:55 AM

HCS 2010 Signalized Intersection Results Summary

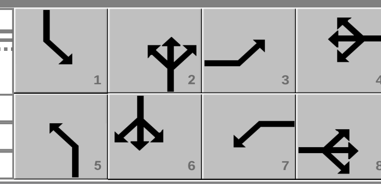


General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM 2035 No Build	PHF	0.90
Intersection	33rd Street	Analysis Year	2035	Analysis Period	1> 7:00
File Name	pm 2035 no build.xus				
Project Description	I-229/Cliff interchange				

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	150	90	110	260	20	170	380	40	10	930	120



Signal Information									
Cycle, s	110.0	Reference Phase	2						
Offset, s	64	Reference Point	Begin	Green	4.1	1.9	45.0	4.5	3.0	23.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.5	4.5	5.0	4.5	0.0	5.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	1.0	1.0	0.0	1.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	3	8	7	4	5	2	1	6
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	4.0
Phase Duration, s	13.0	32.0	10.0	29.0	17.0	58.4	9.6	51.0
Change Period, (Y+R_c), s	5.5	6.0	5.5	6.0	5.5	6.0	5.5	6.0
Max Allow Headway (*MAH*), s	3.2	3.2	3.2	3.2	3.2	0.0	3.2	0.0
Queue Clearance Time (g_s), s	9.5	17.5	6.5	20.7	11.8		2.4	
Green Extension Time (g_e), s	0.0	0.8	0.0	0.4	0.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00	1.00	1.00	1.00		1.00	
Max Out Probability	1.00	0.05	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	3	8	18	7	4	14	5	2	12	1	6	16
Adjusted Flow Rate (*v*), veh/h	156	256		122	306		252	312	304	11	586	564
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1664	1640		1664	1729		1655	1689	1636	1689	1723	1659
Queue Service Time (g_s), s	7.5	15.5		4.5	18.7		9.8	15.0	15.2	0.4	31.1	31.1
Cycle Queue Clearance Time (g_c), s	7.5	15.5		4.5	18.7		9.8	15.0	15.2	0.4	31.1	31.1
Green Ratio (*g/C*)	0.28	0.24		0.25	0.21		0.53	0.48	0.48	0.45	0.41	0.41
Capacity (*c*), veh/h	221	388		219	362		299	804	780	387	705	679
Volume-to-Capacity Ratio (*X*)	0.705	0.659		0.558	0.845		0.844	0.388	0.389	0.029	0.831	0.832
Available Capacity (c_a), veh/h	221	388		219	362		299	804	780	387	705	679
Back of Queue (*Q*), veh/ln (50th percentile)	3.8	6.5		1.3	9.5		4.4	6.5	6.4	0.2	12.9	12.5
Queue Storage Ratio (*RQ*) (50th percentile)	0.46	0.00		0.43	0.00		0.90	0.00	0.00	0.04	0.00	0.00
Uniform Delay (d_1), s/veh	34.9	38.0		38.4	41.8		20.4	22.9	23.2	17.2	21.8	21.9
Incremental Delay (d_2), s/veh	8.4	3.3		1.9	15.8		17.1	1.3	1.3	0.0	11.0	11.4
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	43.3	41.3		40.3	57.6		37.5	24.2	24.5	17.2	32.8	33.3
Level of Service (LOS)	D	D		D	E		D	C	C	B	C	C
Approach Delay, s/veh / LOS	42.0	D		52.7	D		28.2	C		32.9	C	
Intersection Delay, s/veh / LOS	35.7						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	2.3	B	2.3	B
Bicycle LOS Score / LOS	1.2	A	1.2	A	1.0	A	1.4	A

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 9:42:36 AM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RL	Intersection	33RD/SHERMAN
Agency/Co.	HDR	Jurisdiction	SIOUX FALLS
Date Performed	1/10/2014	Analysis Year	2035 no-build
Analysis Time Period	PM PEAK		
Project Description	I-229/26TH ST. IMJR		
East/West Street:	33RD STREET	North/South Street:	SHERMAN AVE.
Intersection Orientation:	East-West	Study Period (hrs):	1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	20	140	40	10	250	10
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	22	155	44	11	277	11
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		1			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	130	20	30	20	5	10
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	144	22	33	22	5	11
Percent Heavy Vehicles	1	1	1	1	1	1
Percent Grade (%)		1			-1	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR			LTR	
v (veh/h)	22	11		199			38	
C (m) (veh/h)	1274	1373		465			484	
v/c	0.02	0.01		0.43			0.08	
95% queue length	0.05	0.02		2.21			0.26	
Control Delay (s/veh)	7.9	7.6		18.5			13.1	
LOS	A	A		C			B	
Approach Delay (s/veh)	--	--	18.5			13.1		
Approach LOS	--	--	C			B		

 HCS+™ Version 5.6 Generated: 2/26/2014 3:58 PM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	RL	Intersection	33RD/VAN EPS
Agency/Co.	HDR	Jurisdiction	SIOUX FALLS
Date Performed	1/10/2014	Analysis Year	2035 no-build
Analysis Time Period	PM PEAK		

Project Description I-229/26TH ST. IMJR

East/West Street: 33RD STREET | North/South Street: VAN EPS AVE.

Intersection Orientation: East-West | Study Period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	10	170	10	10	200	10
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	11	188	11	11	222	11
Percent Heavy Vehicles	2	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal		1			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	30	5	5	10	5	20
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	33	5	5	11	5	22
Percent Heavy Vehicles	1	1	1	1	1	1
Percent Grade (%)		2			-2	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LTR	LTR		LTR			LTR	
v (veh/h)	11	11		43			38	
C (m) (veh/h)	1335	1373		477			658	
v/c	0.01	0.01		0.09			0.06	
95% queue length	0.02	0.02		0.30			0.18	
Control Delay (s/veh)	7.7	7.6		13.3			10.8	
LOS	A	A		B			B	
Approach Delay (s/veh)	--	--	13.3			10.8		
Approach LOS	--	--	B			B		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*RL*	Intersection	*33RD/BLAUVELT*
Agency/Co.	*HDR*	Jurisdiction	*SIOUX FALLS*
Date Performed	*1/10/2014*	Analysis Year	*2035 no-build*
Analysis Time Period	*PM PEAK*		

Project Description *I-229/26TH ST. IMJR*

East/West Street: *33RD STREET* | North/South Street: *BLAUVELT AVE.*

Intersection Orientation: *East-West* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*20*	*160*	*10*	*10*	*180*	*10*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*22*	*177*	*11*	*11*	*200*	*11*
Percent Heavy Vehicles	*2*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LTR*			*LTR*		
Upstream Signal		*1*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*20*	*20*	*70*	*10*	*5*	*20*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*22*	*22*	*77*	*11*	*5*	*22*
Percent Heavy Vehicles	*1*	*1*	*1*	*1*	*1*	*1*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LTR*	*LTR*		*LTR*			*LTR*	
v (veh/h)	*22*	*11*		*121*			*38*	
C (m) (veh/h)	*1360*	*1386*		*671*			*601*	
v/c	*0.02*	*0.01*		*0.18*			*0.06*	
95% queue length	*0.05*	*0.02*		*0.66*			*0.20*	
Control Delay (s/veh)	*7.7*	*7.6*		*11.5*			*11.4*	
LOS	*A*	*A*		*B*			*B*	
Approach Delay (s/veh)	--	--		*11.5*			*11.4*	
Approach LOS	--	--		*B*			*B*	

 HCS+™ Version 5.6 Generated: 2/26/2014 4:01 PM

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*RL*	Intersection	*I-229/YEAGER*
Agency/Co.	*HDR*	Jurisdiction	*SIOUX FALLS*
Date Performed	*1/10/2014*	Analysis Year	*2035 no-build*
Analysis Time Period	*PM PEAK*		

Project Description *I-229/26TH ST. IMJR*

East/West Street: *I-229 RAMPS*	North/South Street: *YEAGER ROAD*
Intersection Orientation: *North-South*	Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)		*230*	*10*	*610*	*90*	
Peak-Hour Factor, PHF	*0.79*	*0.90*	*0.90*	*0.90*	*0.90*	*0.64*
Hourly Flow Rate, HFR (veh/h)	*0*	*255*	*11*	*677*	*100*	*0*
Percent Heavy Vehicles	*1*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration			*TR*	*L*	*T*	
Upstream Signal		*0*			*1*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)				*110*		*670*
Peak-Hour Factor, PHF	*0.79*	*0.79*	*0.79*	*0.90*	*0.77*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*122*	*0*	*744*
Percent Heavy Vehicles	*2*	*0*	*0*	*2*	*0*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

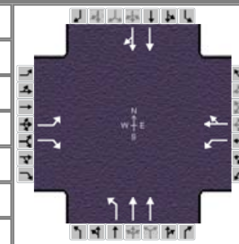
Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*L*	*L*		*R*			
v (veh/h)		*677*	*122*		*744*			
C (m) (veh/h)		*1298*	*47*		*779*			
v/c		*0.52*	*2.60*		*0.96*			
95% queue length		*3.24*	*41.87*		*25.78*			
Control Delay (s/veh)		*10.8*	*3074*		*67.1*			
LOS		*B*	*F*		*F*			
Approach Delay (s/veh)	--	--	*490.6*					
Approach LOS	--	--	*F*					

 *HCS+*TM Version 5.6 Generated: 2/26/2014 4:03 PM

HCS 2010 Signalized Intersection Results Summary

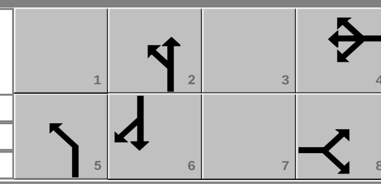
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM 2035 No Build	PHF	0.90
Intersection	41st Street	Analysis Year	2035	Analysis Period	1> 7:00
File Name	pm 2035 no build.xus				
Project Description	I-229/Cliff interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	90		380	480	110	40	140	480			1040	110

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	3	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.3	44.6	39.6	0.0	0.0	0.0
Yellow	4.5	5.0	5.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



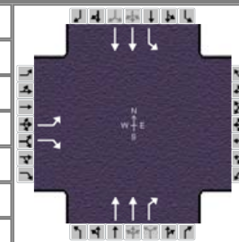
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		8		4	5	2		6
Case Number		5.0		6.0	1.0	4.0		8.3
Phase Duration, s		45.6		45.6	13.8	64.4		50.6
Change Period, (Y+R_c), s		6.0		6.0	5.5	6.0		6.0
Max Allow Headway (*MAH*), s		3.1		3.1	3.4	0.0		0.0
Queue Clearance Time (g_s), s		23.5		36.2	10.3			
Green Extension Time (g_e), s		2.2		1.1	0.0	0.0		0.0
Phase Call Probability		1.00		1.00	1.00			
Max Out Probability		0.02		0.93	1.00			

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	3		18	7	4	14	5	2			6	16
Adjusted Flow Rate (*v*), veh/h	100		333	533	161		241	826			634	611
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1126		1427	1631	1725		1448	1618			1757	1682
Queue Service Time (g_s), s	7.6		21.5	34.2	7.3		8.3	18.5			39.4	36.1
Cycle Queue Clearance Time (g_c), s	14.8		21.5	34.2	7.3		8.3	18.5			39.4	36.1
Green Ratio (*g/C*)	0.36		0.36	0.36	0.36		0.50	0.53			0.41	0.41
Capacity (*c*), veh/h	397		514	652	621		195	1718			712	682
Volume-to-Capacity Ratio (*X*)	0.252		0.649	0.817	0.260		1.236	0.481			0.890	0.896
Available Capacity (c_a), veh/h	397		514	652	621		195	1718			712	682
Back of Queue (*Q*), veh/ln (50th percentile)	2.1		7.6	14.0	2.9		12.5	7.0			15.1	14.6
Queue Storage Ratio (*RQ*) (50th percentile)	0.38		1.16	1.14	0.00		1.25	0.00			0.00	0.00
Uniform Delay (d_1), s/veh	30.1		29.4	33.5	24.8		25.9	17.5			25.1	25.0
Incremental Delay (d_2), s/veh	0.1		2.3	7.5	0.1		135.4	0.7			8.9	9.6
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	30.2		31.7	41.0	24.9		161.3	18.3			34.0	34.7
Level of Service (LOS)	C		C	D	C		F	B			C	C
Approach Delay, s/veh / LOS	31.3		C	37.3		D	50.6		D	34.3		C
Intersection Delay, s/veh / LOS	39.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.7	B	1.7	A	2.4	B
Bicycle LOS Score / LOS		F	1.6	A	1.1	A	1.5	A

HCS 2010 Signalized Intersection Results Summary

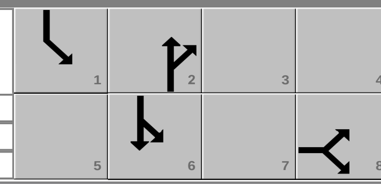
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM 2035 No Build	PHF	0.90
Intersection	I-229 NB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	pm 2035 no build.xus				
Project Description	I-229/Cliff interchange				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	180		350					780	180	130	1230	

Signal Information			
Cycle, s	110.0	Reference Phase	2
Offset, s	63	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	8.5	45.0	40.0	0.0	0.0	0.0
Yellow	4.5	5.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		8				2	1	6
Case Number		9.0				7.3	1.0	4.0
Phase Duration, s		45.0				51.0	14.0	65.0
Change Period, (*Y+R*c), s		5.0				6.0	5.5	6.0
Max Allow Headway (*MAH*), s		3.2				0.0	3.3	0.0
Queue Clearance Time (g_s), s		24.5					10.5	
Green Extension Time (g_e), s		1.0				0.0	0.0	0.0
Phase Call Probability		1.00					1.00	
Max Out Probability		0.00					1.00	

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	3		18					2	12	1	6	
Adjusted Flow Rate (*v*), veh/h	200		356					867	178	200	1891	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1529		1461					1623	1498	1528	1756	
Queue Service Time (g_s), s	10.5		22.5					14.0	3.7	8.5	59.0	
Cycle Queue Clearance Time (g_c), s	10.5		22.5					14.0	3.7	8.5	59.0	
Green Ratio (*g/C*)	0.36		0.36					0.41	0.41	0.50	0.54	
Capacity (*c*), veh/h	556		531					1328	613	353	1883	
Volume-to-Capacity Ratio (*X*)	0.360		0.669					0.653	0.290	0.566	1.004	
Available Capacity (c_a), veh/h	556		531					1328	613	353	1883	
Back of Queue (*Q*), veh/ln (50th percentile)	3.7		7.8					3.2	1.1	2.7	21.6	
Queue Storage Ratio (*RQ*) (50th percentile)	0.71		0.00					0.00	0.00	0.69	0.00	
Uniform Delay (d_1), s/veh	25.6		29.4					9.5	7.6	16.4	17.3	
Incremental Delay (d_2), s/veh	0.1		2.6					1.1	0.5	0.6	15.0	
Initial Queue Delay (d_3), s/veh	0.0		0.0					0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh	25.8		32.1					10.5	8.1	17.0	32.3	
Level of Service (LOS)	C		C					B	A	B	F	
Approach Delay, s/veh / LOS	29.8		C	0.0			10.1		B	30.8		C
Intersection Delay, s/veh / LOS	24.8						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.9	C	2.9	C	1.9	A	1.7	A
Bicycle LOS Score / LOS		F			1.3	A	1.7	A

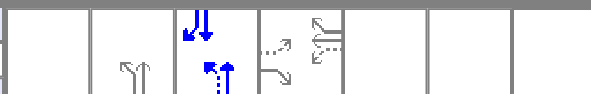
 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:52:20 AM

HCS 2010 Interchanges Results Summary

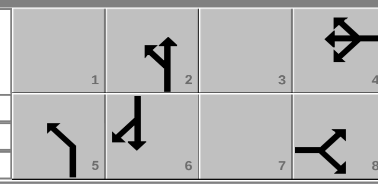
General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Oct 8, 2013	Segment Distance, ft	820
Jurisdiction	Sioux Falls	Duration,h	0.25	Freeway Direction	East-West
Intersection	I-229 NB	PHF	0.90	Arterial Direction	North-South
File Name	pm 2035 no build.xus				
Project Description	I-229/Cliff interchange				

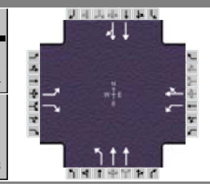
Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h	90		380	480	110	40	140	480			1040	110
Intersection Two Demand (*v*), veh/h	180		350					780	180	130	1230	

Signal One Information	
Cycle, s	110.0
Offset, s	63
Uncoordinated	No
Force Mode	Fixed

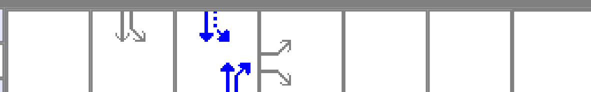


Green	8.3	44.6	39.6	0.0	0.0	0.0
Yellow	4.5	5.0	5.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0

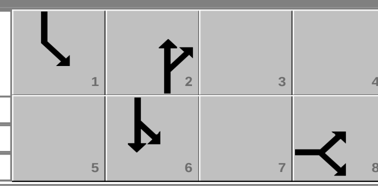


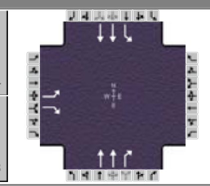


Signal Two Information	
Cycle, s	110.0
Offset, s	63
Uncoordinated	No
Force Mode	Fixed



Green	8.5	45.0	40.0	0.0	0.0	0.0
Yellow	4.5	5.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0





Interchange Results

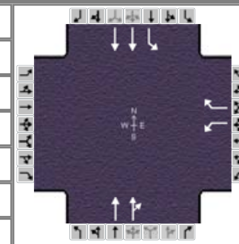
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	EBL - EBU	200	EBL(II) + EBT(II) + NBT(I)	44.0	C
B	EBR	356	EBT(II)	32.1	C
C	WBR	39	WBT(I)	24.9	B
D	WBL - WBU	533	WBL(I) + WBT(I) - SBT(II)	73.3	F
E	SBL(INT) - WBU	200	SBL(II) + SBT(II) + SBT(I)	51.1	C
F	SBR(EXT)	109	SBT(I)	34.0	C
G	NBR(EXT)	178	NBT(II)	8.1	A
H	NBL(INT) - EBU	241	NBL(I) + NBT(I) + NBT(II)	171.8	F
I	SBT(INT) - WBL + WBU	1358	SBT(I) + SBT(II)	66.3	F
J	NBT(INT) - EBL + EBU	626	NBT(I) + NBT(II)	28.8	B
K	EBT	0	EBT	-	-
L	WBT	122	WBT	-	-
M	EBU	0	EBU	-	-
N	WBU	0	WBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	30.2		31.7	41.0	24.9		161.3	18.3			34.0	34.7
Level of Service (LOS)	C		C	D	C		F	B			C	C
Approach Delay, s/veh / LOS	31.3	C		37.3	D		50.6	D		34.3	C	
Intersection Delay, s/veh / LOS	39.6						D					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh	25.8		32.1					10.5	8.1	17.0	32.3	
Level of Service (LOS)	C		C					B	A	B	F	
Approach Delay, s/veh / LOS	29.8	C		0.0			10.1	B		30.8	C	
Intersection Delay, s/veh / LOS	24.8						C					

HCS 2010 Signalized Intersection Results Summary

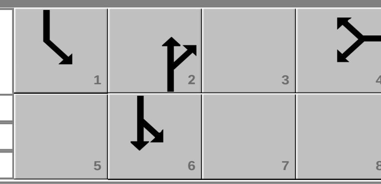
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Oct 8, 2013	Area Type	Other
Jurisdiction	Sioux Falls	Time Period	PM 2035 No Build	PHF	0.90
Intersection	49th Street	Analysis Year	2035	Analysis Period	1> 7:00
File Name	pm 2035 no build.xus				
Project Description	I-229/Cliff interchange				



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		280		680	110	540	1040	

Signal Information			
Cycle, s	110.0	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	38.5	32.2	22.8	0.0	0.0	0.0
Yellow	4.5	5.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase				4		2	1	6
Case Number				9.0		8.3	1.0	4.0
Phase Duration, s				27.8		38.2	44.0	82.2
Change Period, ($Y+R_c$), s				5.0		6.0	5.5	6.0
Max Allow Headway (*MAH*), s				3.4		0.0	3.2	0.0
Queue Clearance Time (g_s), s				17.2			40.5	
Green Extension Time (g_e), s				0.3		0.0	0.0	0.0
Phase Call Probability				1.00			1.00	
Max Out Probability				0.19			1.00	

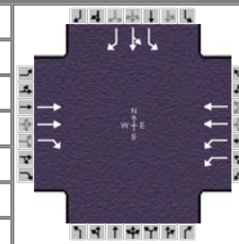
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement				7		14		2	12	1	6	
Adjusted Flow Rate (*v*), veh/h				67		222		443	423	777	1496	
Adjusted Saturation Flow Rate (*s*), veh/h/ln				1681		1496		1714	1637	1672	1624	
Queue Service Time (g_s), s				3.6		15.2		27.0	26.5	38.5	22.8	
Cycle Queue Clearance Time (g_c), s				3.6		15.2		27.0	26.5	38.5	22.8	
Green Ratio (g/C)				0.21		0.21		0.29	0.29	0.66	0.69	
Capacity (*c*), veh/h				348		310		502	479	681	2250	
Volume-to-Capacity Ratio (*X*)				0.191		0.717		0.883	0.884	1.141	0.665	
Available Capacity (c_a), veh/h				348		310		502	479	681	2250	
Back of Queue (*Q*), veh/ln (50th percentile)				1.5		6.1		12.7	12.3	24.4	5.3	
Queue Storage Ratio (*RQ*) (50th percentile)				0.47		0.00		0.00	0.00	1.38	0.00	
Uniform Delay (d_1), s/veh				36.0		40.6		31.8	31.8	28.9	6.1	
Incremental Delay (d_2), s/veh				0.1		6.7		19.7	20.5	67.6	0.3	
Initial Queue Delay (d_3), s/veh				0.0		0.0		0.0	0.0	0.0	0.0	
Control Delay (*d*), s/veh				36.1		47.3		51.5	52.3	96.5	6.4	
Level of Service (LOS)				D		D		D	D	F	A	
Approach Delay, s/veh / LOS	0.0			44.7	D		51.9	D		37.2	D	
Intersection Delay, s/veh / LOS	41.6						D					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	2.9	C	2.4	B	0.7	A
Bicycle LOS Score / LOS				F	1.2	A	1.9	A

 HCS 2010™ Streets Version 6.60 Generated: 8/22/2014 10:52:20 AM

HCS 2010 Signalized Intersection Results Summary

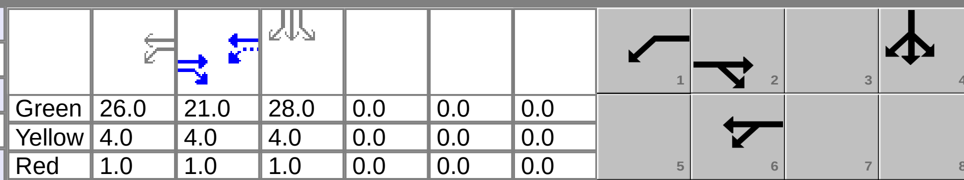
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 6, 2014	Area Type	Other
Jurisdiction	SDDOT/Sioux Falls	Time Period	AM peak	PHF	0.90
Intersection	Interstate 229 SB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	option 5a AM.xus				
Project Description	Option 5a				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		550	70	720	1140					150	0	380

Signal Information			
Cycle, s	90.0	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	26.0	21.0	28.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	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	1.0	4.0				9.0
Phase Duration, s		26.0	31.0	57.0				33.0
Change Period, (*Y*+*R*c), s		5.0	5.0	5.0				5.0
Max Allow Headway (*MAH*), s		0.0	3.2	0.0				3.4
Queue Clearance Time (*g*s), s			14.5					27.8
Green Extension Time (*g*e), s		0.0	1.6	0.0				0.0
Phase Call Probability			1.00					1.00
Max Out Probability			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		2	12	1	6					7	4	14
Adjusted Flow Rate (*v*), veh/h		611	78	720	1140					167	0	422
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1637	1410	1617	1679					1613	1694	1435
Queue Service Time (*g*s), s		15.4	3.7	12.5	20.8					7.1	0.0	25.8
Cycle Queue Clearance Time (*g*c), s		15.4	3.7	12.5	20.8					7.1	0.0	25.8
Green Ratio (*g/C*)		0.23	0.23	0.54	0.58					0.31	0.31	0.31
Capacity (*c*), veh/h		764	329	1193	1940					502	527	447
Volume-to-Capacity Ratio (*X*)		0.800	0.236	0.603	0.588					0.332	0.000	0.946
Available Capacity (*c*a), veh/h		764	329	1193	1940					502	527	447
Back of Queue (*Q*), veh/ln (50th percentile)		6.3	1.3	5.3	7.8					2.7	0.0	12.2
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.17	0.53	0.00					0.00	0.00	0.00
Uniform Delay (*d*1), s/veh		29.1	25.0	18.6	13.8					23.8	0.0	30.3
Incremental Delay (*d*2), s/veh		8.6	1.7	0.4	0.9					0.1	0.0	28.9
Initial Queue Delay (*d*3), s/veh		0.0	0.0	0.0	0.0					0.0	0.0	0.0
Control Delay (*d*), s/veh		37.7	26.7	19.0	14.7					24.0	0.0	59.2
Level of Service (LOS)		D	C	B	B					C		E

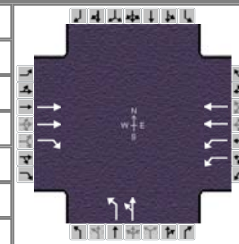
	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	36.5	D	16.4	B	0.0		49.2	D
Intersection Delay, s/veh / LOS	27.0				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	1.9	A	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	2.2	B			1.5	A

 HCS 2010™ Streets Version 6.60 Generated: 8/21/2014 2:10:19 PM

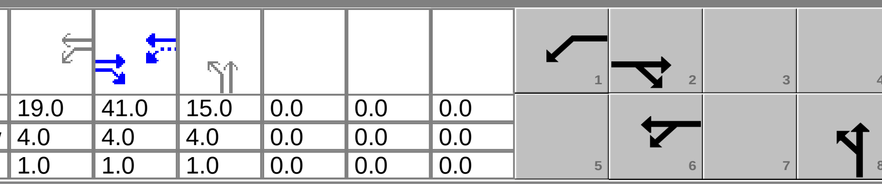
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 6, 2014	Area Type	Other
Jurisdiction	SDDOT/Sioux Falls	Time Period	AM peak	PHF	0.90
Intersection	Interstate 229 NB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	option 5a AM.xus				
Project Description	Option 5a				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		570	130	440	1740		120	0				

Signal Information									
Cycle, s	90.0	Reference Phase	2	Green	19.0	41.0	15.0	0.0	0.0	0.0
Offset, s	0	Reference Point	Begin	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Red	1.0	1.0	1.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On							



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		10.0		
Phase Duration, s		46.0	24.0	70.0		20.0		
Change Period, (Y+R_c), s		5.0	5.0	5.0		5.0		
Max Allow Headway (MAH), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (g_s), s			6.9			8.7		
Green Extension Time (g_e), s		0.0	1.1	0.0		0.1		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			0.03		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8				
Adjusted Flow Rate (v), veh/h		633	144	489	1933		133	0				
Adjusted Saturation Flow Rate (s), veh/h/ln		1629	1421	1586	1764		1636	1685				
Queue Service Time (g_s), s		9.7	2.8	4.9	6.8		6.7	0.0				
Cycle Queue Clearance Time (g_c), s		9.7	2.8	4.9	6.8		6.7	0.0				
Green Ratio (g/C)		0.46	0.46	0.69	0.72		0.17	0.17				
Capacity (c), veh/h		1484	647	1363	2548		273	281				
Volume-to-Capacity Ratio (X)		0.427	0.223	0.359	0.759		0.489	0.000				
Available Capacity (c_a), veh/h		1484	647	1363	2548		273	281				
Back of Queue (Q), veh/ln (50th percentile)		3.2	0.8	1.3	1.3		2.6	0.0				
Queue Storage Ratio (RQ) (50th percentile)		0.00	0.11	0.13	0.00		0.00	0.00				
Uniform Delay (d_1), s/veh		12.3	6.5	5.7	0.6		34.0	0.0				
Incremental Delay (d_2), s/veh		0.6	0.5	0.1	2.2		0.5	0.0				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (d), s/veh		12.9	7.1	5.7	2.8		34.5	0.0				
Level of Service (LOS)		B	A	A	A		C					

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	11.8	B	3.4	A	34.5	C	0.0	
Intersection Delay, s/veh / LOS	6.6				A			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	1.8	A	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	2.5	B	0.7	A		

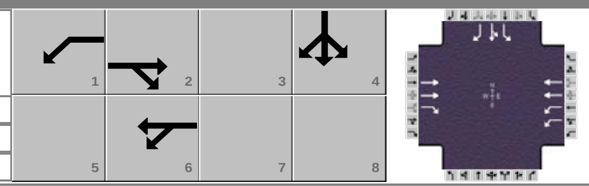
HCS 2010 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 6, 2014	Segment Distance, ft	550
Jurisdiction	SDDOT/Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	Interstate 229 NB	PHF	0.90	Arterial Direction	East-West
File Name	option 5a AM.xus				
Project Description	Option 5a				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		550	70	720	1140					150	0	380
Intersection Two Demand (*v*), veh/h		570	130	440	1740		120	0				

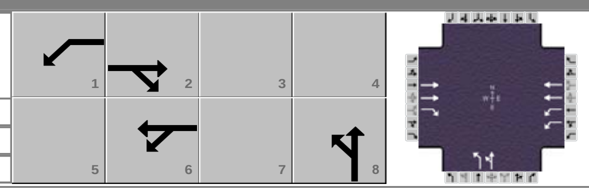
Signal One Information	
Cycle, s	90.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	26.0	21.0	28.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



Signal Two Information	
Cycle, s	90.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	19.0	41.0	15.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



Interchange Results

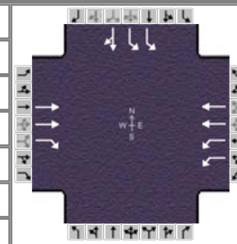
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	133	NBL(II) + NBT(II) + WBT(I)	50.1	C
B	NBR	0	NBT(II)	0.0	A
C	SBR	422	SBT(I)	59.2	D
D	SBL - SBU	167	SBL(I) + SBT(I) - EBT(II)	36.8	C
E	EBL(INT) - SBU	0	EBL(II) + EBT(II) + EBT(I)	37.7	C
F	EBR(EXT)	78	EBT(I)	37.7	C
G	WBR(EXT)	0	WBT(II)	0.0	A
H	WBL(INT) - NBU	800	WBL(I) + WBT(I) + WBT(II)	22.7	B
I	EBT(INT) - SBL + SBU	467	EBT(I) + EBT(II)	50.6	C
J	WBT(INT) - NBL + NBU	1133	WBT(I) + WBT(II)	18.3	B
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		37.7	26.7	19.9	15.5					24.0	0.0	59.2
Level of Service (LOS)		D	C	B	B					C		E
Approach Delay, s/veh / LOS	36.5	D		17.2	B		0.0			49.2	D	
Intersection Delay, s/veh / LOS	26.8						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		12.9	7.1	5.7	2.8		34.5	0.0				
Level of Service (LOS)		B	A	A	A		C					
Approach Delay, s/veh / LOS	11.8	B		3.4	A		34.5	C		0.0		
Intersection Delay, s/veh / LOS	6.6						A					

HCS 2010 Signalized Intersection Results Summary

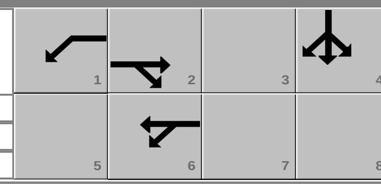
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 6, 2014	Area Type	Other
Jurisdiction	SDDOT/Sioux Falls	Time Period	PM peak	PHF	0.90
Intersection	Interstate 229 SB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	option 5a PM.xus				
Project Description	Option 5a				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		850	110	510	600					530	0	250

Signal Information				
Cycle, s	90.0	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	23.0	35.0	17.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	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	1.0	4.0				10.0
Phase Duration, s		40.0	28.0	68.0				22.0
Change Period, (Y+R_c), s		5.0	5.0	5.0				5.0
Max Allow Headway (MAH), s		0.0	3.2	0.0				3.3
Queue Clearance Time (g_s), s			8.2					19.0
Green Extension Time (g_e), s		0.0	1.2	0.0				0.0
Phase Call Probability			1.00					1.00
Max Out Probability			0.00					1.00

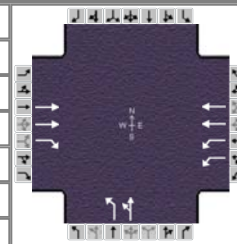
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6					7	4	14
Adjusted Flow Rate (v), veh/h		944	122	510	600					589	278	
Adjusted Saturation Flow Rate (s), veh/h/ln		1678	1417	1589	1625					1599	1465	
Queue Service Time (g_s), s		19.5	4.2	6.2	7.5					16.5	17.0	
Cycle Queue Clearance Time (g_c), s		19.5	4.2	6.2	7.5					16.5	17.0	
Green Ratio (g/C)		0.39	0.39	0.67	0.70					0.19	0.19	
Capacity (c), veh/h		1305	551	1170	2276					604	277	
Volume-to-Capacity Ratio (X)		0.724	0.222	0.436	0.264					0.975	1.003	
Available Capacity (c_a), veh/h		1305	551	1170	2276					604	277	
Back of Queue (Q), veh/ln (50th percentile)		6.8	1.4	2.1	2.3					8.8	10.2	
Queue Storage Ratio (RQ) (50th percentile)		0.00	0.36	0.18	0.00					0.00	0.00	
Uniform Delay (d_1), s/veh		17.9	14.3	13.7	6.5					36.3	36.5	
Incremental Delay (d_2), s/veh		3.5	0.9	0.1	0.3					30.1	55.0	
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0					0.0	0.0	
Control Delay (d), s/veh		21.5	15.2	13.8	6.7					66.4	91.5	
Level of Service (LOS)		C	B	B	A					E	F	

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	20.7	C	10.0	A	0.0		74.4	E
Intersection Delay, s/veh / LOS	32.1				C			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.4	B	1.9	A	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.4	A	1.5	A			1.9	A

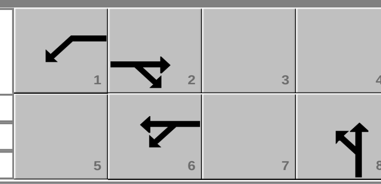
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 6, 2014	Area Type	Other
Jurisdiction	SDDOT/Sioux Falls	Time Period	PM peak	PHF	0.90
Intersection	Interstate 229 NB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	option 5a PM.xus				
Project Description	Option 5a				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1300	80	80	1060		50	0				

Signal Information										
Cycle, s	90.0	Reference Phase	2	Green	5.0	53.0	17.0	0.0	0.0	0.0
Offset, s	0	Reference Point	Begin	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Red	1.0	1.0	1.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On							



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		10.0		
Phase Duration, s		58.0	10.0	68.0		22.0		
Change Period, ($Y+R_c$), s		5.0	5.0	5.0		5.0		
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (g_s), s			2.9			4.6		
Green Extension Time (g_e), s		0.0	0.0	0.0		0.0		
Phase Call Probability			1.00			1.00		
Max Out Probability			1.00			0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8				
Adjusted Flow Rate (*v*), veh/h		1444	89	89	1178		56	0				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1710	1412	1536	1683		1616	1664				
Queue Service Time (g_s), s		31.2	2.2	0.9	3.9		2.6	0.0				
Cycle Queue Clearance Time (g_c), s		31.2	2.2	0.9	3.9		2.6	0.0				
Green Ratio (*g/C*)		0.59	0.59	0.67	0.70		0.19	0.19				
Capacity (*c*), veh/h		2014	831	499	2356		305	314				
Volume-to-Capacity Ratio (*X*)		0.717	0.107	0.178	0.500		0.182	0.000				
Available Capacity (c_a), veh/h		2014	831	499	2356		305	314				
Back of Queue (*Q*), veh/ln (50th percentile)		12.8	0.6	0.3	0.9		1.0	0.0				
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.08	0.03	0.00		0.00	0.00				
Uniform Delay (d_1), s/veh		19.2	7.0	11.9	1.0		30.7	0.0				
Incremental Delay (d_2), s/veh		1.0	0.1	0.1	0.8		0.1	0.0				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (*d*), s/veh		20.2	7.1	12.0	1.8		30.8	0.0				
Level of Service (LOS)		C	A	B	A		C					
Approach Delay, s/veh / LOS	19.5	B		2.5	A		30.8	C		0.0		
Intersection Delay, s/veh / LOS	12.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	1.9	A	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	1.5	A	0.6	A		

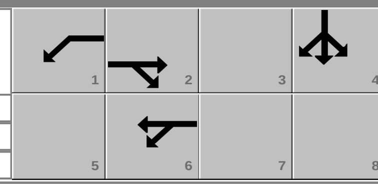
HCS 2010 Interchanges Results Summary

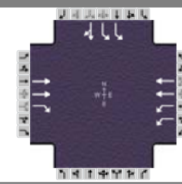
General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 6, 2014	Segment Distance, ft	550
Jurisdiction	SDDOT/Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	Interstate 229 NB	PHF	0.90	Arterial Direction	East-West
File Name	option 5a PM.xus				
Project Description	Option 5a				

Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		850	110	510	600					530	0	250
Intersection Two Demand (*v*), veh/h		1300	80	80	1060		50	0				

Signal One Information	
Cycle, s	90.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

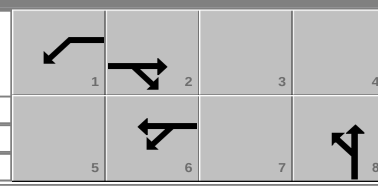
Green	23.0	35.0	17.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0

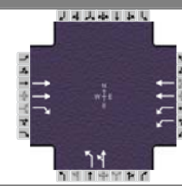




Signal Two Information	
Cycle, s	90.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

Green	5.0	53.0	17.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0





Interchange Results

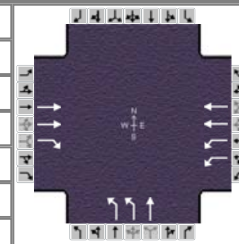
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	56	NBL(II) + NBT(II) + WBT(I)	37.5	C
B	NBR	0	NBT(II)	0.0	A
C	SBR	278	SBT(I)	91.5	F
D	SBL - SBU	589	SBL(I) + SBT(I) - EBT(II)	86.6	E
E	EBL(INT) - SBU	0	EBL(II) + EBT(II) + EBT(I)	21.5	B
F	EBR(EXT)	122	EBT(I)	21.5	B
G	WBR(EXT)	0	WBT(II)	0.0	A
H	WBL(INT) - NBU	567	WBL(I) + WBT(I) + WBT(II)	15.7	B
I	EBT(INT) - SBL + SBU	856	EBT(I) + EBT(II)	41.7	C
J	WBT(INT) - NBL + NBU	611	WBT(I) + WBT(II)	8.5	A
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		21.5	15.2	13.9	6.7					66.4	91.5	
Level of Service (LOS)		C	B	B	A					E	F	
Approach Delay, s/veh / LOS	20.7	C		10.0	B		0.0			74.4	E	
Intersection Delay, s/veh / LOS	31.3						C					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		20.2	7.1	12.0	1.8		30.8	0.0				
Level of Service (LOS)		C	A	B	A		C					
Approach Delay, s/veh / LOS	19.5	B		2.5	A		30.8	C		0.0		
Intersection Delay, s/veh / LOS	12.2						B					

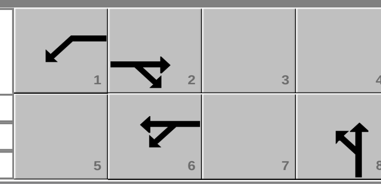
HCS 2010 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 6, 2014	Area Type	Other
Jurisdiction	SDDOT/Sioux Falls	Time Period	AM peak	PHF	0.90
Intersection	Interstate 229 SB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	option 7a AM.xus				
Project Description	Option 7a				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		550	70	720	1140		380	0				

Signal Information										
Cycle, s	90.0	Reference Phase	2							
Offset, s	0	Reference Point	Begin	Green	32.0	23.0	20.0	0.0	0.0	0.0
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	1.0	0.0	0.0	0.0



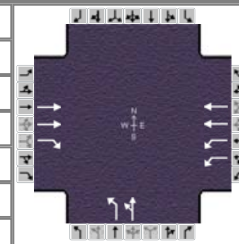
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		10.0		
Phase Duration, s		28.0	37.0	65.0		25.0		
Change Period, ($Y+R_c$), s		5.0	5.0	5.0		5.0		
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (g_s), s			11.7			12.8		
Green Extension Time (g_e), s		0.0	2.1	0.0		0.7		
Phase Call Probability			1.00			1.00		
Max Out Probability			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		2	12	1	6		3	8				
Adjusted Flow Rate (*v*), veh/h		611	78	800	1267		422	0				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1627	1410	1627	1692		1577	1706				
Queue Service Time (g_s), s		14.9	3.5	9.7	11.9		10.8	0.0				
Cycle Queue Clearance Time (g_c), s		14.9	3.5	9.7	11.9		10.8	0.0				
Green Ratio (*g/C*)		0.26	0.26	0.63	0.67		0.22	0.22				
Capacity (*c*), veh/h		831	360	1463	2256		701	379				
Volume-to-Capacity Ratio (*X*)		0.735	0.216	0.547	0.562		0.602	0.000				
Available Capacity (c_a), veh/h		831	360	1463	2256		701	379				
Back of Queue (*Q*), veh/ln (50th percentile)		5.8	1.3	2.5	2.7		4.1	0.0				
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.32	0.25	0.00		0.70	0.00				
Uniform Delay (d_1), s/veh		27.0	23.2	8.3	4.1		31.4	0.0				
Incremental Delay (d_2), s/veh		5.7	1.4	0.1	0.6		1.0	0.0				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (*d*), s/veh		32.7	24.6	8.4	4.7		32.5	0.0				
Level of Service (LOS)		C	C	A	A		C					
Approach Delay, s/veh / LOS	31.8		C	6.1		A	32.5		C	0.0		
Intersection Delay, s/veh / LOS	15.2						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	1.9	A	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	2.2	B	1.2	A		

HCS 2010 Signalized Intersection Results Summary

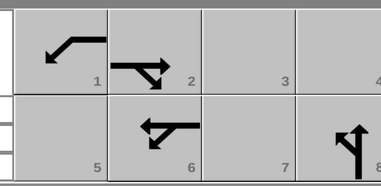
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 6, 2014	Area Type	Other
Jurisdiction	SDDOT/Sioux Falls	Time Period	AM peak	PHF	0.90
Intersection	Interstate 229 NB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	option 7a AM.xus				
Project Description	Option 7a				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		570	130	440	1740		120	0				

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	21.0	38.0	16.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		10.0		
Phase Duration, s		43.0	26.0	69.0		21.0		
Change Period, (*Y*+*Rc*), s		5.0	5.0	5.0		5.0		
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (*gs*), s			7.1			8.6		
Green Extension Time (*ge*), s		0.0	1.1	0.0		0.1		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			0.01		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8				
Adjusted Flow Rate (*v*), veh/h		498	113	489	1933		133	0				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1616	1416	1586	1764		1636	1685				
Queue Service Time (*gs*), s		13.9	7.2	5.1	9.5		6.6	0.0				
Cycle Queue Clearance Time (*gc*), s		13.9	7.2	5.1	9.5		6.6	0.0				
Green Ratio (*g/C*)		0.21	0.21	0.68	0.71		0.18	0.18				
Capacity (*c*), veh/h		677	598	997	2508		291	299				
Volume-to-Capacity Ratio (*X*)		0.735	0.190	0.490	0.771		0.458	0.000				
Available Capacity (*ca*), veh/h		677	598	997	2508		291	299				
Back of Queue (*Q*), veh/ln (50th percentile)		6.6	2.7	1.8	1.7		2.6	0.0				
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.00	0.23	0.00		0.00	0.00				
Uniform Delay (*d1*), s/veh		32.9	29.3	12.4	0.9		33.1	0.0				
Incremental Delay (*d2*), s/veh		4.3	0.4	0.1	2.4		0.4	0.0				
Initial Queue Delay (*d3*), s/veh		0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (*d*), s/veh		37.2	29.7	12.6	3.3		33.5	0.0				
Level of Service (LOS)		D	C	B	A		C					

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	35.8	D	5.2	A	33.5	C	0.0	
Intersection Delay, s/veh / LOS	12.3				B			

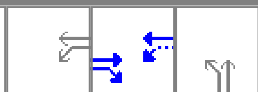
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	1.9	A	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.1	A	2.5	B	0.7	A		

HCS 2010 Interchanges Results Summary

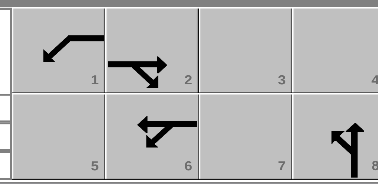
General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 6, 2014	Segment Distance, ft	1060
Jurisdiction	SDDOT/Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	Interstate 229 NB	PHF	0.90	Arterial Direction	East-West
File Name	option 7a AM.xus				
Project Description	Option 7a				

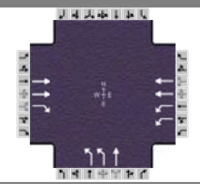
Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		550	70	720	1140		380	0				
Intersection Two Demand (*v*), veh/h		570	130	440	1740		120	0				

Signal One Information	
Cycle, s	90.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed

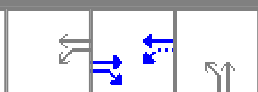


Green	32.0	23.0	20.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0

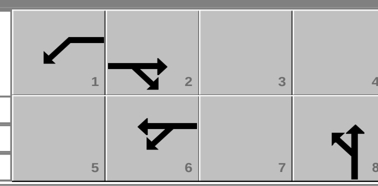


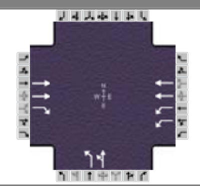


Signal Two Information	
Cycle, s	90.0
Offset, s	0
Uncoordinated	No
Force Mode	Fixed



Green	21.0	38.0	16.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0





Interchange Results

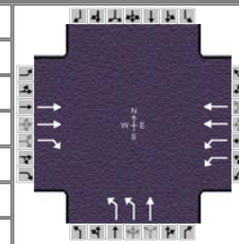
O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	133	NBL(II) + NBT(II) + WBT(I)	38.2	C
B	NBR	0	NBT(II)	0.0	A
C	SBR	0	SBT(I)	0.0	A
D	SBL - SBU	0	SBL(I) + SBT(I) - EBT(II)	37.2	C
E	EBL(INT) - SBU	0	EBL(II) + EBT(II) + EBT(I)	32.7	C
F	EBR(EXT)	78	EBT(I)	32.7	C
G	WBR(EXT)	0	WBT(II)	0.0	A
H	WBL(INT) - NBU	800	WBL(I) + WBT(I) + WBT(II)	11.7	A
I	EBT(INT) - SBL + SBU	498	EBT(I) + EBT(II)	69.9	D
J	WBT(INT) - NBL + NBU	1133	WBT(I) + WBT(II)	7.9	A
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		32.7	24.6	8.4	4.7		32.5	0.0				
Level of Service (LOS)		C	C	A	A		C					
Approach Delay, s/veh / LOS	31.8	C		6.1	A		32.5	C		0.0		
Intersection Delay, s/veh / LOS	15.2						B					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		37.2	29.7	12.6	3.3		33.5	0.0				
Level of Service (LOS)		D	C	B	A		C					
Approach Delay, s/veh / LOS	35.8	D		5.2	A		33.5	C		0.0		
Intersection Delay, s/veh / LOS	12.3						B					

HCS 2010 Signalized Intersection Results Summary

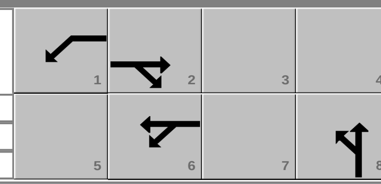
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 6, 2014	Area Type	Other
Jurisdiction	SDDOT/Sioux Falls	Time Period	PM peak	PHF	0.90
Intersection	Interstate 229 SB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	option 7a PM.xus				
Project Description	Option 7a				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h		850	110	510	600		250	0				

Signal Information			
Cycle, s	90.0	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	23.0	35.0	17.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		10.0		
Phase Duration, s		40.0	28.0	68.0		22.0		
Change Period, ($Y+R_c$), s		5.0	5.0	5.0		5.0		
Max Allow Headway (MAH), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (g_s), s			7.4			9.1		
Green Extension Time (g_e), s		0.0	1.2	0.0		0.4		
Phase Call Probability			1.00			1.00		
Max Out Probability			0.00			0.01		

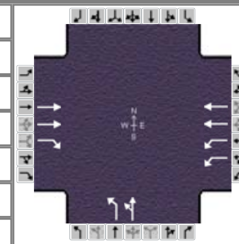
Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8				
Adjusted Flow Rate (v), veh/h		944	122	510	600		278	0				
Adjusted Saturation Flow Rate (s), veh/h/ln		1659	1417	1589	1625		1559	1686				
Queue Service Time (g_s), s		19.9	4.2	5.4	5.2		7.1	0.0				
Cycle Queue Clearance Time (g_c), s		19.9	4.2	5.4	5.2		7.1	0.0				
Green Ratio (g/C)		0.39	0.39	0.67	0.70		0.19	0.19				
Capacity (c), veh/h		1290	551	1165	2276		589	318				
Volume-to-Capacity Ratio (X)		0.732	0.222	0.438	0.264		0.472	0.000				
Available Capacity (c_a), veh/h		1290	551	1165	2276		589	318				
Back of Queue (Q), veh/ln (50th percentile)		6.9	1.4	1.4	1.4		2.7	0.0				
Queue Storage Ratio (RQ) (50th percentile)		0.00	0.36	0.15	0.00		0.68	0.00				
Uniform Delay (d_1), s/veh		18.0	14.3	9.2	4.0		32.5	0.0				
Incremental Delay (d_2), s/veh		3.7	0.9	0.1	0.3		0.2	0.0				
Initial Queue Delay (d_3), s/veh		0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (d), s/veh		21.7	15.2	9.3	4.3		32.7	0.0				
Level of Service (LOS)		C	B	A	A		C					

	EB		WB		NB		SB	
Approach Delay, s/veh / LOS	21.0	C	6.6	A	32.7	C	0.0	
Intersection Delay, s/veh / LOS	15.8				B			

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.8	C	1.9	A	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.4	A	1.5	A	0.9	A		

HCS 2010 Signalized Intersection Results Summary

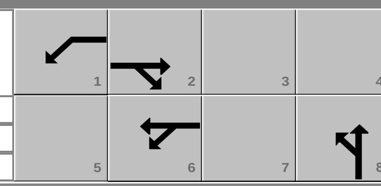
General Information				Intersection Information	
Agency	HDR			Duration, h	0.25
Analyst	RL	Analysis Date	Mar 6, 2014	Area Type	Other
Jurisdiction	SDDOT/Sioux Falls	Time Period	PM peak	PHF	0.90
Intersection	Interstate 229 NB	Analysis Year	2035	Analysis Period	1> 7:00
File Name	option 7a PM.xus				
Project Description	Option 7a				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h		1300	80	80	1060		50	0				

Signal Information			
Cycle, s	90.0	Reference Phase	2
Offset, s	0	Reference Point	Begin
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	5.0	53.0	17.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	1.0	1.0	1.0	0.0	0.0	0.0



Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2	1	6		8		
Case Number		7.3	1.0	4.0		10.0		
Phase Duration, s		58.0	10.0	68.0		22.0		
Change Period, (*Y*+*Rc*), s		5.0	5.0	5.0		5.0		
Max Allow Headway (*MAH*), s		0.0	3.2	0.0		3.2		
Queue Clearance Time (*gs*), s			2.9			4.6		
Green Extension Time (*ge*), s		0.0	0.0	0.0		0.0		
Phase Call Probability			1.00			1.00		
Max Out Probability			1.00			0.00		

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement		2	12	1	6		3	8				
Adjusted Flow Rate (*v*), veh/h		890	55	89	1178		56	0				
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1654	1406	1536	1683		1616	1664				
Queue Service Time (*gs*), s		5.0	0.5	0.9	3.9		2.6	0.0				
Cycle Queue Clearance Time (*gc*), s		5.0	0.5	0.9	3.9		2.6	0.0				
Green Ratio (*g/C*)		0.59	0.59	0.67	0.70		0.19	0.19				
Capacity (*c*), veh/h		1948	828	956	2356		305	314				
Volume-to-Capacity Ratio (*X*)		0.457	0.066	0.093	0.500		0.182	0.000				
Available Capacity (*ca*), veh/h		1948	828	956	2356		305	314				
Back of Queue (*Q*), veh/ln (50th percentile)		1.2	0.1	0.2	0.9		1.0	0.0				
Queue Storage Ratio (*RQ*) (50th percentile)		0.00	0.00	0.03	0.00		0.00	0.00				
Uniform Delay (*d1*), s/veh		2.6	2.3	5.3	1.0		30.7	0.0				
Incremental Delay (*d2*), s/veh		0.5	0.1	0.0	0.8		0.1	0.0				
Initial Queue Delay (*d3*), s/veh		0.0	0.0	0.0	0.0		0.0	0.0				
Control Delay (*d*), s/veh		3.1	2.4	5.3	1.8		30.8	0.0				
Level of Service (LOS)		A	A	A	A		C					
Approach Delay, s/veh / LOS	3.0		A	2.0		A	30.8		C	0.0		
Intersection Delay, s/veh / LOS	3.2						A					

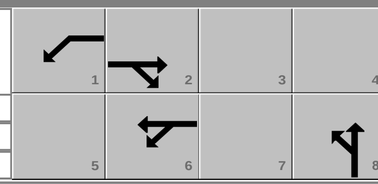
Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.7	B	1.9	A	3.0	C	2.9	C
Bicycle LOS Score / LOS	1.8	A	1.5	A	0.6	A		

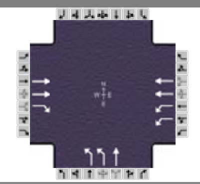
HCS 2010 Interchanges Results Summary

General Information				Interchange Information	
Agency	HDR			Interchange Type	Diamond
Analyst	RL	Analysis Date	Mar 6, 2014	Segment Distance, ft	1060
Jurisdiction	SDDOT/Sioux Falls	Duration,h	0.25	Freeway Direction	North-South
Intersection	Interstate 229 NB	PHF	0.90	Arterial Direction	East-West
File Name	option 7a PM.xus				
Project Description	Option 7a				

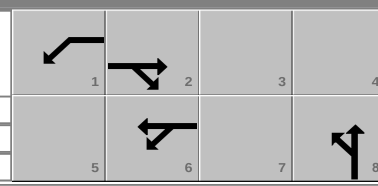
Demand	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Intersection One Demand (*v*), veh/h		850	110	510	600		250	0				
Intersection Two Demand (*v*), veh/h		1300	80	80	1060		50	0				

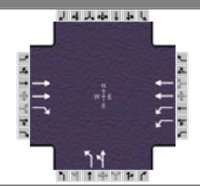
Signal One Information								
Cycle, s	90.0							
Offset, s	0	Green	23.0	35.0	17.0	0.0	0.0	0.0
Uncoordinated	No	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Red	1.0	1.0	1.0	0.0	0.0	0.0





Signal Two Information								
Cycle, s	90.0							
Offset, s	0	Green	5.0	53.0	17.0	0.0	0.0	0.0
Uncoordinated	No	Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Force Mode	Fixed	Red	1.0	1.0	1.0	0.0	0.0	0.0





Interchange Results

O-D	O-D Demand Movements	Demand (veh/h)	Delay Movements	Delay (s)	LOS
A	NBL - NBU	56	NBL(II) + NBT(II) + WBT(I)	37.5	C
B	NBR	0	NBT(II)	0.0	A
C	SBR	0	SBT(I)	0.0	A
D	SBL - SBU	0	SBL(I) + SBT(I) - EBT(II)	3.1	A
E	EBL(INT) - SBU	0	EBL(II) + EBT(II) + EBT(I)	21.7	B
F	EBR(EXT)	122	EBT(I)	21.7	B
G	WBR(EXT)	0	WBT(II)	0.0	A
H	WBL(INT) - NBU	567	WBL(I) + WBT(I) + WBT(II)	14.0	A
I	EBT(INT) - SBL + SBU	890	EBT(I) + EBT(II)	24.8	B
J	WBT(INT) - NBL + NBU	611	WBT(I) + WBT(II)	8.5	A
K	NBT	0	NBT	-	-
L	SBT	0	SBT	-	-
M	NBU	0	NBU	-	-
N	SBU	0	SBU	-	-

Signalized Intersection One Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		21.7	15.2	12.2	6.7		32.7	0.0				
Level of Service (LOS)		C	B	B	A		C					
Approach Delay, s/veh / LOS	21.0	C		9.2	A		32.7	C		0.0		
Intersection Delay, s/veh / LOS	16.6						B					

Signalized Intersection Two Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Control Delay (*d*) , s/veh		3.1	2.4	5.3	1.8		30.8	0.0				
Level of Service (LOS)		A	A	A	A		C					
Approach Delay, s/veh / LOS	3.0	A		2.0	A		30.8	C		0.0		
Intersection Delay, s/veh / LOS	3.2						A					

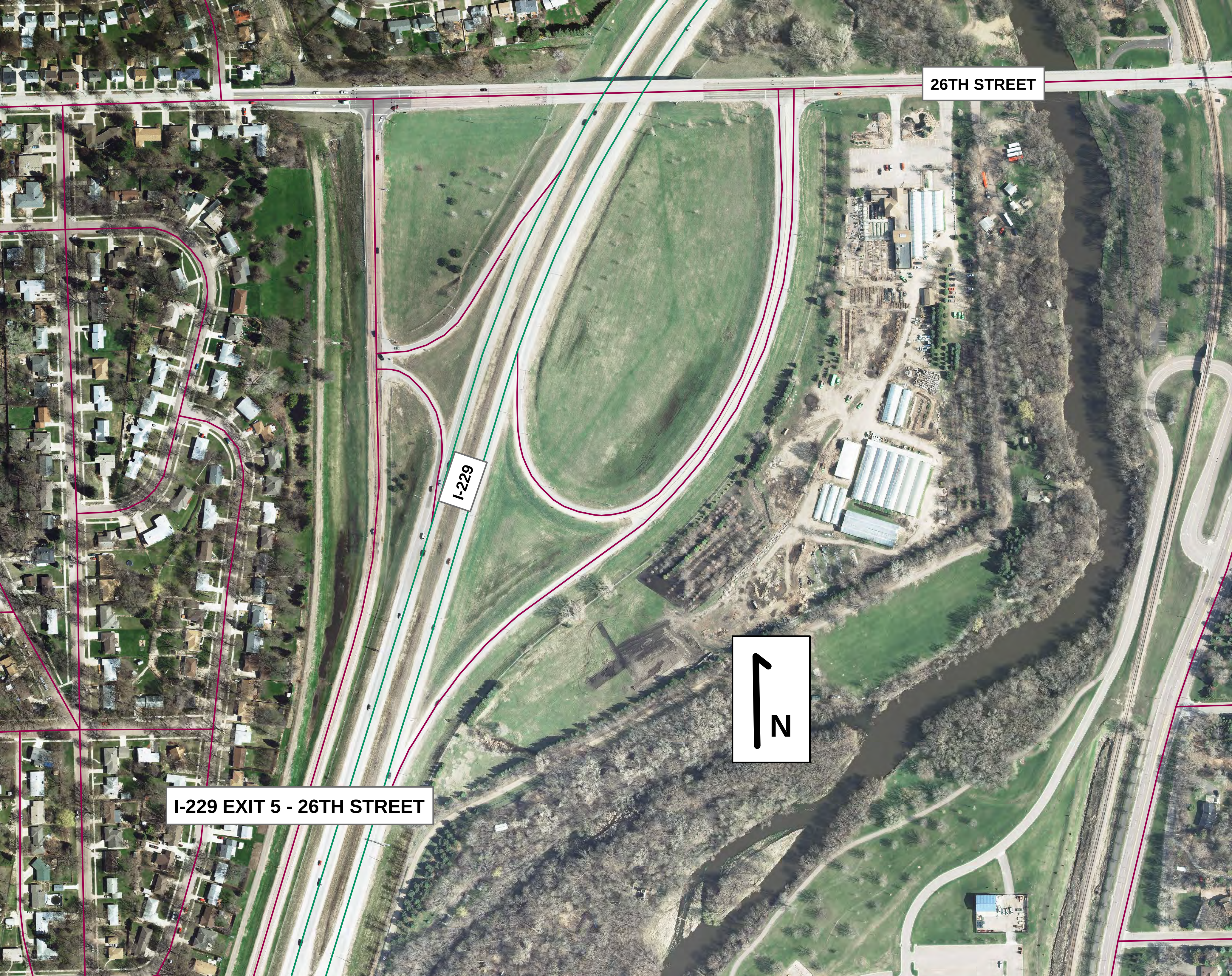
I-229/26th Street Interchange Modification Justification Report

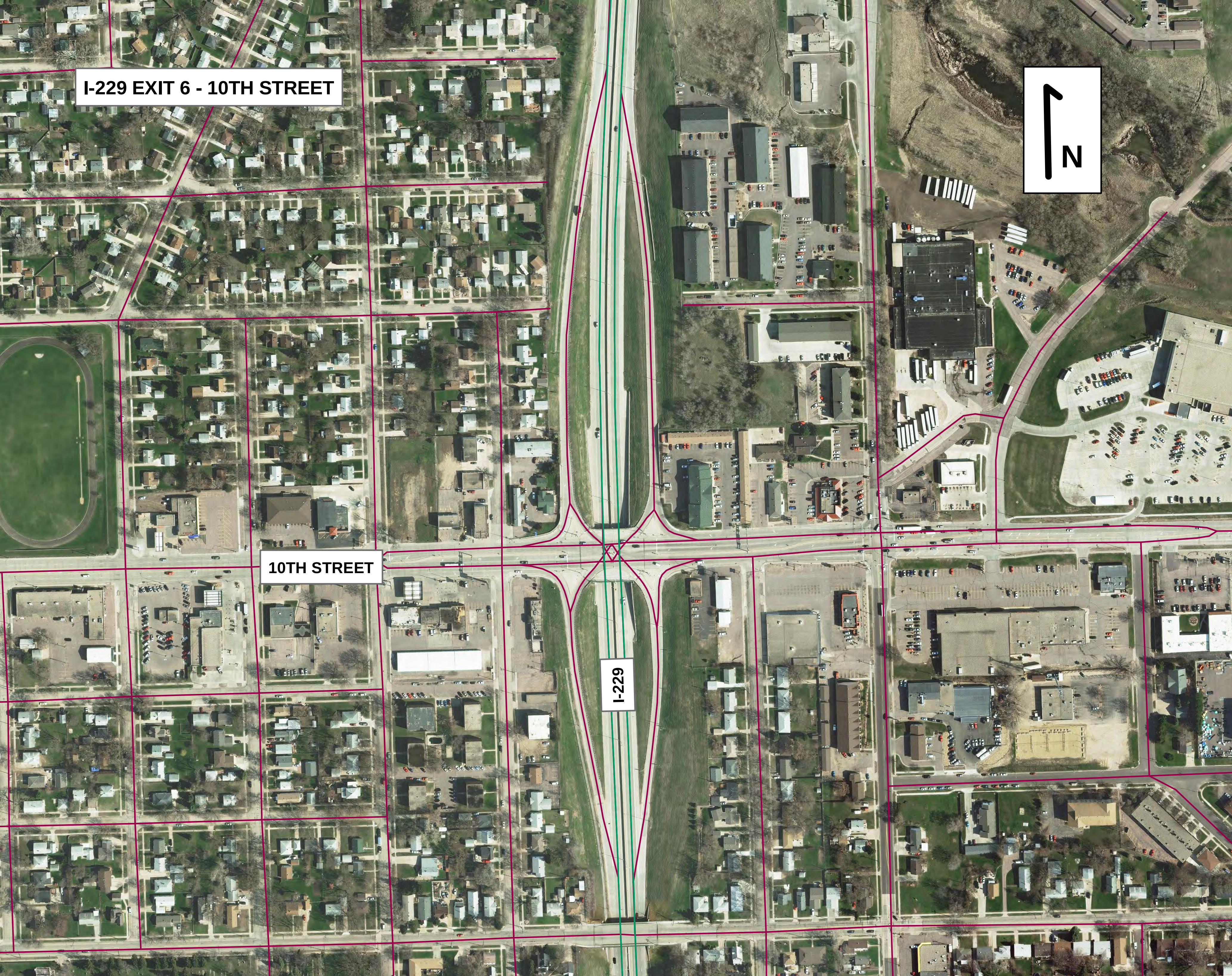
APPENDIX

PART 5

Interchange Area Air Photos

I-229 EXIT 4 - CLIFF AVENUE
N
I-229
CLIFF AVENUE


26TH STREET
I-229
N
I-229 EXIT 5 - 26TH STREET


I-229 EXIT 6 - 10TH STREET
N
10TH STREET
I-229

I-229/26th Street Interchange Modification Justification Report

APPENDIX

PART 6

Signed Methods & Assumptions Document

(Contains Appendix A, B, and Appendix to original M&A Document)

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Federal Highway Administration

I-229 EXIT 5 (26TH STREET)
CROSSROAD CORRIDOR STUDY

Methods & Assumptions Meeting Documentation "Amendment #2"

To: Study Advisory Team (SDDOT, FHWA, HDR, City of Sioux Falls, MPO)	
From: HDR	Project: I229 Exit 5 (26th Street) Crossroad Corridor Study Project PL 0100(88) 3616 P, PCN 03KM
CC: File	Job No: 179168
Date: November 27, 2013	

Methods and Assumptions Document

This Methods and Assumptions Amendment #2 document was developed to address issues with achieving our previously agreed upon Level of Service (LOS) thresholds as outlined in Section 6. The current version of the Method & Assumptions document Amendment #1 is located in Appendix B for reference. It was determined during this study that meeting LOS C criteria for the non-interchange intersections (intersections under the jurisdiction of the City of Sioux Falls) causes severe property impacts and is cost prohibitive. This amendment is intended to serve as a historical record of the acceptance of this decision at it relates to this specific study.

1. Stakeholder Acceptance Page

"The undersigned parties concur with the Methods and Assumptions for the ***I-229 Exit 5 (26th Street) Crossroad Corridor Study*** as presented in this document.

SDDOT:

Signature

Data Analysis Engineer

Title

12-20-2013

Date

FHWA:

Signature

Planning/Civil Rights Spec

Title

12/20/13

Date

Revisions Proposed for Adoption of Amendment #2:

6. Traffic Operations Analysis (Current Version Adopted)

Traffic Operations Analysis

- ii. Software Discussion
  1. Uncontrolled or Signalized Intersections
     - a. HCS Version 6.3 and Synchro Version 8 by Trafficware (2010 HCM Methodology)
       - i. Synchro Version 8 will be utilized to evaluate all signalized intersections within the study corridor except along 26th Street from Cliff Avenue to Village Square Circle, it was agreed that HCS "Streets Module" will be used for that segment of the study.
       - ii. HCS Release 6.3 (or current release) Streets module will be used to evaluate the 26th Street Corridor from Cliff Avenue to Village Square Circle. Arrival Type 4 will be used to represent the platooning of the corridor per the SDDOT Design Manual.
  2. Freeway Segments, Weave Segments, & Ramp Junctions
     - a. HCS Release 6.3 (2010 HCM Methodology)
  3. Interchange Ramp Intersections
     - a. HCS has a planned release to include interchanges and intersections at Ramp Terminals for August 2012. HDR will utilize the software when it becomes available.
- iii. Operational Analysis Assumptions or Variables
  1. Level of Service (LOS)
     - a. Signalized intersections
       - i. Minimum Allowable LOS – C
         1. Individual movements will be allowed to operate at LOS "D" but the overall intersection LOS shall be "C" or better.
     - b. Freeway Segments, Weave Segments (if any), Ramp Junctions, and Ramp Terminals
       - i. Minimum Allowable LOS – C

6. Traffic Operations Analysis (Amended Version)

Traffic Operations Analysis

i. Software Discussion

   2. Uncontrolled or Signalized Intersections
      a. HCS Version 6.3 and Synchro Version 8 by Trafficware (2010 HCM Methodology)
         i. Synchro Version 8 will be utilized to evaluate all signalized intersections within the study corridor except along 26th Street from Cliff Avenue to Village Square Circle, it was agreed that HCS "Streets Module" will be used for that segment of the study.
         ii. HCS Release 6.3 (or current release) Streets module will be used to evaluate the 26th Street Corridor from Cliff Avenue to Village Square Circle. Arrival Type 4 will be used to represent the platooning of the corridor per the SDDOT Design Manual.
   3. Freeway Segments, Weave Segments, & Ramp Junctions
      a. HCS Release 6.3 (2010 HCM Methodology)
   4. Interchange Ramp Intersections
      a. HCS has a planned release to include interchanges and intersections at Ramp Terminals for August 2012. HDR will utilize the software when it becomes available.

ii. Operational Analysis Assumptions or Variables

   5. Level of Service (LOS)
      a. Signalized intersections at I-229 Ramp Termini
         i. Minimum Allowable LOS – C with individual movements at LOS - D
      b. Signalized intersections not at I-229 Ramp Termini
         i. Minimum Allowable Intersection LOS – D
            1. Justification is City of Sioux Falls allows existing intersections to be reconstructed to allow for LOS "D"
            2. Property impacts and associated costs are considered prohibitive for adding a 3rd lane in each direction to 26th Street in order to achieve an overall LOS C at the 26th Street/Southeastern Avenue intersection. (See Technical Memo in Appendix A)
      c. Freeway Segments, Weave Segments (if any), Ramp Junctions, and Ramp Terminals
         i. Minimum Allowable LOS – C

Appendix A

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Technical Memo

To:	Steve Gramm, SDDOT
From:	HDR Project: I-229 Exit 5 (26th Street) Crossroad Corridor Study (PL 0100(88); PCN 03KM)
CC:	Mark Hoines, FHWA; Shannon Ausen, City of Sioux Falls
Date:	September 9, 2013; rev. 9/30/13 Job No: 179168

RE: 26th Street/Southeastern Avenue Level of Service Considerations

Background

Section 6.0, Traffic Operations Analysis, of the I-229 Exit 5 Methods and Assumptions Document specified the intersection Level of Service (LOS) for the project:

1. Level of Service (LOS)
    a. Signalized intersections
        i. Minimum Allowable LOS – C
            1. Individual movements will be allowed to operate at LOS "D" but the overall intersection LOS shall be "C" or better.

Concept options developed to date provide year 2035 intersection LOS C for the I-229 Exit 5 ramp/26th Street intersections.

Concept options for the 26th Street/Southeastern Avenue intersection provide overall LOS D for year 2035 traffic conditions. This does not meet the Methods and Assumptions Document criteria.

The purpose of this memo is to evaluate the 26th Street/Southeastern Avenue LOS criteria and various methods to achieve an appropriate LOS.

City of Sioux Falls and SDDOT Standards

The City of Sioux Falls Engineering Design Standards for Public Improvements Section 5.1.2.8 states: *"Level of Service. Level of Service (LOS) C during the peak hour will be the design objective for all new street components and intersections. Individual approaches shall be designed to at least LOS D for arterial street approaches or a LOS E for collector/local/private street approaches, with no individual movement having a volume/capacity ratio of greater than 1.00. Existing corridors with established adjacent development shall be designed to LOS D. The design year will be the MPO planning year horizon or at build-out."* The 26th Street/Southeastern Avenue intersection is definitely within existing roadway corridors with adjacent development and therefore an overall intersection LOS D is an allowable criterion for design *(emphasis added)*.

The SDDOT Road Design Manual lists a desirable LOS C for arterial roadways with a minimum LOS D in heavily developed sections of metropolitan areas.

Design Required to Provide LOS C

In their review of concept options developed to date, FHWA provided this comment regarding the 26th Street/Southeastern Avenue intersection: *"All of the 26th Street/Southeastern Avenue intersection options are showing an intersection level of service of D. The Methods and Assumptions document had a minimum of C for signalized intersections. What is causing the level of service D and what would it take to have an option that has a level of service of C or better? If there is not a feasible alternative that meets the level of service in the Methods and Assumption document this will need to be documented."*

The basic requirement to achieve an overall LOS C at the intersection (for year 2035 traffic) is **3 through lanes in each direction on 26th Street.** (The LOS worksheets are included with this memo in the Apendix.) Attached Figures 1 and 2 illustrate the lane configurations necessary for 26th Street and Southeastern Avenue to achieve an overall LOS C for intersection Options A and C (raised intersection) and Options B and D (raised intersection with Southeastern Avenue tunnels), respectively.

Drawbacks of 3 through lanes on 26th Street include:

- There is no logical location to drop/add the 3rd lane east of 26th Street until Sycamore Avenue, approximately 1 mile east of Southeastern Avenue.
- Existing development adjacent to 26th Street, especially parking lots, would be impacted by adding a lane in each direction.
- For a 6 lane roadway, a raised center median would be necessary for safety and access control. A corridor access control plan would be required with a system of back access roadways to businesses.

Photo looking east along 26th Street

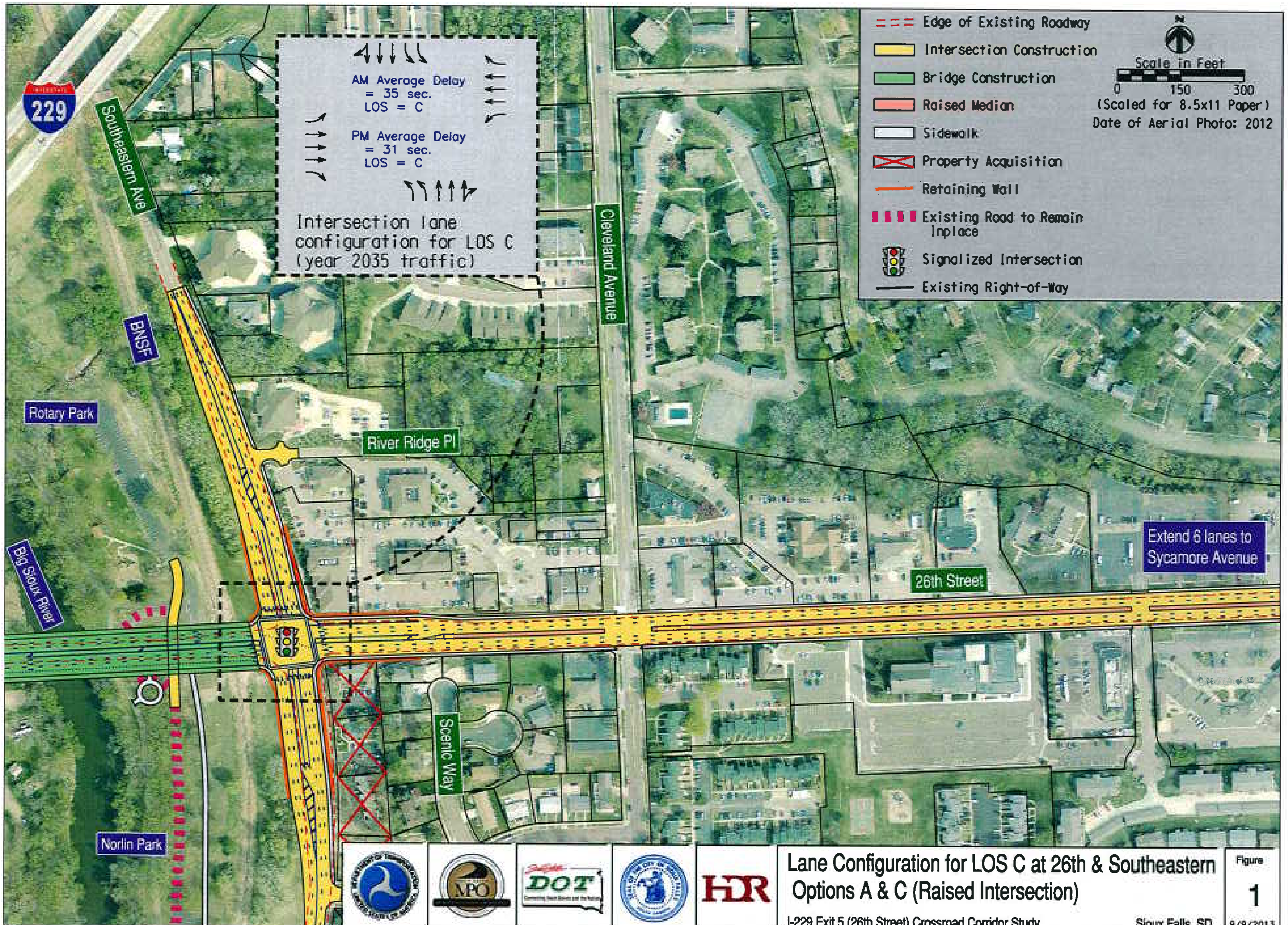
Safety Considerations

HDRs safety analysis determined that the crash rate at the existing 26th Street/Southeastern Avenue intersection was approximately 27% below the critical rate for the 2008 to 2011 analysis period. The existing intersection operates at LOS D during the AM and PM peak hour periods. There is no reason to anticipate a significant safety issue at the intersection with LOS D traffic conditions in year 2035.

Summary and Recommendation

Property impacts and associated costs are considered prohibitive for adding a 3rd lane in each direction to 26th Street in order to achieve an overall LOS C at the 26th Street/Southeastern Avenue intersection.

Therefore, it is recommended that the intersection be designed for overall LOS D under year 2035 traffic conditions per City of Sioux Falls and SDDOT criteria.



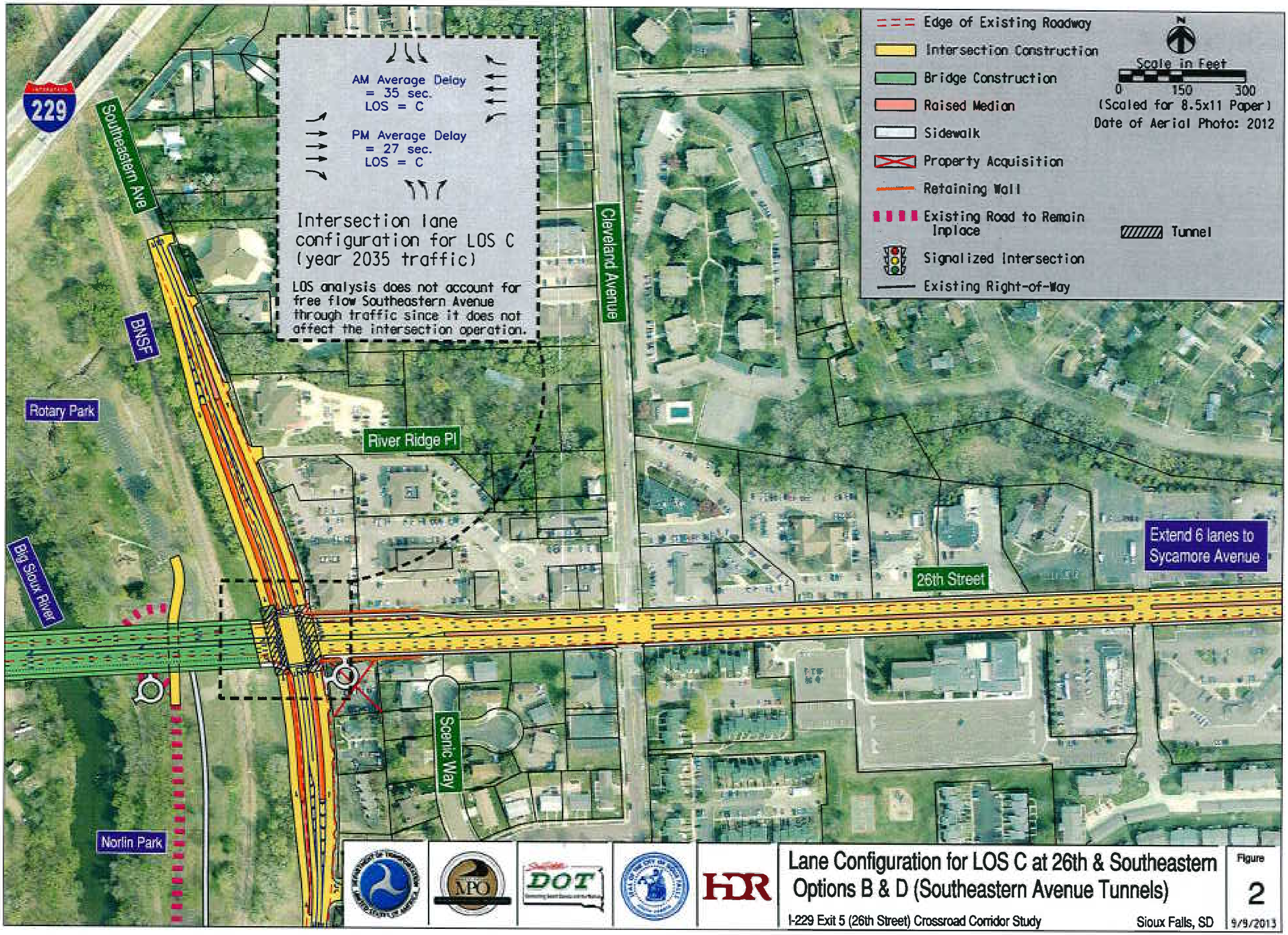
Lane Configuration for LOS C at 26th & Southeastern
Options A & C (Raised Intersection)

I-229 Exit 5 (26th Street) Crossroad Corridor Study

Sioux Falls, SD

Figure 1

9/9/2013


Edge of Existing Roadway
Intersection Construction
Bridge Construction
Raised Median
Sidewalk
Property Acquisition
Retaining Wall
Existing Road to Remain Inplace
Signalized Intersection
Existing Right-of-Way
Tunnel
N
Scale in Feet
0 150 300
(Scaled for 8.5x11 Paper)
Date of Aerial Photo: 2012
AM Average Delay = 35 sec. LOS = C
PM Average Delay = 27 sec. LOS = C
Intersection lane configuration for LOS C (year 2035 traffic)
LOS analysis does not account for free flow Southeastern Avenue through traffic since it does not affect the intersection operation.
229
Southeastern Ave
BNSF
Rotary Park
Big Sioux River
Norlin Park
River Ridge Pl
Cleveland Avenue
Scenic Way
26th Street
Extend 6 lanes to Sycamore Avenue
HDR
Lane Configuration for LOS C at 26th & Southeastern
Options B & D (Southeastern Avenue Tunnels)
I-229 Exit 5 (26th Street) Crossroad Corridor Study
Sioux Falls, SD
Figure
2
9/9/2013

Appendix – Level of Service Worksheets

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	70	760	160	50	1140	300	900	1160	180	110	130	60
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0	186.3	186.3	190.0
Lanes	1	3	1	1	3	1	2	3	0	2	3	0
Cap, veh/h	173	1781	505	249	1723	488	1111	2156	335	179	697	289
Arrive On Green	0.04	0.32	0.00	0.03	0.31	0.31	0.32	0.46	0.46	0.05	0.19	0.19
Sat Flow, veh/h	1774	5588	1583	1774	5588	1583	3442	4726	733	3442	3754	1559
Grp Volume(v), veh/h	78	844	0	56	1267	333	1000	1016	473	122	143	68
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1733	1721	1863	1588
Q Serve(g_s), s	3.3	13.8	0.0	2.4	23.1	21.0	31.6	23.2	23.2	4.0	3.7	4.2
Cycle Q Clear(g_c), s	3.3	13.8	0.0	2.4	23.1	21.0	31.6	23.2	23.2	4.0	3.7	4.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.42	1.00		0.98
Lane Grp Cap(c), veh/h	173	1781	505	249	1723	488	1111	1700	791	179	692	295
V/C Ratio(X)	0.45	0.47	0.00	0.22	0.74	0.68	0.90	0.60	0.60	0.68	0.21	0.23
Avail Cap(c_a), veh/h	190	1814	514	285	1814	514	1329	1700	791	272	692	295
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.7	31.1	0.0	26.3	35.3	34.5	36.8	23.2	23.2	53.1	39.3	39.5
Incr Delay (d2), s/veh	1.8	0.2	0.0	0.5	1.5	3.5	7.7	1.6	3.3	4.5	0.7	1.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.6	6.5	0.0	1.1	11.2	8.9	15.1	11.0	10.6	1.9	1.8	1.8
Lane Grp Delay (d), s/veh	29.6	31.3	0.0	26.8	36.8	38.0	44.5	24.7	26.5	57.6	40.0	41.3
Lane Grp LOS	C	C		C	D	D	D	C	C	E	D	D
Approach Vol, veh/h		922			1656			2489			333	
Approach Delay, s/veh		31.2			36.7			33.0			46.7	
Approach LOS		C			D			C			D	
Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	8.9	40.3		7.7	39.1		40.8	56.0		9.9	25.2	
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Max Green Setting (Gmax), s	6.0	37.0		6.0	37.0		44.0	52.0		9.0	17.0	
Max Q Clear Time (g_c+I1), s	5.3	15.8		4.4	25.1		33.6	25.2		6.0	6.2	
Green Ext Time (p_c), s	0.0	16.3		0.0	10.0		3.2	14.4		0.1	7.7	
Intersection Summary												
HCM 2010 Ctrl Delay			34.7									
HCM 2010 LOS			C									
Notes												

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	70	1410	570	90	690	110	320	300	170	470	680	110
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow veh/h/ln	186.3	186.3	186.3	186.3	186.3	186.3	186.3	186.3	190.0	186.3	186.3	190.0
Lanes	1	3	1	1	3	1	2	3	0	2	3	0
Cap, veh/h	336	2148	609	214	2198	623	437	802	341	615	1256	201
Arrive On Green	0.04	0.38	0.00	0.05	0.39	0.39	0.13	0.22	0.22	0.18	0.27	0.27
Sat Flow, veh/h	1774	5588	1583	1774	5588	1583	3442	3725	1583	3442	4703	752
Grp Volume(v), veh/h	78	1567	0	100	767	122	356	333	189	522	597	281
Grp Sat Flow(s),veh/h/ln	1774	1863	1583	1774	1863	1583	1721	1863	1583	1721	1863	1730
Q Serve(g_s), s	2.5	22.5	0.0	3.1	9.0	4.7	9.4	7.2	10.0	13.7	13.1	13.3
Cycle Q Clear(g_c), s	2.5	22.5	0.0	3.1	9.0	4.7	9.4	7.2	10.0	13.7	13.1	13.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.43
Lane Grp Cap(c), veh/h	336	2148	609	214	2198	623	437	802	341	615	995	462
V/C Ratio(X)	0.23	0.73	0.00	0.47	0.35	0.20	0.81	0.42	0.55	0.85	0.60	0.61
Avail Cap(c_a), veh/h	376	2268	643	238	2268	643	551	802	341	772	995	462
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	16.5	24.7	0.0	19.5	20.0	18.7	39.8	31.7	32.7	37.2	29.9	30.0
Incr Delay (d2), s/veh	0.4	1.2	0.0	1.6	0.1	0.2	7.4	1.6	6.4	7.3	2.7	5.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q (50%), veh/ln	1.1	10.4	0.0	1.4	4.1	1.8	4.6	3.6	4.6	6.6	6.4	6.5
Lane Grp Delay (d), s/veh	16.9	25.8	0.0	21.1	20.1	18.8	47.2	33.2	39.1	44.5	32.6	35.8
Lane Grp LOS	B	C		C	C	B	D	C	D	D	C	D
Approach Vol, veh/h		1645			989			878			1400	
Approach Delay, s/veh		25.4			20.0			40.2			37.7	
Approach LOS		C			C			D			D	

Timer												
Assigned Phs	7	4		3	8		5	2		1	6	
Phs Duration (G+Y+Rc), s	7.9	40.0		8.7	40.8		15.9	24.2		20.7	29.0	
Change Period (Y+Rc), s	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Max Green Setting (Gmax), s	6.0	38.0		6.0	38.0		15.0	19.0		21.0	25.0	
Max Q Clear Time (g_c+I1), s	4.5	24.5		5.1	11.0		11.4	12.0		15.7	15.3	
Green Ext Time (p_c), s	0.0	11.5		0.0	20.4		0.5	4.7		1.0	6.0	

Intersection Summary	
HCM 2010 Ctrl Delay	30.5
HCM 2010 LOS	C

Notes

HCM Signalized Intersection Capacity Analysis

3: 9/13/2013

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	70	760	160	50	1140	300	900	0	180	110	0	60
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	0.97		1.00	0.97		1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00		0.85	1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (prot)	1676	4818	1500	1676	4818	1500	3252		1500	3252		1500
Flt Permitted	0.11	1.00	1.00	0.25	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (perm)	189	4818	1500	435	4818	1500	3252		1500	3252		1500
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	78	844	178	56	1267	333	1000	0	200	122	0	67
RTOR Reduction (vph)	0	0	109	0	0	206	0	0	54	0	0	61
Lane Group Flow (vph)	78	844	69	56	1267	127	1000	0	146	122	0	6
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	custom		custom	custom		custom
Protected Phases	5	2		1	6							
Permitted Phases	2		2	6		6	4		4	8		8
Actuated Green, G (s)	53.2	46.2	46.2	52.2	45.7	45.7	41.4		41.4	9.9		9.9
Effective Green, g (s)	53.2	46.2	46.2	52.2	45.7	45.7	41.4		41.4	9.9		9.9
Actuated g/C Ratio	0.44	0.39	0.39	0.44	0.38	0.38	0.34		0.34	0.08		0.08
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	170	1854	577	256	1834	571	1121		517	268		123
v/s Ratio Prot	c0.03	0.18		0.01	c0.26							
v/s Ratio Perm	0.18		0.05	0.08		0.08	c0.31		0.10	c0.04		0.00
v/c Ratio	0.46	0.46	0.12	0.22	0.69	0.22	0.89		0.28	0.46		0.04
Uniform Delay, d1	22.1	27.5	23.8	20.4	31.2	25.1	37.2		28.5	52.5		50.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00
Incremental Delay, d2	2.0	0.8	0.4	0.4	2.2	0.9	9.2		0.3	1.2		0.2
Delay (s)	24.1	28.3	24.2	20.8	33.4	26.0	46.4		28.8	53.7		50.8
Level of Service	C	C	C	C	C	C	D		C	D		D
Approach Delay (s)		27.4			31.5			43.5			52.7	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	64.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	70	1410	570	90	690	110	340	0	170	470	0	110
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	0.97		1.00	0.97		1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00		0.85	1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (prot)	1676	4818	1500	1676	4818	1500	3252		1500	3252		1500
Flt Permitted	0.29	1.00	1.00	0.11	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (perm)	511	4818	1500	188	4818	1500	3252		1500	3252		1500
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	78	1567	633	100	767	122	378	0	189	522	0	122
RTOR Reduction (vph)	0	0	364	0	0	71	0	0	91	0	0	89
Lane Group Flow (vph)	78	1567	269	100	767	51	378	0	98	522	0	33
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	custom		custom	custom		custom
Protected Phases	5	2		1	6							
Permitted Phases	2		2	6		6	4		4	8		8
Actuated Green, G (s)	43.3	38.3	38.3	41.7	37.5	37.5	14.6		14.6	16.9		16.9
Effective Green, g (s)	43.3	38.3	38.3	41.7	37.5	37.5	14.6		14.6	16.9		16.9
Actuated g/C Ratio	0.48	0.43	0.43	0.46	0.42	0.42	0.16		0.16	0.19		0.19
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	310	2050	638	156	2007	625	527		243	610		281
v/s Ratio Prot	0.01	c0.33		c0.03	0.16							
v/s Ratio Perm	0.11		0.18	0.27		0.03	c0.12		0.07	c0.16		0.02
v/c Ratio	0.25	0.76	0.42	0.64	0.38	0.08	0.72		0.40	0.86		0.12
Uniform Delay, d1	13.0	22.0	18.1	16.6	18.2	15.8	35.7		33.8	35.4		30.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00
Incremental Delay, d2	0.4	2.8	2.0	8.7	0.6	0.3	4.6		1.1	11.3		0.2
Delay (s)	13.4	24.8	20.1	25.3	18.8	16.1	40.4		34.9	46.7		30.6
Level of Service	B	C	C	C	B	B	D		C	D		C
Approach Delay (s)		23.1			19.1			38.5			43.6	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	27.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	64.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Appendix B

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I-229 EXIT 5 (26TH STREET)
CROSSROAD CORRIDOR STUDY

Methods & Assumptions Meeting Documentation "Amendment #1"

To: Study Advisory Team (SDDOT, FHWA, HDR, City of Sioux Falls, MPO)	
From: HDR	Project: I229 Exit 5 (26th Street) Crossroad Corridor Study Project PL 0100(88) 3616 P, PCN 03KM
CC: File	
Date: August 9th, 2013	Job No: 179168

Methods and Assumptions Document

This Methods and Assumptions document amendment was developed to address how the analysis of the Diverging Diamond Interchange (DDI) concepts would be completed for this project. The signed original Method & Assumptions document in Appendix A indicated that HCS software using HCM procedures would be used. It was determined during this study that current HCS software modules do not specifically address DDI's therefore HDR developed methodology using HCS to allow the analysis to be completed in compliance with the original M&A document. This amendment is intended to serve as a historical record of the acceptance of this methodology for this study.

1. Stakeholder Acceptance Page

"The undersigned parties concur with the Methods and Assumptions for the ***I-229 Exit 5 (26th Street) Crossroad Corridor Study*** as presented in this document.

SDDOT:	FHWA:
Signature	Signature
Data Analysis Engineer	Planning/Civil Rights Specialist
Title	Title
Aug. 12, 2013	8/14/13
Date	Date

HDR Engineering, Inc.
C:\Users\JKjensta\Desktop\M_M&A Amendment Documentation_08 09 13.docx

6300 So Old Village Place
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Sioux Falls, South Dakota 57108

Phone (605) 977-7740
Fax (605) 977-7747
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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

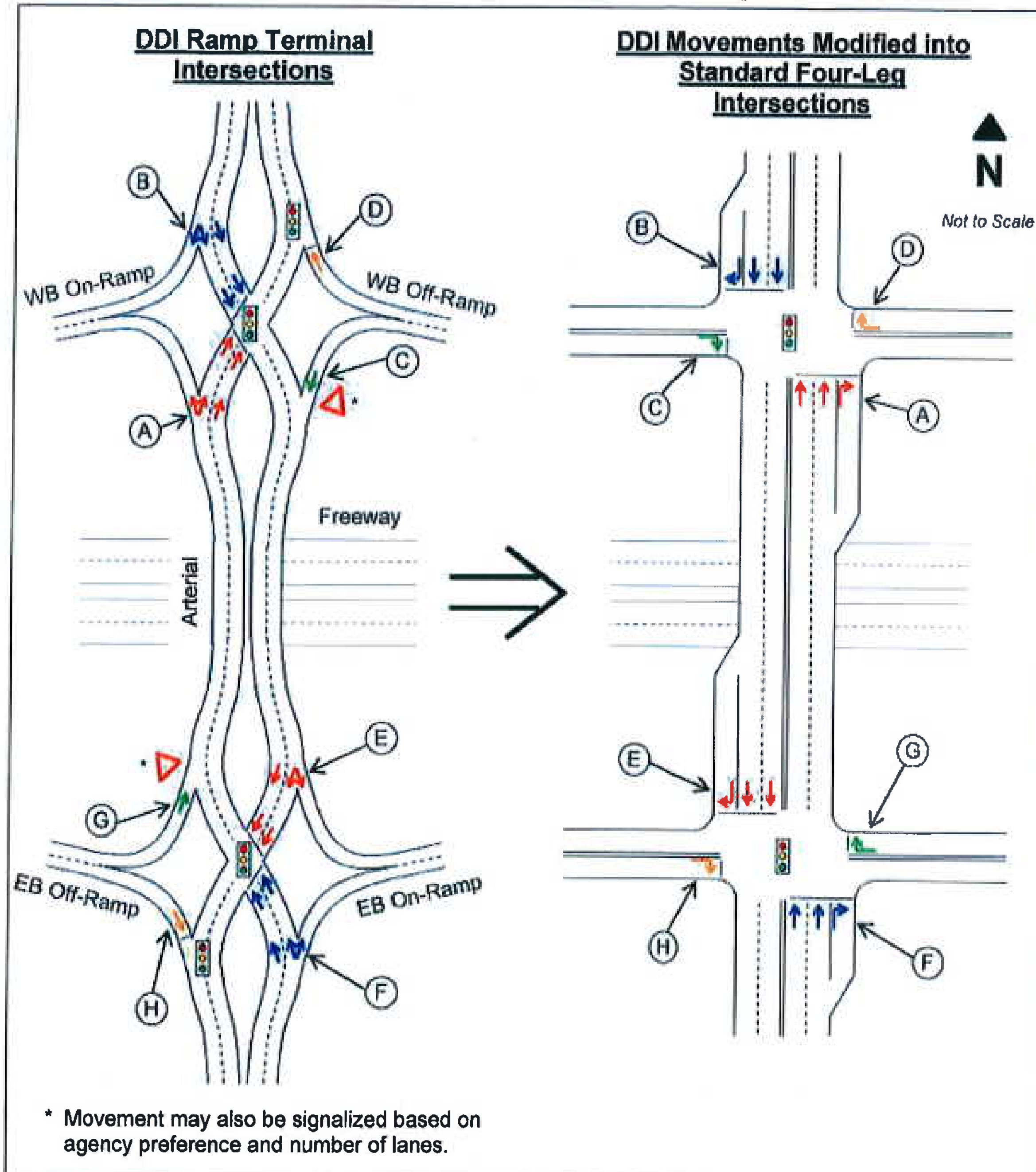
This document presents a proposed methodology for analyzing a Diverging Diamond Interchange (DDI) using Highway Capacity Software (HCS) 2010 Streets module. The Federal Highway Agency (FHWA) has indicated that HCS 2010 is the preferred traffic analysis tool for various projects within certain agencies. 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.

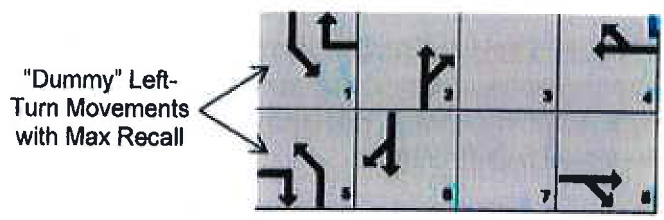
- To model split-phase operations for the arterial street (northbound and southbound movements) in HCS 2010 Streets, the following coding elements would be needed. Additionally, the diagrams shown in **Figure 2** supplement the coding elements listed below.
    - Artificial ("dummy") northbound and southbound 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

Movement Phases



Operational Phases and Times

Green	42.0	0.0	38.0	1.0
Yellow	4.0	0.0	4.0	0.0
Red	1.0	0.0	0.0	0.0

Phase 1 Lagging

"Dummy" All Red Phase

- 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 A

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I-229 EXIT 5 (26TH STREET)
CROSSROAD CORRIDOR STUDY

Methods & Assumptions Meeting Documentation

To: Study Advisory Team (SDDOT, FHWA, HDR, City of Sioux Falls, MPO)	
From: HDR	Project: I229 Exit 5 (26th Street) Crossroad Corridor Study Project PL 0100(88) 3616 P, PCN 03KM
CC: File	
Date: April 30th, 2012 @ 8:30 A.M.	Job No: 179168

Methods and Assumptions Document

This Methods and Assumptions document was developed as a summation of the Methods and Assumptions Meeting held on April 30th, 2012 with representatives from FHWA, SDDOT, City of Sioux Falls, 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 Exit 5 (26th Street) Crossroad Corridor Study***.

1. Stakeholder Acceptance Page

"The undersigned parties concur with the Methods and Assumptions for the ***I-229 Exit 5 (26th Street) Crossroad Corridor Study*** as presented in this document.

SDDOT:

Signature

Data Analysis Engineer

Title

8-9-2012

Date

FHWA

Signature

Planning & Civil Rights Specialist

Title

8/13/12

Date

2. Introduction and Project Description

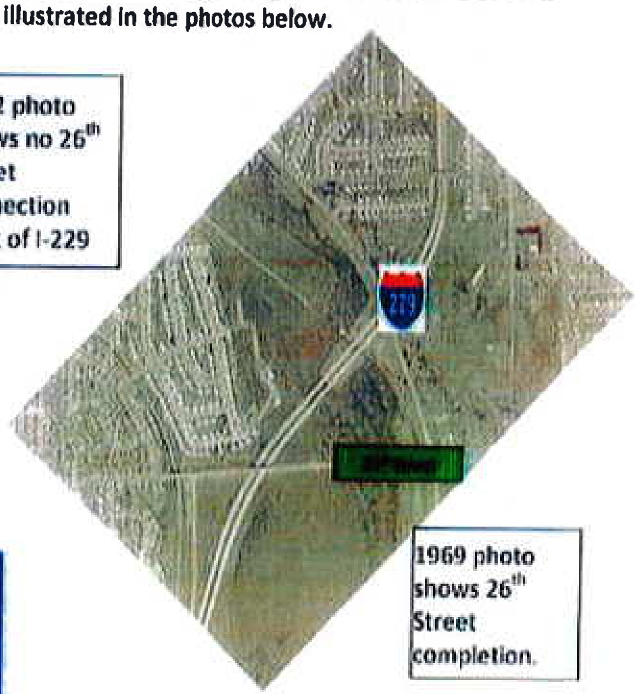
Project Background and Understanding

The area surrounding the I-229/26th Street interchange is more than just a junction of major roadways. It is a complex network of urban activity involving housing, commerce, recreation, drainage and transportation concerns. Each of these concerns is inter-related to the others – no interchange-area changes can be contemplated without considering the potential effects on the other activities.

Existing Interchange

I-229 in the vicinity of 26th Street was completed by 1962 when this location was at the fringe of development in Sioux Falls and 26th Street did not extend to the west. The 26th Street interchange was constructed several years later with completion by 1970 as illustrated in the photos below.

1962 photo shows no 26th Street connection west of I-229



1969 photo shows 26th Street completion.

1970 photo shows completed interchange

The interchange was built as a folded diamond to avoid new houses north of 26th Street and the Big Sioux River flood plain. Ramps on the west side of the interchange intersect with Yeager Road, which runs parallel to I-229, while ramps on the east side of the interchange intersect with 26th Street. Generally, the southbound ramp geometrics are short, with tight curves, although these ramps were improved as part of the 2000-2001 I-229 design-build reconstruction project. The northbound ramps, meanwhile, are more generous. The most significant characteristic of the existing interchange is the 26th Street cross-road, which has:

- insufficient width to meet peak hour demands,
- driveways close to the northbound I-229 ramp terminals,
- a nearby railroad crossing
- ramp intersections operate poorly causing long queues during the peak hours

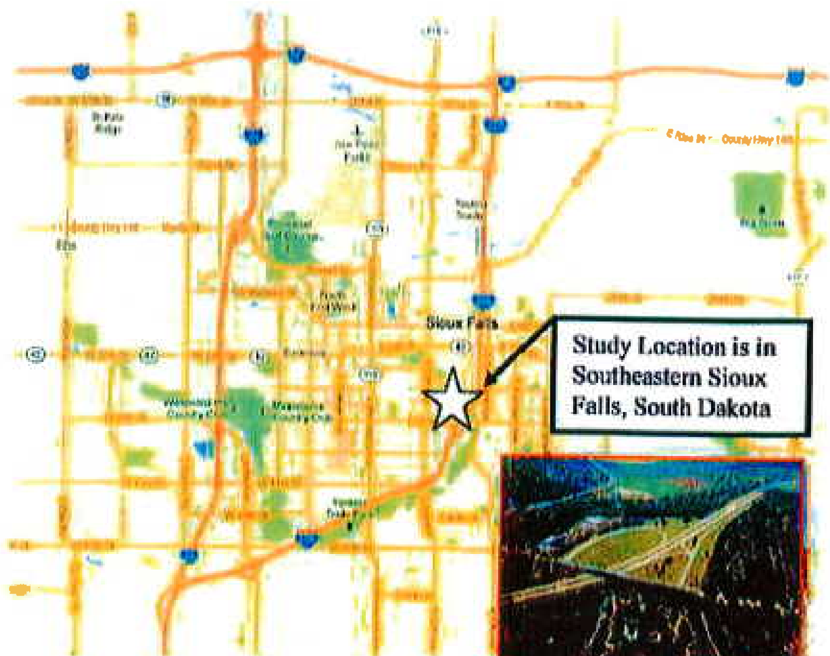
Existing 26th Street at Railroad Crossing

Any reconstruction or reconfiguration of the I-229 interchange needs to address the bottleneck conditions that occur on 26th Street during peak hours. Currently, the need for additional capacity can cause backups on the northbound off-ramp and throughout the interchange area.

Perhaps more significant, however, are the backups caused by the at-grade railroad crossing just east of the interchange. When a train stops traffic during the afternoon traffic peak, congestion can become severe.

Location

The study area is located in Southeastern Sioux Falls at the junction of I-229 and 26th Street. Cliff Avenue to the west of I-229, 26th Street, Southeastern Avenue to the east of I-229, and 10th Street approximately 1 mile north of 26th Street are all facilities that could be impacted by changes at Exit 5.



Need for Study

The study team has determined the following needs for this specific study:

- Complete a list of multi-model transportation issues and needs facing the 26th Street and Southeastern Avenue corridors within the designated limits.
- Develop feasible solutions to address those issues and needs that meet current design standards and/or traffic level of service expectations under both the current and predicted future traffic conditions while promoting a livable community that will enhance the economic and social well-being of Sioux Falls area residents and visitors.
- Review geometric interchange alternatives that meet current guidelines.
- Determine the feasibility for a grade separated railroad crossing on 26th Street over/under the BNSF track.
- Create final products for use by the City of Sioux Falls, Sioux Falls MPO and SDDOT which will provide guidance to implement recommended improvements and react to future development plans within the area.

Previous Studies

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

- 2010 Decennial Interstate Corridor Study Phases 1, 2, & 3
    - http://www.sddot.com/transportation/highways/planning/specialstudies/Default.aspx
- Sioux Falls Metropolitan Planning Organization Long Range Plan
    - http://www.siouxfallsmpo.org/LongRangeTransportationPlan.htm
- Current Statewide Long Range Transportation Plan
    - http://www.sddot.com/transportation/highways/planning/longrangeplan/Default.aspx
- Sioux Falls Trail Masterplan
    - http://www.siouxfalls.org/planning-building/planning/transportation/highlights/bicycle-planning/trail-master-plan.aspx
- SD 100 Corridor Preservation
    - http://www.sddot.com/transportation/highways/planning/specialstudies/sd100/default.aspx
- Northeast Transportation Study
    - http://www.siouxfalls.org/public-works/special-projects/ne-transportation-network.aspx
- BNSF Rail Studies (07-02-02 Benefits Study, 03-08-02 Conceptual Phasing Plan, 05-10-01 Feasibility Study)
    - http://www.siouxfalls.org/public-works/special-projects/rr-relocation-plan.aspx

Study Advisory Team Members

Study Advisory Team:

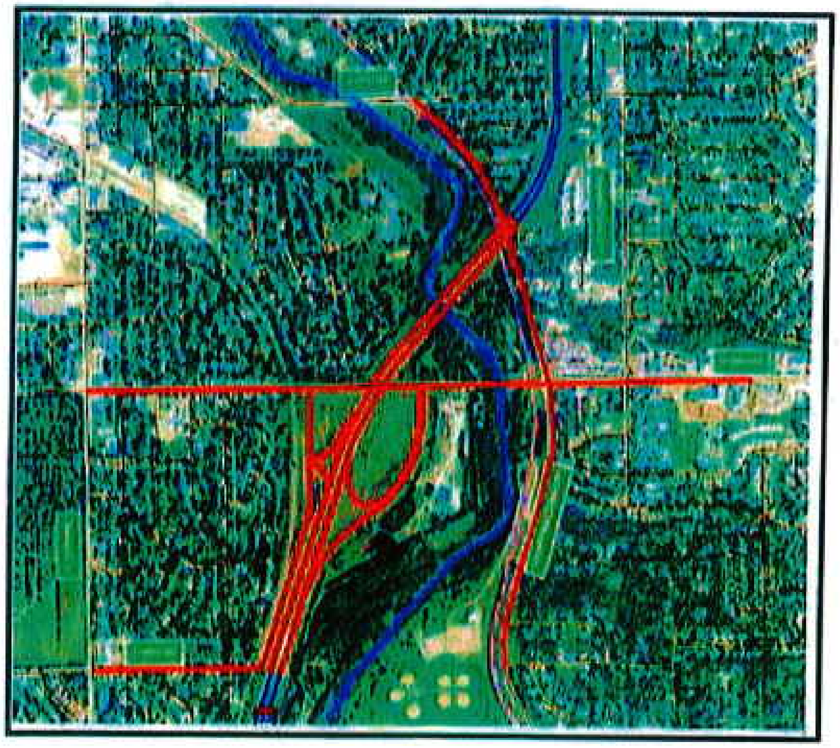
A Study Advisory Team has been formed to guide the study through completion. The Study Advisory Team is comprised of representative parties of the SDDOT, City of Sioux Falls, Sioux Falls MPO, and the FHWA. Members of the Study Advisory Team are:

Shannon Ausen	City of Sioux Falls – Engineering	Darin Johnson	SDDOT – Road Design
Jeff Brosz	SDDOT – Trans. Inv. Management	Pete Longman	SDDOT – Road Design
Amber Gibson	Sioux Falls MPO (SECOG)	Brad Remmich	SDDOT – Project Development
David Coley	SDDOT – Bridge Design	Sam Trebilcock	City of Sioux Falls – Planning
Steve Gramm	SDDOT - Project Development	Brooke White	SDDOT – Mitchell Region
Mark Hoines	FHWA		

Additional team members may be added as the study progresses.

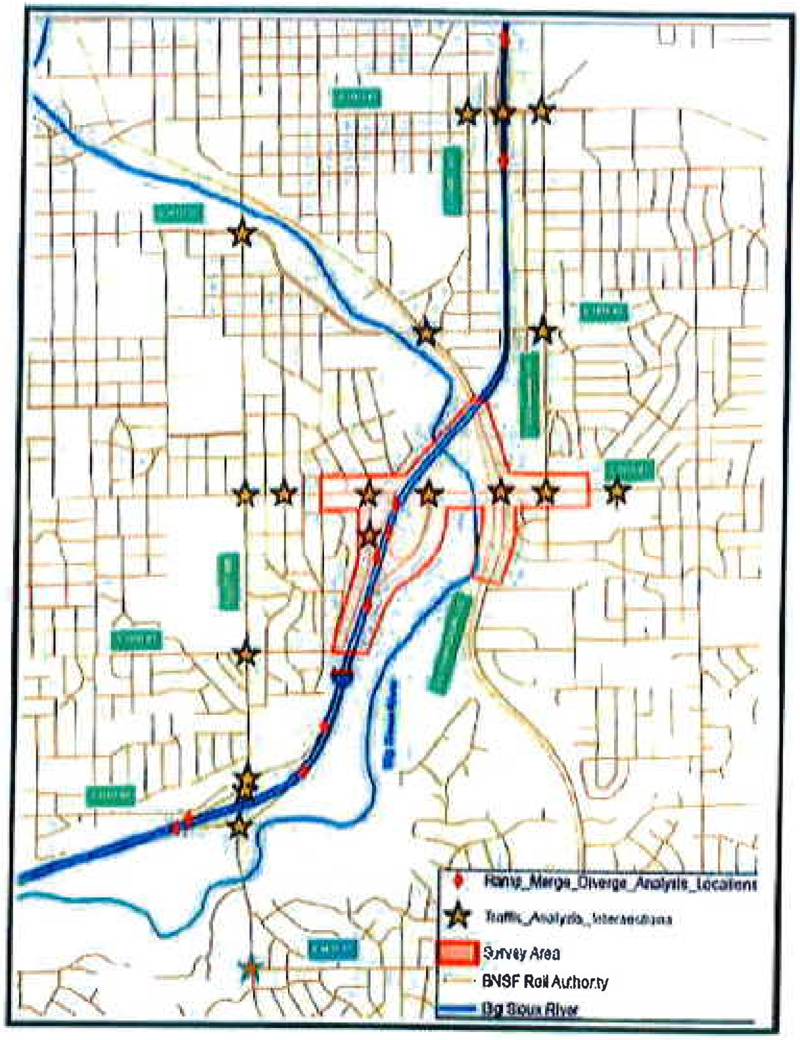
Study Complexity

This study will evaluate a variety of options for a new interchange configuration at Exit 5 along with a variety of improvements to the 26th Street and Southeastern Avenue intersection. The project is complex in that we have significant environmental constraints that exist within the study area. Each alternative evaluated will need to be reviewed for several different factors. The actual geometric possibilities are unknown at this time but will likely not involve simple geometric improvements. The graphic below illustrates the study arterial corridors that will be evaluated as part of this study:



3. Study Area

The study area was defined by the Study Advisory Team in the Request for Proposal document and is illustrated in this report for documentation. The study area is shown in pink shading on the adjacent graphic but necessary traffic evaluation is required outside of the study area for the purposes of determining the affects of the alternatives on all the adjacent arterial streets and freeway facilities.



Specific intersections evaluated as part of this study are shown for documentation purposes. The intersections and interchanges, including ramp junctions, will be evaluated to ensure we are meeting the level of service criteria discussed later within this document. Interchanges to be evaluated include the Cliff Avenue and I-229 interchange, 26th Street and I-229 interchange, and the 10th Street and I-229 interchange.

> **Traffic Analysis Intersections of Study**
>
> Both the SDDOT and the City of Sioux Falls believe intersection level of service analyses need to be conducted at certain intersections for all interchange concepts.
>
> The study will require traffic analysis at the intersections of:
>
> - E. 26th Street & S. Cliff Avenue
> - E. 26th Street & S. Van Eps Avenue
> - E. 26th Street & S. Yeager Road
> - E. 26th Street & I-229 Northbound Ramp Terminal
> - E. 26th Street & S. Southeastern Avenue
> - E. 26th Street & S. Cleveland Avenue
> - E. 26th Street & S. Village Square Circle
> - S. Yeager Road & I-229 Southbound Ramp Terminal
> - S. Cliff Avenue & E. 14th Street
> - S. Cliff Avenue & E. 33rd Street
> - S. Cliff Avenue & E. 41st Street / I-229 Southbound Off-ramp Terminal
> - S. Cliff Avenue & I-229 Southbound On-ramp Terminal
> - S. Cliff Avenue & I-229 Northbound Ramp Terminal
> - S. Cliff Avenue & E. 49th Street
> - E. 18th Street & S. Southeastern Avenue
> - E. 18th Street & S. Cleveland Avenue
> - E. 10th Street & S. Lowell Avenue
> - E. 10th Street & I-229 SPI Ramp Terminal
> - E. 10th Street & S. Cleveland Avenue

4. Analysis Years/Periods

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

Existing Conditions – Existing conditions are traffic volumes taken in the years of 2011 and 2012. Traffic data collected prior to 2011 will be utilized only if construction in Sioux Falls caused volume data in 2011 or 2012 to not be representative of the actual conditions. For existing conditions the following time periods will be evaluated:

- Existing Conditions (2012) – A.M. Peak Hour
- Existing Conditions (2012) – P.M. Peak Hour

It should be noted that the volume data will be factored to the existing conditions analysis year of 2012 and balanced. Since all data was collected during the 2011-2012 school year general smoothing procedures will likely minimize amount of factoring required.

Design Conditions – Design conditions are traffic volumes projected to the year 2035. The Travel Demand Model was calibrated and updated in 2008 to a planning horizon of 2035. The design conditions evaluated as part of this study:

- Design Conditions (2035) – A.M. Peak Hour
- Design Conditions (2035) – P.M. Peak Hour

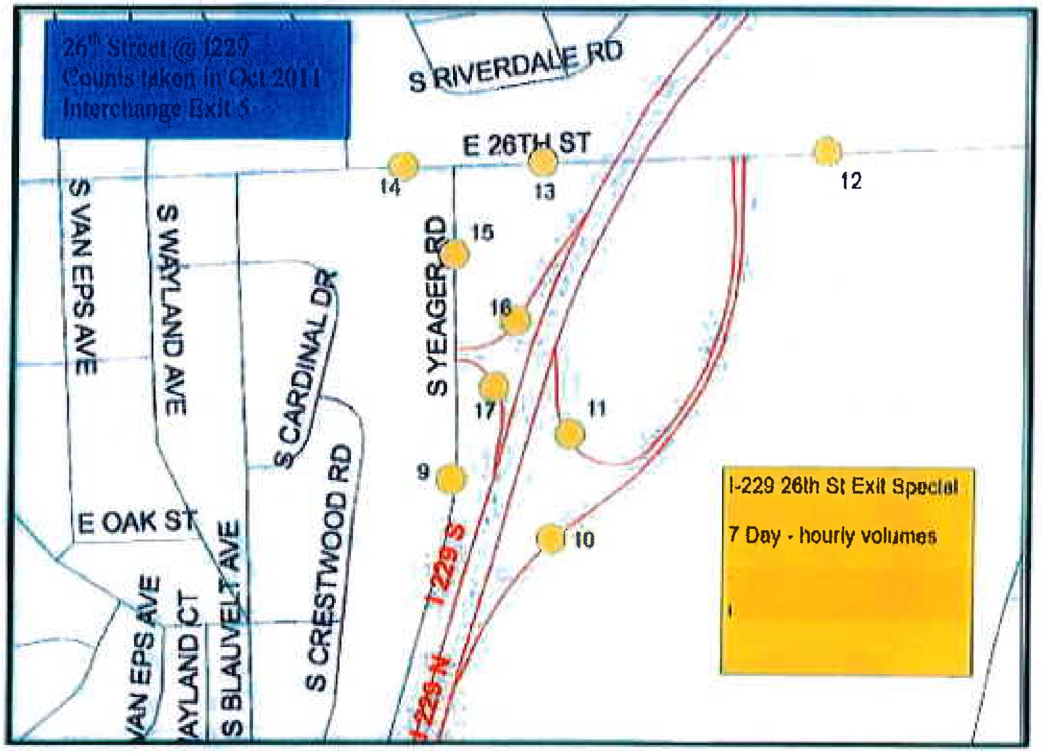
Interim Conditions – No interim conditions will be evaluated as part of this study.

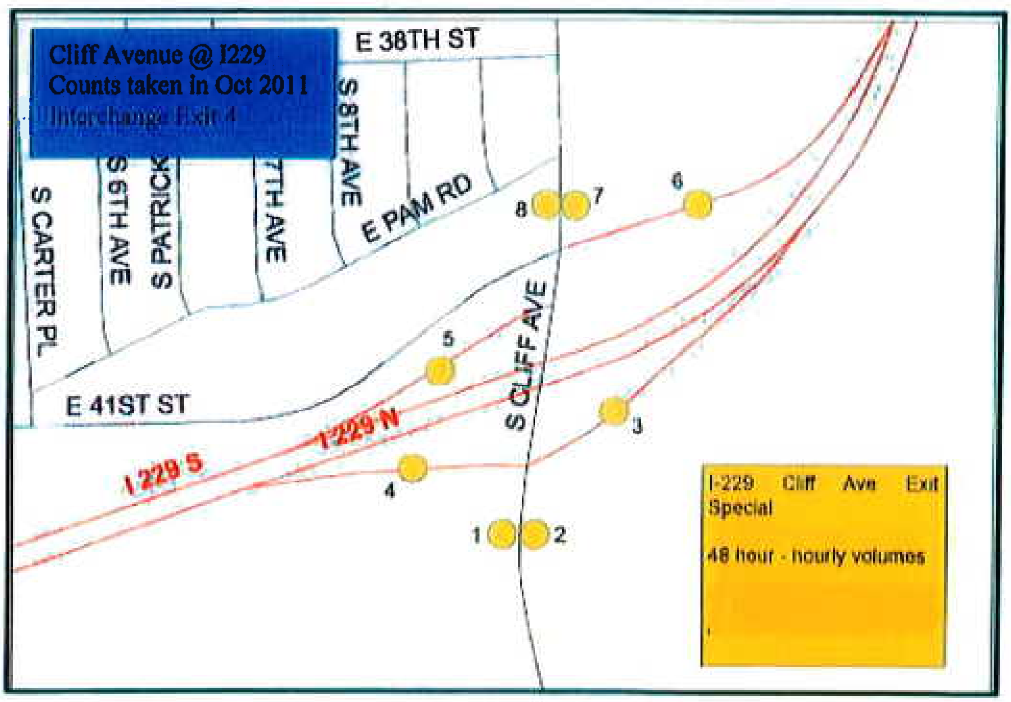
5. Data Collection

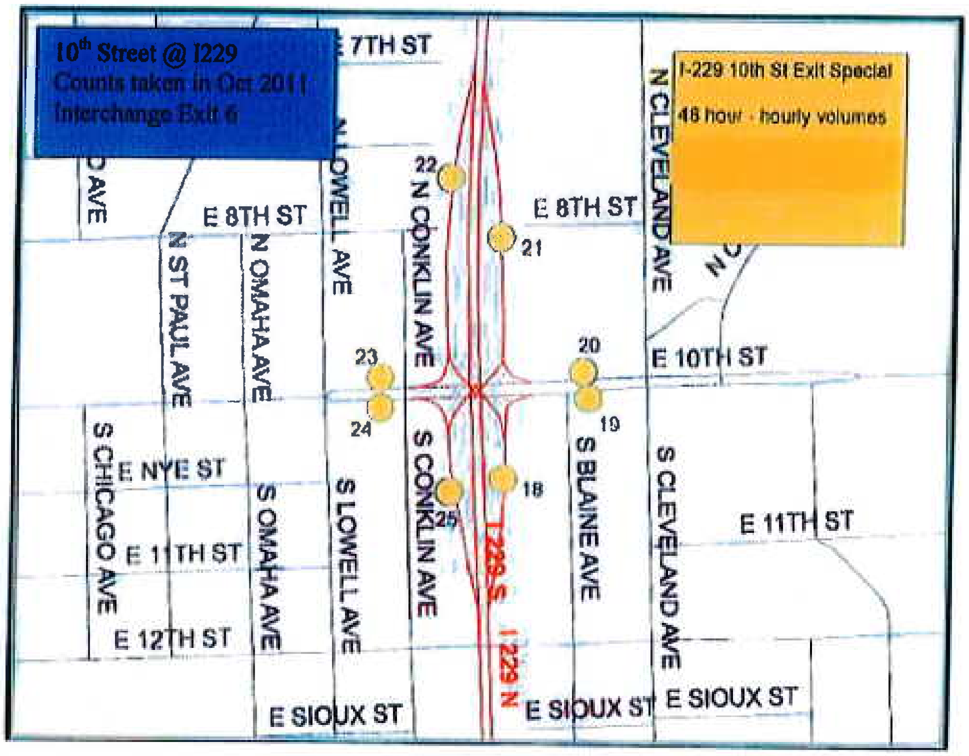
Data Collection is one of the most important items during any transportation planning study. The data collection efforts are documented below:

Existing Arterial Intersection Data – The City of Sioux Falls and HDR provided traffic data collected in either 2011 or 2012 at the study intersections. The data collected was turning movement counts defining actual traffic at the study intersections during the course of the day. The intersection count at 26th Street and Southeastern Avenue was collected using cameras to allow for use during our public involvement campaign. Since the peak hours are well defined, all traffic counts with the exception of the 26th Street Corridor were taken for a period of 15 minutes before and after the identified peak hours of 7:15 a.m. to 8:15 a.m. and 4:45 p.m. to 5:45 p.m. Counts taken on 26th Street in the afternoon began at 2:30 pm and went through 6:00 pm. The intersection of 26th Street and Southeastern Avenue was counted for a period of 12 hours. It should be noted that yearly 24 hour count data is also available for the study area arterial roadways.

Existing Freeway Ramp Traffic Data – The SDDOT provided traffic data collected at the study interchanges. The following graphics illustrate the locations of the traffic counts. All counts are hourly for periods of 24 hours or greater.



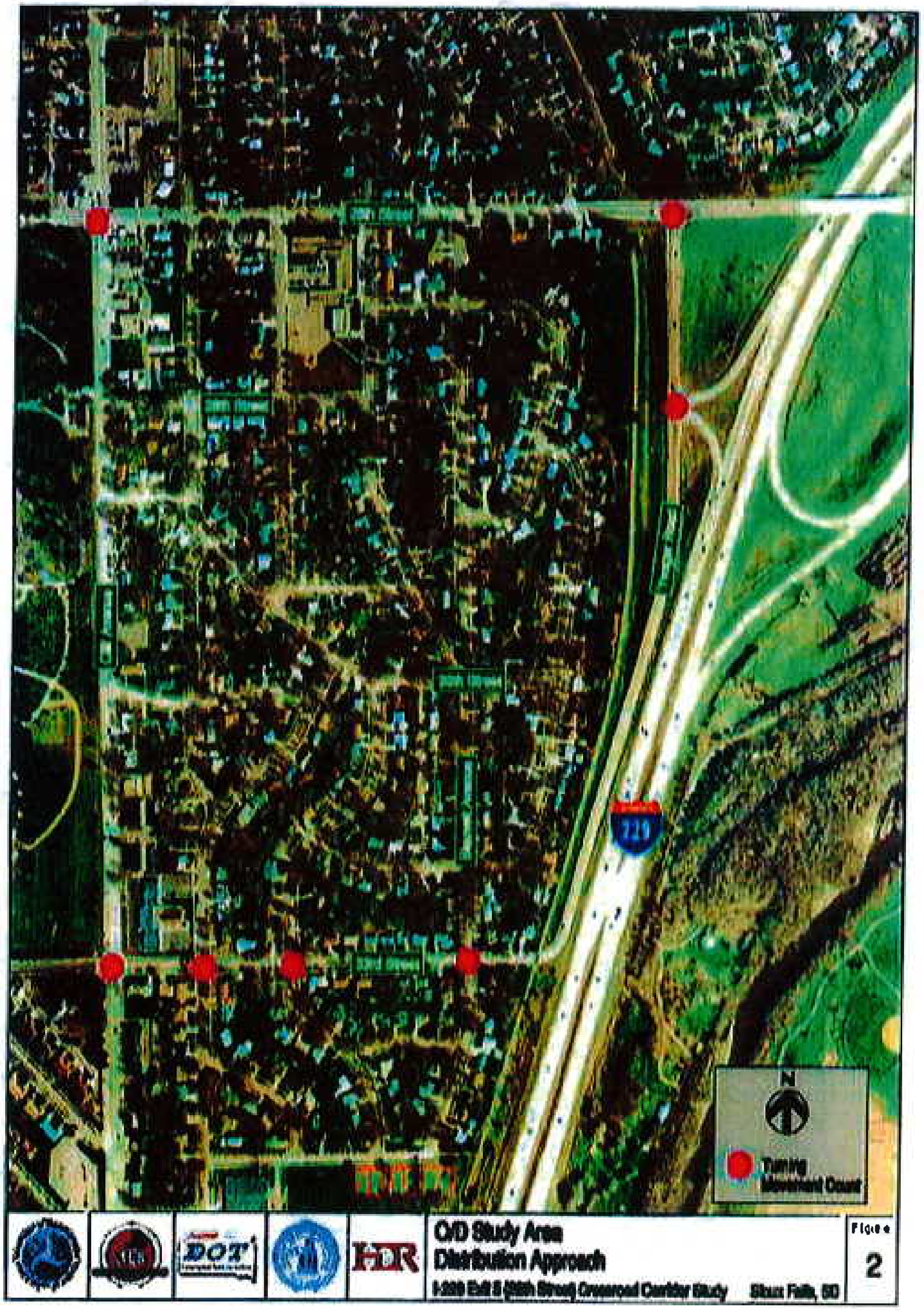




<u>Existing Freeway Traffic Data</u> – The SDDOT provided traffic data collected on the study freeway sections. The data is for the I-229 segments between Exit 3 and Exit 4, Exit 4 and Exit 5, Exit 5 and Exit 6, and Exit 6 to Exit 7. The data is hourly in increments and for periods of 24 hours or greater.

The existing traffic data will be compiled, factored (if needed due to count date), and balanced.

<u>Additional Data Collection Needed</u> – The study advisory team identified two special traffic data collection studies to be done. The first study consisted of collecting turning movement counts for a 24 hour period. The data was processed to intervals of 15 minutes. The study was completed the week of April 16th, 2012 using Miovision cameras. This study was conducted to be able to better determine traffic patterns within the study area for the Yeager Road evaluation component of the study. The intersections counted as part of this study are shown in the graphic.



The second special study was completed to help determine the interaction between the I229 northbound/southbound off/on ramp terminal with 26th Street and the 26th Street and Southeastern Avenue intersection. This study was a small version of an Origin / Destination study and it was conducted using infrared cameras that captured the license plate information so the data could be evaluated to determine traffic patterns. The study location is shown on the graphic below and was completed the week of April 23rd, 2012.

Data Collection Techniques – All data was collected using standard field practices which consisted of using cameras, digital count boards, and tube counters.

6. Traffic Operations Analysis

Traffic Operations Analysis

i. Software Discussion
   1. Uncontrolled or Signalized Intersections
      a. HCS Version 6.3 and Synchro Version 8 by Trafficware (2010 HCM Methodology)
         i. Synchro Version 8 will be utilized to evaluate all signalized intersections within the study corridor except along 26th Street from Cliff Avenue to Village Square Circle, it was agreed that HCS "Streets Module" will be used for that segment of the study.
         ii. HCS Release 6.3 (or current release) Streets module will be used to evaluate the 26th Street Corridor from Cliff Avenue to Village Square Circle. Arrival Type 4 will be used to represent the platooning of the corridor per the SDDOT Design Manual.
   2. Freeway Segments, Weave Segments, & Ramp Junctions
      a. HCS Release 6.3 (2010 HCM Methodology)
   3. Interchange Ramp Intersections
      a. HCS has a planned release to include interchanges and intersections at Ramp Terminals for August 2012. HDR will utilize the software when it becomes available.

ii. Operational Analysis Assumptions or Variables
   1. Level of Service (LOS)
      a. Signalized intersections
         i. Minimum Allowable LOS – C
            1. Individual movements will be allowed to operate at LOS "D" but the overall intersection LOS shall be "C" or better.
      b. Freeway Segments, Weave Segments (if any), Ramp Junctions, and Ramp Terminals
         i. Minimum Allowable LOS – C

iii. Variables
   1. Peak Hour Factor (PHF)
      a. Existing conditions analysis to use calculated PHF
      b. Design year conditions analysis to use PHF of 0.90
         i. City Traffic Engineering Staff would support 0.90 due to understanding of study area
   2. Saturation Flow Rate
      a. SDDOT Design Manual (Page 24, Chapter 15) requires the use of 1800 vph in Sioux Falls based on a local study. Additional studies completed in smaller communities in South Dakota would also support this value.
   3. Traffic Signal Controllers

a. Arterial / Arterial Intersections - Operational Analysis should allow for both actuated and coordinated controllers
b. Arterial / Collector Intersection – Semi-actuation with coordination option

4. Left-Turn Phasing
   a. Permitted / Protected or Split Phasing will be allowed at Arterial / Arterial Intersections
5. Lane Utilization Factors
   a. Default HCM Factors to be used
6. Heavy Vehicle Percentage
   a. I-229 – HDR will collect data to develop the HVP for this study
   b. 26th Street - HDR will collect data to develop the HVP for this study
7. Phase Change Intervals
   a. Minimum All red Clearance Interval
      i. Thru vehicles – 1 sec all red
      ii. Protected lefts – 1 sec all red
      iii. Protected/Permitted –1 sec all red
   b. Minimum Yellow Clearance Interval
      i. Clearance intervals for intersections warranting improvements will be based on standard ITE procedures for determining clearance intervals.
8. Posted Speed
   a. Arterials – when using the HSC Streets Module the input parameters are FFS (unsaturated conditions) speed and the speed limit. Use 3 mph above the posted speed for the FFS.

   b. Freeway – SDDOT Mitchell Region traffic engineer completed a speed study on I-229 between Cliff Avenue and 10th Street. The results of the study when averaged would indicate that the average speed is 63 mph with an 85th percentile speed of 66 mph. The average speed will be used when evaluating freeway segments, ramp junctions, and merge areas.

iv. Micro-simulation

Micro-Simulation will not be done on this project - it was agreed upon by the study team that micro-simulation is not required for the purposes of this study since probable concepts can be evaluated using conventional traffic assessment methodology. If geometric concepts are derived during the course of the study that requires the use of micro-simulation, the M & A document will be amended on how to handle those specific instances.

7. Travel Forecast

Travel Demand Model

i. The Sioux Falls MPO Travel Demand Model (TDM) will be utilized for the purposes of this corridor study
   1. The TDM was created using Citilabs software CUBE VOYAGER.
   2. Model was calibrated and verified in 2008 by MPO travel demand model consultant William G. Allen. Calibrated year for forecasting purposes is 2008. The *Sioux Falls Travel Forecasting Model Update 2009* report provides insight on the calibration techniques used and there compliance with Federal procedures.
   3. Model build year is 2035 to match the long range plan.
      a. Travel Demand Model Forecasts include:
         i. All projects currently in the CIP, STIP, and TIP
         ii. All fiscally constrained projects in the Sioux Falls MPO Long Range Plan
      b. No Model update is currently scheduled until 2014.

ii. Study Forecasting Methodology
   1. Obtain existing traffic data for the study area freeway segments and intersections, this information shall include ADT volumes.
   2. Identify A.M. and P.M. peak hour volumes for the area freeway segments and intersections.
   3. Develop "K" factors for the A.M. and P.M. peak periods
   4. Obtain 2008 calibrated Model from City Staff
      a. Generate A.M. Peak 2 hour run file
         i. Develop A.M. peak hour link volume by multiplying 2 hour data by the appropriate factor (0.58 is the appropriate factor)
      b. Generate P.M. Peak 2 hour run file
         i. Develop P.M. peak hour link volume by multiplying 2 hour data by the appropriate factor (0.55 is the appropriate factor)
      c. Generate 24 hour run file
   5. Obtain 2035 calibrated Model from City Staff
      a. Generate A.M. Peak 2 hour run file
         i. Develop A.M. peak hour link volume by multiplying 2 hour data by the appropriate factor (0.58 is the appropriate factor, factor determined by dividing peak hour volume into peak two hour volume in the calibrated model)
      b. Generate P.M. Peak 2 hour run file
         i. Develop P.M. peak hour link volume by multiplying 2 hour data by the appropriate factor (0.55 is the appropriate factor, factor determined by dividing peak hour volume into peak two hour volume in the calibrated model)
      c. Generate 24 hour run file

6. Develop a growth rate from the 2008 and 2035 models. If the 2012 volumes differ greatly than what the model trend line would indicate for 2012, then the 2035 link volumes should be adjusted accordingly to provide the best representative design volumes. Example spreadsheet shown below.

Road	Location	2008 Model ADT	2035 Model ADT	Annual Growth Rate	2010 Calculated "Model" ADT	2010 Actual ADT	ADT Absolute Deviation	ADT Percent Deviation	ADT Absolute Method	ADT Percent Method	2035 Adjusted Model ADT	Model Ratio	Adjusted Ratio	[illegible] Annual Growth Rate
41st Street	East of Sertoma Eastbound Westbound	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sertoma Avenue	North of 41st Street Northbound Southbound	8150	14023	2.00%	10140	9100	-1040	11%	15800	14730	15170	1.7[illegible]	1.87	2.07%
Sertoma Avenue	South of 41st Street Northbound Southbound	8730	[illegible]	[illegible]	[illegible]	[illegible]	150	-2%	16100	14230	15170	1.92[illegible]	[illegible]	[illegible]
41st Street	Bet Sertoma and Grinnell Eastbound Westbound	2640	14438	6.31%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.0[illegible]	[illegible]	[illegible]
Grinnell Avenue	North of 41st Street Northbound Southbound	100	8382	16.63%	140	1800	1660	-92%	4000	17230	6382	83.82	[illegible]	[illegible]
Grinnell Avenue	South of 41st Street Northbound Southbound	100	3477	14.06%	130	100	-30	30%	3400	3430	3477	34.77	[illegible]	[illegible]
41st Street	Bet Grinnell and Tea Ellis Eastbound Westbound	2540	13820	6.09%	3190	7100	3910	-66%	17400	20960	17400	4.76373234	2.45	3.65%
Tea Ellis	North of 41st Street Northbound Southbound	3100	22900	7.66%	3690	5200	1530	-29%	24500	29880	24500	7.22264181	4.71	6.40%
Tea Ellis	South of 41st Street Northbound Southbound	2930	25618	8.36%	3430	4000	570	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.61	[illegible]
41st Street	West of Tea Ellis Eastbound Westbound	960	7100	7.68%	1130	5800	4668	-80%	11800	17980	11800	7.34400[illegible]	2.05	2.92%

7. Using existing turning movement percentages from data collected and model distribution, develop design (2035) turning movement volumes for the purposes of intersection evaluation. If needed, smooth out forecasts to balance network.
8. Complete needed evaluation on design (2035) volumes calculated.

8. Safety Issues

It was determined during our Study Advisory Team Meeting on April 24th, 2012 that crash data would be analyzed for the years 2008 to 2011. The SDDOT provided their accident database to be utilized for the study. To be consistent through the corridor study, the SDDOT's database will be the only database used in the calculation of crash rates and critical crash rates. Although SDDOT data will be the main data analyzed, City of Sioux Falls is providing their database as well. That information will be filtered only to determine if that additional data from the City will provide insight on existing safety concerns. If City data is determined pertinent, it will be covered in the text of the study document. The following information will be provided as a result of the crash analysis:

- Segment and Intersection Crash Rates
- Segment and Intersection Critical Crash Rates
- Accident trends identified
- Potential Mitigation efforts if rates are determined to be critical

9. Selection of Measures of Effectiveness (MOE)

The main goal of this corridor study is as follows:

- *Develop feasible solutions to address those issues and needs that meet current design standards and/or traffic level of service expectations under both the current and predicated future traffic conditions while promoting a livable community that will enhance the economic and social well-being of Sioux Falls area residents and visitors.*

[redacted]

- Signalized Intersections: **LEVEL OF SERVICE** and **INDIVDUAL MOVEMENT DELAY**
- Freeway Segments, Ramp Junctions, and Merge Areas: **LEVEL OF SERVICE**
- Arterial Corridor Segments along 26th Street: **LEVEL OF SERVICE, SPEED,** and **DELAY**
- Ramp Terminal Intersections: **LEVEL OF SERVICE** and **INDIVIDUAL MOVEMENT DELAY**

It is understood that all traffic analysis reporting will be completed using 2010 HCM Methodology.

10. Deviations/Justifications

All deviations to traffic assessment parameters discussed previously will guide the traffic assessment, currently no other deviations are anticipated. If it is determined during the study that deviations are required, the methods and assumptions document will be amended prior to proceeding.

11. Conclusion

All sections contained in this document will guide the traffic data collection and traffic assessment for this corridor study. If it is determined during the study that deviations are required to any of the sections included in this document, the document will be amended prior to proceeding.

12. Appendices

The appendix includes the following:

- Methods and Assumptions Study Team Meeting Minutes

Appendix

4/30/12 M & A Meeting Minutes (Meeting #1)

7/09/12 M & A Meeting Minutes (Meeting #2)

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M & A Meeting Notes

Subject: I229 26th Street (Exit 5) Crossroad Corridor Study – Methods and Assumptions Meeting	
Client: SDDOT / City of Sioux Falls	
Project: I229 26th Street (Exit 5) Crossroad Corridor Study	Project No: 179168
Meeting Date: April 30th, 2012	Meeting Location: SDDOT Area Office Conference Room B
Notes by: HDR	

Attendees:

HDR – Jason Kjenstad, Rick Laughlin, James Unruh, and Steve Speth

SDDOT – Steve Gramm, Brad Remmich, Jeff Brosz, Pete Longman, Dan Martel

FHWA – Mark Hoines

City of Sioux Falls – Shannon Ausen, Sam Trebilcock

SECOG – Amber Gibson

Topics Discussed: On April 30th, 2012 the I229 Exit 5 (26th Street) Crossroad Corridor Study team (HDR, SDDOT, FHWA, City of Sioux Falls, SECOG) met to discuss the "Methods and Assumptions" the study consultant was considering for the data collection, traffic assessment, and micro-simulation portion of this study. This meeting was not originally identified in the scope of work but was considered crucial to the overall success of the project to ensure all parties involved are in agreement on how the study tasks are to be completed. HDR understands that the approval of the "Methods and Assumptions" document will signify that all members of the study team are in agreement to proceed.

HDR prepared the "Methods and Assumption" document for this study based on the standard template provide by SDDOT, the draft version of the document was submitted to group 04/27/12. On April 30th, 2012 the study team assembled to discuss the document in detail, the following notes were derived from the discussions. HDR would like to note that the discussions were very beneficial and this process was believed to be a necessity for future planning studies.

Notes: (all page number references below are for original document submitted)

Section 1 (Page 1) – Stakeholder Page – Remove statement under Stakeholder Acceptance Page – that information can be deleted once M & A document is formatted.

Section 2 (Pages 2 – 5) – Project Background – general discussion but no major adjustments to this section. Sam and Shannon indicated that additional studies should be included under the heading **Previous Studies**. The added studies are as follows:

Sioux Falls Trails Masterplan
http://www.siouxfalls.org/planning-building/planning/transportation/highlights/bicycle-planning/trail-master-plan.aspx

Northeast Transportation Study
http://www.siouxfalls.org/public-works/special-projects/ne-transportation-network.aspx

SD 100 Corridor Preservation
http://www.sddot.com/transportation/highways/planning/specialstudies/sd100/default.aspx

BNSF Rail Studies
http://www.siouxfalls.org/public-works/special-projects/rr-relocation-plan.aspx

Section 3 (Pages 6 – 7) – Study Area – general discussion but no major comments or concerns on this section.

Section 4 (Pages 7) – Analysis Years / Periods – no comments

Section 5 (Pages 8 – 13) – Data Collection – Under **Existing Arterial Intersection Data** it was agreed upon by the group that all intersection turning movement counts should be retaken if they were not completed in 2011 or 2012. HDR and City staff to determined who will complete the counts and at which locations (a follow-up meeting was held and City staff agreed to count 14 of the 16 intersections and HDR would count the remaining 2 intersections – all the counts were completed prior to May 11th, 2012). A sentence was added under this section to indicate counts on 26th Street would begin at 2:30 p.m. to in lieu of 4:30 pm. It should be noted that no new pedestrian counts will be taken. Current data is from 2008/2009 and it was agreed upon by all parties that they can be used as needed. Under the heading **Existing Freeway Ramp Traffic Data** HDR discussed the counts taken by SDDOT, only comment was that the counts were provided in hour intervals versus in 15 minute intervals. SDDOT should consider on future studies to record at intervals of 15 minutes for comparison with the arterial turning movement counts. No further data collection is necessary. Under the heading **Additional Data Collection Needed** HDR discussed that the data was collected during the weeks of April 16th and April 24th, 2012. The counts were completed as discussed during the scoping phase of this study.

Section 6 (Pages 13 – 16) – Traffic Operations Analysis – Under Traffic Operations Analysis the follow decisions were agreed upon: Under i. Software Discussion for Uncontrolled or Signalized Intersections – HDR will use Synchro Version 8 by Trafficware (2010 HCM Methodology); for Freeways and Ramps HCS Release 6.3 will be used.

Under ii. Operational Analysis Assumptions or Variables – The minimum allowable composite Level of Service (LOS) for a signalized intersection in a build condition shall be "C" although individual lane movements can operate at LOS "D".

Under iii. Variables - the following discussion took place:

1. Design year PHF shall not be higher than 0.90 as recommended by SDDOT quoting a previous version of the HCM (follow-up discussion with the City of Sioux Falls traffic engineer indicated that corridors experiencing high PHF's under existing conditions will likely see the PHF's grow as the corridors see additional traffic, for this study area a design year (2035) PHF of 0.90 is certainly within reason).
2. The saturation flowrate used for this study will be 1800 vph unless a study area rate can be calculated. (Follow-Up discussion with City Traffic Engineer Heath H. indicated that he is going to have his new assistant starting in May and if time allows he will have him complete a site study to determine if the saturation flowrate can be adjusted from 1800 vph; if a site study is completed the results will be included in the Appendix of the corridor study as documentation as to why the rate varied from 1800 vph).
3. **Heavy Vehicle Percentage** – HDR will complete sample studies during the peak hours for I229, Cliff Avenue, 10th Street, Southeastern Avenue, and 26th Street to determine an appropriate HVP. A brief memo will be completed and included in the appendix of the corridor study report. Additional data will be gathered for the purposes of the noise study as well.
4. **Phase Change Intervals** – City requested Protected/Permitted to have a 1 second all red interval, the other factors seemed reasonable to the group but the intersections of 26th/Cliff, I229/Yeager, I229/Northbound Ramp, and 26th/Southeastern Avenue should be evaluated per the manual to determine the correct yellow clearance interval.
5. **Speeds** – posted speeds will be used for the purposes of the study (Follow-up discussion with city traffic Engineer indicated speeds are typically 2-4 miles per hour below the posted limit during the peak hours and 2-4 miles per hour above during the non-peak hours when free flow conditions are observed. Heath indicated that if time allows he will provide some travel time run data using "tru-traffic", if that information becomes available to HDR then we will document it in the appendix and use the information to better calibrate our Synchro model.
6. Arrival Type – since HDR will be using Synchro the arrival type is chosen based on the lane geometry, in HCS the arrival type for an arterial would be 4.

Under iv. Micro-simulation – delete this section of the M & A document, animations will be completed without the use of Vissim. It was agreed upon by the study team that micro-simulation is not required for the purposes of this study since probable concepts can be evaluated using conventional standard methodology. If geometric concepts are derived during the course of the study that requires the use of micro-simulation, the M & A document will be amended on how to handle those specific instances.

Section 7 (17 – 18) – Travel Demand Model Discussions

1. It was determined that the travel demand model design year files shall include all projects in the CIP, STIP, and TIP and shall also include fiscally constrained project in the Long Range Plan. This includes earmarks as indicated on page 15 of the Long Range Plan Appendix attached to these notes. The next model update will likely be in 2014/2015 so it will not conflict with this study timeline.

2. Under II. Items 4 & 5 – use 0.55 in lieu of 0.68 for the PM peak hour
3. Under II Item 6 & 7 – delete item 6 & 7 as we will use the A.M. and P.M. model runs instead of the 24 hour file to develop the peak hour intersection volumes.

Section 8 (18) – Safety – general discussion with no changes

Section 9 (19) – Measures of Effectiveness (MOE) – general discussions favored the use of LOS but it was agreed upon to add in delay and v/c as needed to be able to provide a level of difference for intersections that operate at D, E, or F.

Section 10 (19) – Deviations / Justifications – a general sentence was added indicating that the document provides insight to the parameters agreed upon by the group and any changes would require an amendment to the document..

Section 11 (19) – Conclusion – a general statement was added indicating that the sections discussed in the M & A document will be the basis for the traffic assessment for this study, changes to the agreed upon processes will require an amendment to the document.

Section 12 (19) – Appendices - The M & A meeting minutes are included as an appendix item to document the discussions and decisions.

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M & A Meeting Notes

Subject: I229 26th Street (Exit 5) Crossroad Corridor Study – Methods and Assumptions Meeting #2	
Client: SDDOT / City of Sioux Falls	
Project: I229 Exit 5 (26th Street) Crossroad Corridor Study	Project No: 179168
Meeting Date: July 9th, 2012 via Conf. Call	Meeting Location: Conference Call
Notes by: HDR	

Attendees:

HDR – Jason Kjenstad, Rick Laughlin, and Steve Speth

SDDOT – Steve Gramm, Brad Remmich, Jeff Brosz, Pete Longman, Dan Martel

FHWA – Mark Hoines, Ron Mcmahon, Tran Chung

City of Sioux Falls – Shannon Ausen

Topics Discussed: The goal of the conference call was to discuss comments made by FHWA Regional Resource Center and SDDOT staff regarding the Methods and Assumptions Document prepared for the I229 Exit 5 (26th Street) Crossroad Corridor Study.

HDR prepared the "Methods and Assumption" document for this study based on the standard template provide by SDDOT, the draft version of the document was submitted to group 04/27/12. On April 30th, 2012 the study team assembled to discuss the document in detail. Since April 30th several comments have been provided to HDR regarding the document, the following list represents the status of the document as we have moved along with this study:

a. M & A Meeting held April 30th, 2012 with team members, HDR provided draft document for discussion
b. Several study members attended FHWA training in Pierre on May 2nd and 3rd, training discussed tools available for traffic assessment on projects such like this
c. DOT and FHWA met to further discuss requirements for corridor studies and interchange studies
d. May 29th, 2012 HDR submitted a revised M & A document for further review by Study Team
e. SDDOT completed review on June 6th and provided additional comments
f. Updates were made by HDR and provided back the SDDOT, SDDOT provided to FHWA for review, comments returned from FHWA Resource Center on June 19th, 2012 via email
g. June 22nd, 2012 HDR responded to the comments provided by the FHWA resource center
h. June 26th, 2012 a follow-up responses were provided by the FHWA resource center
i. June 29th, 2012 HDR provided follow-up discussion to the responses from FHWA
j. July 3rd, 2012 – SDDOT began coordinating today's conference call to discuss next steps; HDR also provided the O/D information gained from the License Plate study for the segment of 26th Street between the interchange and Southeastern Avenue.

During the July 9th Conference Call the Comments provided by the Regional Resource Center were discussed and a direction to move forward was agreed upon and the M & A document was updated. The following questions shown on the next two pages were discussed, the agreed upon direction is noted following the questions starting on page 4.

Comments from FHWA regional resource center, with HDR responses:

1. **Based on the good data collection here, I would recommend that a balanced traffic map be developed for the study area to ensure what comes out of one intersection goes into the next. This is required for the 2010 arterial analysis.**

   A balanced traffic map and analysis will be prepared as part of the study, since all volumes were taken in roughly the same school year general smoothing procedures will allow for a balanced network. Synchro can display the link volumes to check our manual balancing procedures to ensure volumes are balanced.

2. **How will Synchro version 8 treats interchange ramp terminals? Will they follow the methodology defined by the HCM 2010?**

   Interchange analysis (Ramp Terminal) is not yet available in HCS. Ramp termini will be analyzed as signalized intersections for the purposes of this study. Synchro software will be used to apply HCM procedures.

3. **When LOS "D" is reached, will we be able to understand the impact to adjacent Intersections based on the methodology defined by the Urban Street Chapter of the 2010 HCM?**

   It was HDR's intent to analyze arterial streets within the study area using Synchro. Intersection pedestrian and bike reports are also available in Synchro and impacts will be documented. The use of HCS software was not anticipated for the arterial evaluation. Standard procedures of reviewing the individual lane movement LOS at the intersections (along with queues) and reviewing time-space diagrams to check for blocking at intersections will provide the study team with an accurate depiction of how the arterial corridor is reacting to the recommended improvements.

4. **What about weave sections? if any.**

   Weaving segments would only take place between Cliff Avenue and 26th Street on I-229 due to the geometrics in our study area, HDR will calculate L(max) using equation 12-4 of the HCM manual to determine whether a weave analysis is required in that segment, if it is the LOS determined will be documented.

5. **Have you look at the default value of HCM for pop less than 200K?**

   The saturation flowrate proposed was based on a study completed in Sioux Falls, although several years old both HDR and City traffic engineering staff believe it is appropriate. HDR will not be using default values from HCM for this study.

6. **This should be based on ITE standard.**

   The City of Sioux Falls has provided signal timings for all existing intersections within the study area; HDR will only adjust the clearance intervals for intersections that are being studied for reconstruction which would include the following intersections along 26th Street:
   - *26th Street and Cliff Avenue*
   - *26th Street and Yeager Rd(Southbound on/off Ramp to I-229)*
   - *26th Street and Northbound on/off Ramp to I-229*
   - *26th Street and Southeastern Avenue*

- *26th Street and Cleveland Avenue*

The ITE formula will be utilized for the calculation of the clearance intervals for the intersections being evaluated for reconstruction.

Intersections that are not being studied for reconstruction but are within the study boundary will be analyzed under 2035 volumes and the LOS will be reported. Although these intersections will be optimized, clearance intervals will be locked and will stay as they currently are in the controllers.

7. **Should this be calculated based on intersection width, and ITE formula?**

   See response #6.

8. **Do take into consideration for reduction due to posted speed versus measured speed.**

   City traffic engineering and HDR staff believes the use of the posted speed for the I-229 corridor is acceptable for the freeway segment between 26th Street and Cliff Avenue on I-229. The posted speed of 65 mph is generally both your traveling speed and following speed during the peak hours as congestion is mostly noticed only during a traffic incident or when construction projects displace traffic creating non-standard delays. From 26th Street to 10th Street along I-229 horizontal curve constraints reduce the speed to approximately 3 mph below the speed limit per direction from the City Traffic engineer.

9. **Not sure of this section, since you are not requiring it.**

   Originally the use of micro-simulation was going to be used for public involvement purposes. It was later discussed and determined that the public involvement campaign for this project really needs to focus on the geometric improvements and how they affect the adjacent land and business owners. This section will be removed from the document.

10. **How will you calibrate if you are just building a future year model?**

    The discussion under the Micro-simulation section of this report identified our approach for building the simulation model; the narrative reviews our approach to constructing the existing conditions model for the purposes of calibration and assessment. It was always the intent to construct an existing conditions model as described. This section however is being removed from the document since simulation will not be utilized.

11. **Where was this derived from? same with .55**

    These factors have been determined based on the ratios of the one-hour volumes to the two-hour volumes in the calibrated model.

Discussion of Questions noted below

Question 1: No further discussion, previous response is adequate.

Question 2: FHWA indicated that HCS will be releasing the upgrades to the "Streets Module" that will include the 2010 Methodology for evaluating ramp terminal intersections in August 2012. HDR will use the module when released and will not be using Synchro to evaluate ramp terminal intersections.

Question 3: FHWA and SDDOT traffic engineers would like HDR to use HCS to evaluate the 26th Street Corridor using the "Streets Module" rather than Synchro since the Arterial Level of Service report in Synchro is not per the 2010 methodology.

Question 4: No further discussion, previous response is adequate.

Question 5: The HCM would recommend that if you don't have locally collected data to use 1700 vpd for the saturation flow rate in community's less than 200k people. It was agreed that 1800 vpd would be used and is representative in Sioux Falls.

Question 6: No further discussion, previous response is adequate.

Question 7: No further discussion, previous response is adequate.

Question 8: It was discussed that since we are using the "Streets" module in HCS that we would use 3 mph above the speed limit to represent the FFS during unsaturated conditions on the 26th Street arterial corridor. For I229, SDDOT provided speed study information after the meeting indicating that the average speed within the study area on I229 is 63 mph with an 85th percentile speed of 66 mph. The speeds were derived from information provided by Scott J. (Mitchell Region Traffic Engineer).

Question 9: No further discussion, previous response is adequate.

Question 10: No further discussion, previous response is adequate.

Question 11: No further discussion, previous response is adequate.

Conclusion

The M & A document has been updated to reflect the discussion that took place during this meeting.

Location	Ave	85th %	Location Description
1.	64	67	
2.	64	67	I-229 NB MRM 4.5
3.	63	67.5	I-229 SB MRM 5.5
4.	62	65.0	I-229 NB MRM 6.5
5.	63	67.5	I-90 WB MRM 399.5
6.	68	71.8	I-90
7.	63	67	I-29 SB MRM ~~[illegible]~~ 83
8.	65	68	I-29 NB MRM 76
9.	65	69	I-29 SB MRM 75
	64.1	67.8	

I-229/26th Street Interchange Modification Justification Report

APPENDIX

PART 7

Option 7a SW & SE Quadrant Loop Design Analysis Memo

(Includes Attachment A)

HDR | ONE COMPANY *Many Solutions*℠

Memo

To:	Steve Gramm, SDDOT
From:	HDR Project: I-229 Exit 5 (26th Street) Interchange Environmental Assessment IM-PH 2292(06)5 P; PCN 4778
CC:	Mark Hoines, FHWA; Shannon Ausen, City of Sioux Falls
Date:	April 18, 2014; revised 8/26/14 Job 179168

RE: Interchange Loop Design Analysis

1. Purpose

Regarding interchange loop design, the SDDOT Road Design Manual states:

> *A design speed of 30 mph is preferred for loop ramps. A lower design speed may be used, but must be approved by the Chief Road Design Engineer. A corresponding radius that meets or exceeds the design speed should be selected based on balancing the needs for traffic and impacts to the surrounding properties. Where right of way costs are high (urban) a smaller radius may be selected.* (SDDOT Road Design Manual page 13-13).

The existing and proposed loops for the I-229 Exit 5 (26th Street) interchange improvement project do not provide the preferred loop design speed. SDDOT has decided to prepare a formal Design Exception for the proposed loops to allow for FHWA approval. This memo is intended to provide the data necessary for SDDOT to complete the design exception (C2C) application.

2. Southeast Quadrant Loop

The existing 26th Street westbound to I-229 northbound loop is a compound curve loop that was prevalent with the design and construction of the original interstate system (see Figure 1). The drawback of these loops was that traffic would speed up on the large radius curve and then have slow down to negotiate the tight curve. The tight curve of the southeast quadrant loop has a 205' radius which corresponds to approximately a 27 mph design speed. The curve is posted with a 25 mph sign. Current interchange design practice generally provides a constant radius curve for loops so vehicles can maintain a constant speed around the loop.

2.1 ***2000/2001 I-229 Reconstruction*** – I-229 was reconstructed in 2000 and 2001 from Western Avenue to Benson Road. Auxiliary lanes were added between most interchanges; the I-229 ramps northbound on/off ramps at 26th Street were reconstructed on the same alignments as the original ramps because:

- There was no evidence, based on crash data, that indicated a problem with the curve.
- In the original Exit 5 construction, acceleration lane length on I-229 for the northbound on-ramp was only 400 feet with the merge taper ending prior to the 26th Street bridge as shown in the left photo below. The 2001 reconstruction of the I-229 northbound lanes and the northbound on-ramp extended the acceleration lane length to 900 feet. However, SDDOT did not desire to widen the I-229 northbound bridge over the Big Sioux River to provide the desired 1,420 foot acceleration lane length because the bridge and approaches had just been re-built in the early 1990s. The right photo below is approaching the I-229 northbound Big Sioux River bridge.


NB I-229 at 26th Street bridge in June 2000


NB I-229 at Big Sioux bridge in June 2000

2.2 ***2009 to 2012 Crash analysis*** – The I-229/26th Street (Exit 5) Corridor Study, as well as the I-229 Major Investment Study, evaluated crash records for the years 2009-2012 and compared crash rates for interstate mainline segments, interstate ramps, arterial street segments, and arterial intersections to critical crash rates for the I-229 Exit 5 facilities***. It was found that the crash incidence on the 26th Street westbound to I-229 northbound loop was below the critical rate***. Five total crashes were reported for the 2009 to 2012 period with no injuries or fatalities. Four of the five crashes involved drivers striking signs or delineators under a variety of driving conditions, while the fifth crash involved a driver striking debris in the roadway. The crash rate spreadsheet, crash map and crash records are provided in Attachment A to this memorandum.

2.3 ***Acceleration distance*** – The current acceleration lane length for the northbound on-ramp is 900 feet; per the SDDOT Road Design Manual, 1420' should be provided for the existing loop. It is anticipated that an auxiliary lane will be constructed in the future from 26th Street to 10th Street for southbound and northbound I-229. This would resolve the inadequate acceleration lane length. Construction of an auxiliary lane will entail widening the I-229 bridges over the Big Sioux River and BNSF railroad tracks.

2.4 ***Loop size options*** – Figure 1 shows three loop size/location options:

- A 265' radius loop (shown in purple in Figure 1) is the largest radius that could be provided without moving the northbound off-ramp intersection at 26th Street. This <u>is not recommended</u> because:
  - The acceleration length on I-229 is reduced from the existing 900' to 650'. The required acceleration length per the SDDOT Road Design Manual is 1350'.
  - The design speed improvement is not significant.
  - The merge length is shortened to approximately 500' for the dual left turn lane movement from 26th Street. This is not considered adequate (see sections 2.5 and 2.6).
- A 230' foot radius loop (shown in green in Figure 1) could be used to eliminate the compound curve at the I-229 end of the loop. This is a practice SDDOT has implemented at other interchange loops as part of interstate resurfacing work. This option is not considered warranted as part of the currently proposed interchange reconstruction project because of:
  - The relatively recent reconstruction of the loop (2001)
  - The lack of safety problems at the existing loop

  However, this option could be implemented as a small project when the existing pavement has reached the end of its design life.

Maintaining the existing 205' radius loop <u>is recommended</u> because:

- The most recently available crash data did not indicate a safety issue with the relatively small radius of the existing loop.
- With the dual left turn movement from 26th Street westbound to I-229 northbound, an adequate merge length is needed. The proposed 1000' merge length is considered adequate (see sections 2.5 and 2.6).
- The pavement width is adequate for 2 lanes of traffic within the merge section. As shown in the typical section B-B view in Figure 2, the addition of a shoulder along the inside edge of the loop within the merge section would be beneficial and will be further defined during final design. Near 26th Street, the entire ramp will need to be reconstructed because the intersection will be raised from the existing elevation.
- Reconstruction of the loop with minimal improvement for drivers would not be cost effective, especially since the loop was just reconstructed in 2001.

2.5 ***Ramp Merge Length Computational Analysis*** – Dual left turn lanes are proposed for the 26th Street westbound to I-229 northbound movement. Similar to a single point interchange, two ramp receiving lanes are required for the dual left turning traffic; sections A-A and B-B on Figure 2 illustrates this. Generally, the dual receiving lanes are wider than standard traffic lanes to provide a buffer/comfort area between the turning vehicles.

The vehicles will be in 2 lanes separated by a standard skip stripe for 500 feet as shown on Figure 3. Vehicles in the right lane can move to the left lane in this section in anticipation of the upcoming merge. Guidance in AASHTO reflects on the needed sight distance for this type of maneuvering. Table 3-3 below lists avoidance maneuver distances that can provide us with information for these types of lane-change maneuvers.

Table 3-3. Decision Sight Distance

Metric						U.S. Customary					
Design Speed (km/h)	Decision Sight Distance (m) Avoidance Maneuver					Design Speed (mph)	Decision Sight Distance (ft) Avoidance Maneuver				
	A	B	C	D	E		A	B	C	D	E
50	70	155	145	170	195	30	220	490	450	535	620
60	95	195	170	205	235	35	275	590	525	625	720
70	115	325	200	235	275	40	330	690	600	715	825
80	140	280	230	270	315	45	395	800	675	800	930
90	170	325	270	315	360	50	465	910	750	890	1030
100	200	370	315	355	400	55	535	1030	865	980	1135
110	235	420	330	380	430	60	610	1150	990	1125	1280
120	265	470	360	415	470	65	695	1275	1050	1220	1365
130	305	525	390	450	510	70	780	1410	1105	1275	1445
						75	875	1545	1180	1365	1545
						80	970	1685	1260	1455	1650

Avoidance Maneuver A: Stop on rural road—t = 3.0 s

Avoidance Maneuver B: Stop on urban road—t = 9.1 s

Avoidance Maneuver C: Speed/path/direction change on rural road—t varies between 10.2 and 11.2 s

Avoidance Maneuver D: Speed/path/direction change on suburban road—t varies between 12.1 and 12.9 s

Avoidance Maneuver E: Speed/path/direction change on urban road—t varies between 14.0 and 14.5 s

From: *A Policy on Geometric Design of Streets and Highways (AASHTO 2011)*

If we extrapolate the table for avoidance maneuver E (which would represent an urban area), at 15 mph (anticipated turning speed), it would take 320' to negotiate a lane change. If we assume it will take a driver 100' to make the turn and get oriented prior to making this maneuver, a total distance of 420' is needed (rounded up to 500' on Figure 3 for design adaptability during final design).

At the end of the 2-lane section, a merge taper is required to narrow to the standard loop width (see Figure 3). It is anticipated that the width of this merge taper will be a maximum of 9'. In accordance with generally accepted traffic guidelines, a merge taper should be accomplished in accordance with the equation L = W x S where L is the taper length in feet, S is the taper width in feet, and S is the anticipated speed of vehicles in miles per hour. The posted ramp speed is 25 miles per hour. The required taper length is therefore 9 x 25 = 225'. The available distance of 500' shown on Figure 3 is expected to be more than adequate to accommodate merging traffic.

From a computational perspective, the 1000' total length proposed for going from a 2-lane ramp to a single lane for the 26th Street westbound to I-229 northbound movement is considered adequate for driver comfort and safety.

2.6 ***Ramp Merge Length Comparative Analysis*** – In addition to the computational analysis, it was deemed appropriate to make a comparison with other similar ramp merge conditions in Sioux Falls. Figures 3 and 4 illustrate comparable ramp locations where dual left turn lanes merge to a single lane before entry onto the interstate. The table below provides specific comparisons of the pertinent features of each of the ramps considered.

Location	26th WB to I-229 NB (Fig 3 top)	12th WB to I-29 SB (Fig 3 center)	12th EB to I-29 NB (Fig 3 bottom)	Madison WB to I-29 SB (Fig 4 top)	Madison EB to I-29 NB (Fig 4 bottom)
Peak Hour dual left turn lane volume (year)	440 (2035)	655 (2014)	192 (2014)	See Note 1	See Note 1
Loop/ramp design speed before interstate (mph)	27	50	50	50	50
2 lanes with skip stripe (ft)	500 (proposed)	600	346	614	433
Merge 2 lanes to 1 lane (ft)	500 (proposed)	550	525	574	621
Single lane (ft)	925 (proposed)	800	700	250	550

Note 1: Turning movement count data was not gathered for the purposes of this memo.

The conclusion to note from this table is that the proposed 2-lane, merge, and single lane lengths are generally in the same range. At each location, site conditions and traffic volumes dictated the specific design of the ramp.

Crash data is generally considered a good indicator of traffic operations. Research on the specific crashes for years 2009 to 2012 for each of these existing ramps with a merge condition resulted in this data:

- 12th Street westbound to I-29 southbound – 3 crashes on ramp, 1 related to the merge activity (rear-end crash on 11/17/2010 at 5:53 PM, no injury, dry roadway, clear sky, driver cited for following too closely.)
- 12th Street eastbound to I-29 northbound – 3 crashes on ramp, 0 related to the merge activity.
- Madison Street westbound to I-29 southbound – 2 crashes on ramp, 0 related to the merge activity.
- Madison Street eastbound to I-29 northbound – 2 crashes on ramp, 1 related to the merge activity (sideswipe crash on 8/2/2010 at 3:55 PM, no injury, dry roadway, no citations.)

The logical conclusion from the crash analysis is that safety of the merge condition is not a concern at any of these existing ramps.

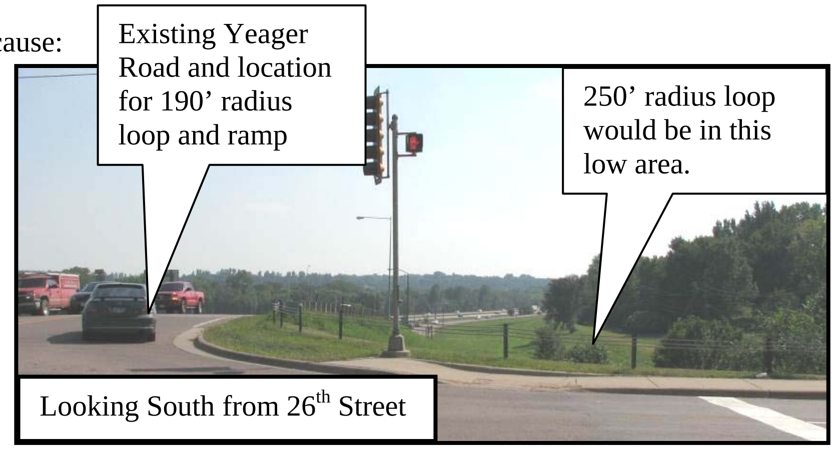
2.7 ***Conclusion*** – Based on the computational and comparative analyses, it is anticipated that traffic operations and safety of the merge condition at the 26th Street westbound to I-229 northbound loop with the proposed design will be adequate.

3. Southwest Quadrant Loop

Reconfiguration of the southwest quadrant of the interchange is necessary to provide a direct connection from the ramps to 26th Street (an arterial street) rather than the existing connection to Yeager Road (a collector street). Providing a standard interchange configuration for the southwest quadrant is a main purpose of the interchange improvement project and will improve traffic operations and safety.

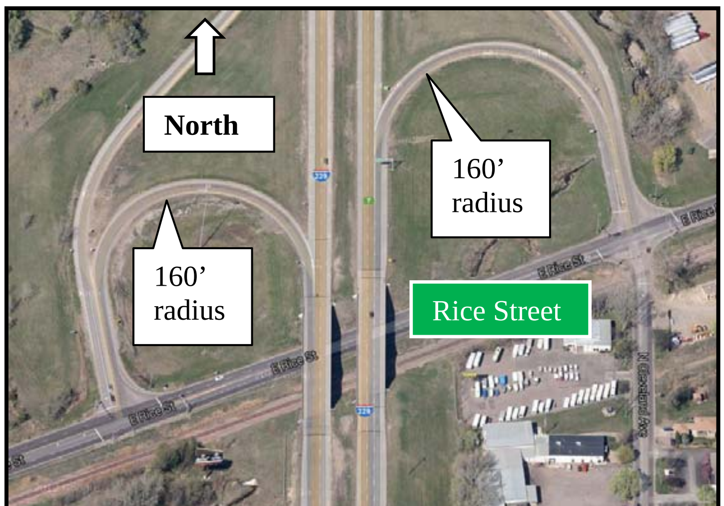
Figure 1 shows two loop size options.

The 190' radius loop is recommended because:



Looking South from 26th Street

- The ramp and loop follow the existing Yeager Road embankment to 26th Street as shown in the photo to the right. Realigned Yeager Road will be able to better follow the existing topography.
- The 190' loop radius provides for an approximate 25 mph design speed. The SDDOT required deceleration lane length of 550' can be provided on I-229.
- The 190' radius loop is consistent with/larger than the 160' radius loops provided at the Rice Street interchange (see photo at right). Crash records from 2009 to 2012 at the Rice Street interchange showed that crash rates are below the critical rate. In fact, only one crash was recorded for the northbound off ramp for the 2009 to 2012 period. The crash data is included in Attachment A to this memo. At 26th Street, loop traffic will be going up a 4.5% grade which helps slow the vehicles. At Rice Street, I-229 is above and off-ramp traffic is going downhill. Therefore, based on the comparison with the Rice Street loop, the proposed 190' radius loop at 26th Street should not pose a safety issue.



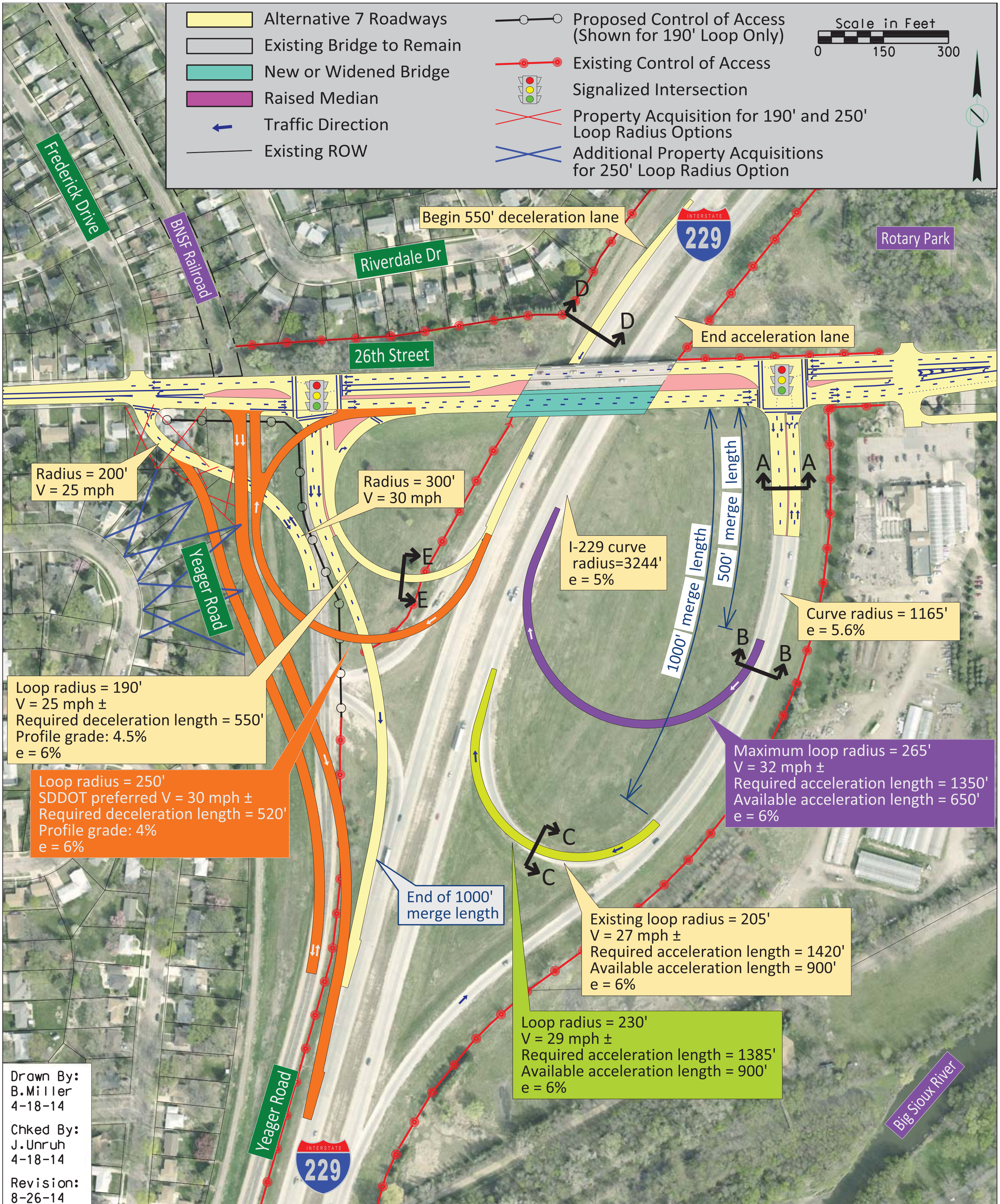
I-229/Rice Street Interchange

The 250' radius loop is not recommended because:

- Four additional residential properties would need to be acquired because of the larger ramp and accompanying shift of Yeager Road to the west. One or two of the acquisitions may be partial takes instead of a total takes.
- Spacing from the ramp intersection to the Yeager Road/Frederick Drive intersection is reduced to just over 100'. This meets FHWA criteria but is not desirable for traffic operations.
- Shifting the ramp/loop to the west will require construction of a large embankment section as noted in the photo above.
- The additional 5 mph loop design speed in comparison to the 190' radius loop is not justified.
- Southbound on-ramp is extended further to the south and closer to the Cliff Avenue interchange.

A comparison table for the southwest quadrant loop options is shown below.

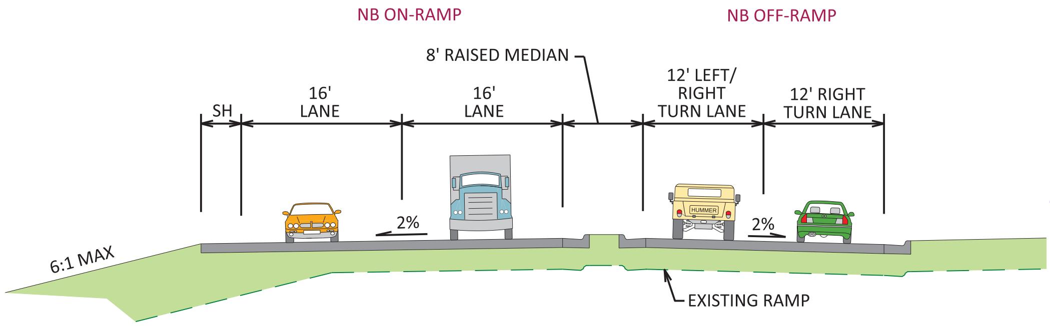
Loop Option	190' radius	250' radius
Design speed (mph)	25	30
Profile grade	4.5%	4%
Residential acquisitions		
Total	2	6
Partial	2	0
Construction Cost	$1.9M	$2.6M
Property Acquisition Cost	$0.4M	$1.2M
Total cost	$2.3M	$3.8M



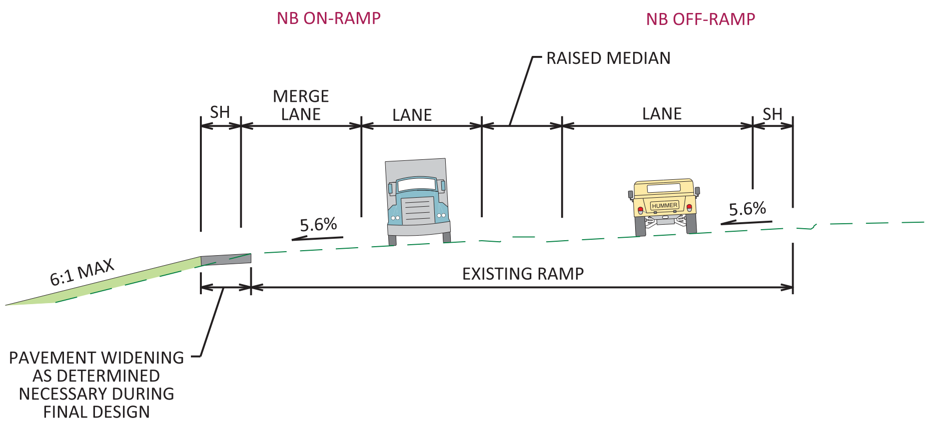
Loop Design Analysis - Alternative 7a Layout

I-229 Exit 5 (26th Street) Interchange Environmental Assessment
Sioux Falls, SD

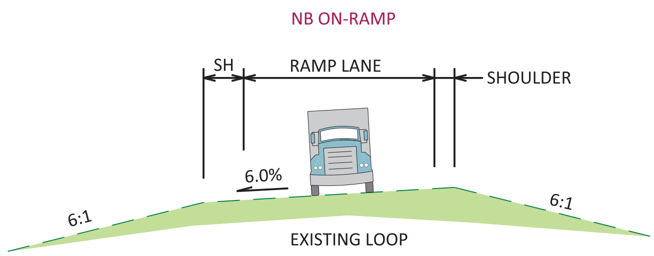
Figure
1



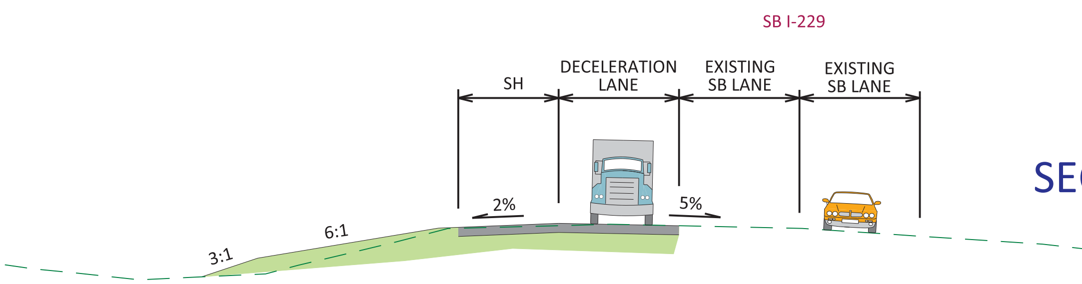
SECTION A-A



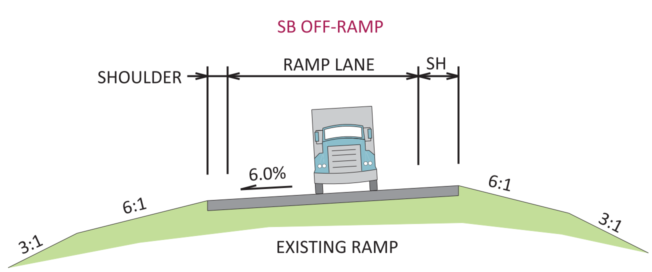
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

Drawn By:
B.Miller
7-25-14

Chked By:
J.Unruh
7-25-14

Revision:
8-26-14

Loop Design Analysis - Alt. 7a Typical Sections

I-229 Exit 5 (26th Street) Interchange Environmental Assessment
Sioux Falls, SD

Figure
2

Drawn By: B.Miller
Date: 8-14-14
Chked By: J. Unruh
Date: 8-14-14
Revision: 8-26-14

Ramp/Loop Merge Length Analysis/Comparison

I-229 Exit 5 (26th Street) Interchange Environmental Assessment
Sioux Falls, SD

Figure
3

Drawn By: B.Miller
Date: 8-14-14
Chked By: J. Unruh
Date: 8-14-14
Revision: 8-26-14

Ramp/Loop Merge Length Analysis/Comparison

I-229 Exit 5 (26th Street) Interchange Environmental Assessment
Sioux Falls, SD

Figure
4

Attachment A

Crash Data Figures and Tables

TABLE 2 - INTERSTATE RAMP CRASH RATES (2009-2012)

I-229 MIS

TRAVEL DIRECTION	SEGMENT	NUMBER CRASHES	SEGMENT LENGTH	DAILY VOLUME	MVMT[1]	CRASH RATE	*TEV*R* [2]	CRITICAL RATE	DIFFERENCE
SB	BENSON OFF RAMP	1	0.403	1090	0.64	1.56	1699.58	5.50	-3.94
SB	BENSON ON RAMP	0	0.332	7840	3.80	0.00	0.00	3.19	-3.19
SB	RICE OFF RAMP	0	0.292	2060	0.88	0.00	0.00	4.88	-4.88
SB	RICE ON RAMP	4	0.194	3540	1.00	3.99	14122.30	4.66	-0.67
SB	10TH OFF RAMP	3	0.264	5210	2.01	1.49	7783.31	3.74	-2.25
SB	10TH ON RAMP	7	0.165	7000	1.69	4.15	29057.70	3.94	**0.22**
SB	26TH OFF RAMP	2	0.138	3120	0.63	3.18	9926.54	5.55	-2.36
SB	26TH ON RAMP	1	0.096	6400	0.90	1.11	7134.70	4.84	-3.73
SB	CLIFF OFF RAMP	2	0.310	2900	1.31	1.52	4418.91	4.25	-2.73
SB	CLIFF ON RAMP	1	0.210	5300	1.62	0.62	3261.58	3.98	-3.36
SB	MINNESOTA OFF RAMP	4	0.193	4080	1.15	3.48	14195.47	4.44	-0.96
SB	MINNESOTA ON RAMP	2	0.233	5300	1.80	1.11	5879.24	3.86	-2.75
SB	WESTERN OFF RAMP	0	0.184	7700	2.07	0.00	0.00	3.71	-3.71
SB	WESTERN ON RAMP	3	0.160	2700	0.63	4.76	12842.47	5.54	-0.78
SB	LOUISE OFF RAMP	4	0.355	8900	4.61	0.87	7717.54	3.06	-2.19
SB	LOUISE ON RAMP	5	0.439	4610	2.95	1.69	7801.04	3.38	-1.69
NB	LOUISE OFF RAMP	8	0.466	3600	2.45	3.27	11758.48	3.55	-0.28
NB	LOUISE LOOP RAMP	0	0.351	4800	2.46	0.00	0.00	3.54	-3.54
NB	LOUISE ON RAMP	3	0.418	3460	2.11	1.42	4915.78	3.69	-2.27
NB	WESTERN OFF RAMP	1	0.204	2900	0.86	1.16	3357.51	4.91	-3.75
NB	WESTERN ON RAMP	2	0.249	7500	2.73	0.73	5501.46	3.45	-2.72
NB	MINNESOTA OFF RAMP	6	0.181	4100	1.08	5.54	22704.91	4.53	**1.01**
NB	MINNESOTA ON RAMP	1	0.211	4670	1.44	0.70	3246.12	4.13	-3.44
NB	CLIFF OFF RAMP	6	0.206	4800	1.44	4.16	19949.46	4.13	**0.03**
NB	CLIFF ON RAMP	0	0.272	3370	1.34	0.00	0.00	4.23	-4.23
NB	26TH OFF RAMP	10	0.444	6300	4.08	2.45	15426.39	3.14	-0.69
NB	26TH ON RAMP	5	0.353	2670	1.38	3.63	9701.58	4.19	-0.56
NB	10TH OFF RAMP	9	0.189	6750	1.86	4.83	32615.79	3.82	**1.01**
NB	10TH ON RAMP	4	0.238	5640	1.96	2.04	11511.45	3.77	-1.73
NB	RICE OFF RAMP	1	0.177	3590	0.93	1.08	3869.67	4.78	-3.71
NB	RICE ON RAMP	2	0.252	2130	0.78	2.55	5435.96	5.09	-2.54
NB	BENSON OFF RAMP	8	0.400	7440	4.34	1.84	13698.63	3.10	-1.26
NB	BENSON ON RAMP	0	0.291	1320	0.56	0.00	0.00	5.81	-5.81

[1]MVMT = MILLION VEHICLE MILES TRAVELED

[2]TEV*R = TOTAL ENTERING VEHICLES TIMES CRASH RATE

SOURCE: HIGHWAY SAFETY MANUAL, FIRST EDITION, 2010, AASHTO

Interstate Ramp – 26th Street NB On Ramp

N

Crash Summary - 26th St. NB on

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
2294	2/4/2012 9:47:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchange area	Straight ahead	None	None	Other	Cloudy
2296	2/16/2012 4:58:00 PM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Dry	Interchange area	Straight ahead	None	None	Exceeded posted speed limit	Clear
2297	12/27/2012 10:15:00 AM	Daylight	No collision between 2 MV in transport	Delineator post	No injury	Snow	Interchange area	Straight ahead	None	None	Running off road	Snow
2298	3/10/2010 9:15:00 AM	Daylight	No collision between 2 MV in transport	Highway traffic sign post/sign	No injury	Wet	Interchange area	Straight ahead	None	None	Running off road	Rain
2315	7/29/2011 5:00:00 PM	Daylight	No collision between 2 MV in transport	Other movable object	No injury	Dry	Interchange area	Straight ahead	None	Debris	None	Clear

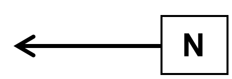
Interstate Ramp – Rice Street SB On Ramp

N

Crash Summary - Rice St. SB on ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHAR	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCON	DRIVERCO	WEATHER
4532	8/7/2009 1:00:00 PM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Oil	Interchange area	Straight ahead	None	Road surface condition wet, icy, snow, slush, etc.	None	Clear
4544	11/18/2009 7:45:00 AM	Daylight	No collision between 2 MV in transport	Guardrail face	No injury	Dry	Interchange area	Straight ahead	None	None	Running off road	Clear
4548	6/23/2012 3:43:00 PM	Daylight	No collision between 2 MV in transport	Overturn/rollover	Non-incapacitating	Dry	Interchange area	Straight ahead	None	None	Over-correcting/over-steering	Clear
4550	5/24/2009 4:10:00 PM	Daylight	Wild animal hit - damage only	Animal - wild	Wild animal hit	Dry	Interchange area	Wild animal hit - damage only	Wild animal hit	Wild animal hit - damage only	Wild animal hit - damage only	Clear

Interstate Ramp – Rice Street NB Off Ramp



Crash Summary - Rice St. NB off ramp

OBJE	ACCIDENT	LIGHTCON	MANNERO	FIRSTHARI	INJURYSE	ROADSURI	JUNCTION	VEHICLEM	VEHCONTI	ROADCONT	DRIVERCO	WEATHER
4555	10/23/2012 6:03:00 AM	Dark - roadway not lighted	Rear-end front to rear	Motor vehicle in transport	No injury	Wet	Interchang e area	Slowing in traffic lane	None	None	None	Fog, smog, smoke